CONTRACT NO. 95-339
FINAL REPORT
DECEMBER 1998

Measuring Concentrations of Selected Air Pollutants Inside California Vehicles

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

AIR RESOURCES BOARD
Research Division

MEASURING CONCENTRATIONS OF SELECTED AIR POLLUTANTS INSIDE CALIFORNIA VEHICLES

Final Report, ARB Contract No. 95-339

supported by
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Disclaimer

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This project integrated the technical skills and personnel from a prime contractor, Research Triangle Institute (RTI), and three subcontractors, Sierra Research, Inc. (SR), Aerosol Dynamics, Inc.(AD), and Desert Research Institute (DRI). SR provided the mobile sampling platform used in all commutes, on-board instrumentation to measure and record traffic conditions, drivers and a navigator (primary vehicle only) for all vehicles, and rental vehicles. SR also selected the commuting routes used for each phase of the study. AD provided the characterization of "real" California aerosol, calibration of the optical particle counter for these aerosols, and the (leased) Aethalometer for monitoring black carbon. AD also provided aerosol monitoring consulting, and assisted in the initial installations of the particle counter and Aethalometer. DRI provided consulting on particle metals' analyses, and conducted the XRF metals' analyses (Main Study only). RTI provided all other equipment and technical services associated with both the Pilot and Main Studies, including the overall study design and project direction, field project direction, field operations technical staff, ICP/MS metals' analyses (Pilot Study only), automated data collection, analyses and interpretations, quality assurance summaries, and reporting. Staff from ARB assisted in the field operations by providing local logistical coordination, and collecting samples and data from the ambient monitoring sites. SCAQMD provided logistical support in Los Angeles. Specific individuals contributing to this project included:

RTI - Charles Rodes and Linda Sheldon (overall project direction), Don Whitaker (field management), Phil Lawless (filter weighing coordination and automated data collection), Mike Roberds (field operations - Pilot Study), Randy Newsome (sampling equipment design and construction, field operations - Main Study Sacramento), Tyson Mew (field operations - Sacramento), Andy Clayton (data analysis), Doris Smith and Jim Flanagan (quality assurance), Peter Grohse (ICP/MS analyses), and Libby Cain (report preparation).

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ABSTRACT

Researchers measured pollutant concentrations inside vehicles on California roadways during 32 driving trips in the cities of Los Angeles and Sacramento. For most of the pollutants, two-hour integrated samples were collected concurrently inside the vehicle, just outside the vehicle, along the roadway where the vehicle traveled, and at ambient monitoring sites. Pollutants measured included PM_{10} and $PM_{2.5}$, metals, and 13 organic chemicals including benzene, MTBE, and formaldehyde. In addition, the researchers obtained continuous measurements of fine particle counts, carbon monoxide (CO), and black carbon. The driving scenarios were designed to evaluate the association between in-vehicle pollutant levels and factors such as the carpool lane, traffic congestion, vehicle type, roadway type, time of day, and ventilation setting.

In-vehicle pollutant levels were generally higher in Los Angeles than Sacramento. In Los Angeles, the average in-vehicle concentrations of benzene, MTBE, and formaldehyde ranged from 10-22 $\mu g/m^3$, 20-90 $\mu g/m^3$, and 0-22 $\mu g/m^3$, respectively. In Sacramento, the average in-vehicle concentrations for benzene, MTBE, and formaldehyde ranged from 3-15 $\mu g/m^3$, 3-36 $\mu g/m^3$, and 5-14 $\mu g/m^3$, respectively. The ranges of mean PM_{10} and $PM_{2.5}$ in-vehicle levels in Los Angeles were 35-105 $\mu g/m^3$ and 29-107 $\mu g/m^3$, respectively. The ranges of mean PM_{10} and $PM_{2.5}$ in-vehicle levels in Sacramento were 20-40 $\mu g/m^3$ and 6-22 $\mu g/m^3$, respectively.

In general, VOC and CO levels inside or just outside the vehicles were higher than those measured at the roadside stations or the ambient air stations. However, in-vehicle levels of $PM_{2.5}$ were consistently lower than $PM_{2.5}$ levels just outside the vehicles and, in many cases, also lower than roadside levels. Nonetheless, $PM_{2.5}$ levels inside or just outside the vehicles were usually higher than levels measured at the nearest ambient site. Except for sulfur, metal concentrations were generally low or below detection limits. Pollutant levels measured inside vehicles traveling in a carpool lane were significantly lower than those in the right-hand, slower lanes. Under the study conditions, factors such as vehicle type and ventilation settings were shown to have little effect on the in-vehicle pollutant levels. Other factors, such as roadway type, freeway congestion level, and time-of-day were shown to have some influence on the in-vehicle pollutant levels. Elevated levels of both fine particles and black carbon were measured inside the test vehicle when it followed diesel-powered vehicles.

This study provided the data needed to characterize in-transit exposures to air pollutants for California drivers. It also demonstrated a number of *in-situ* monitoring techniques in moving vehicles and provided findings that shed new light on particle exposure assessments and research needs.

EXECUTIVE SUMMARY

BACKGROUND - In order to evaluate Californians' total exposure to air pollutants, it is necessary to account for the important microenvironments where people spend the majority of their time. Pollutant concentration data are very limited for many microenvironments, including vehicle passenger compartments. This study was conducted to characterize the concentration levels of selected pollutants inside commuting vehicles in the Sacramento and Los Angeles areas in California. The researchers collected samples integrated over two hours for $PM_{2.5}$ and PM_{10} mass, a number of particle-associated elements, and 13 VOC's, including methyl-tertiary-butyl-ether (MTBE), benzene and formaldehyde. In addition, continuous measurements were made for carbon monoxide (CO), black carbon, and particle count for different particle sizes, ranging from 0.15 to 2.5 μm. This is the first study to measure $PM_{2.5}$ and PM_{10} concentrations inside vehicles. The use of continuous samplers for measuring both particle count and black carbon, while commuting, is also ground-breaking and innovative.

The research was "range-finding" for a wide variety of commuter exposure scenarios, rather than an in-depth evaluation of a few situations. Study objectives included measuring the concentrations of selected pollutants inside and outside the vehicles to evaluate the influences of: 1) freeway conditions (rush versus non-rush), 2) roadway types (freeway, arterial and rural), 3) four vehicle types (2 sedans, a sport-utility vehicle and a California school bus), 4) two driver-adjusted vent settings, 5) the time of day (AM versus PM), and 6) the relationships among pollutant concentrations inside and outside the vehicles compared to roadside and the nearest ambient fixed site monitoring location. The results of this study can be used to define methodologies for assessing both commute-average and real-time in-vehicle concentrations, improve the estimates of current Californians' in-vehicle pollutant exposures, assess the relative contributions of in-vehicle concentrations to total air exposure, suggest actions that drivers and passengers could take to reduce their in-vehicle exposures to air pollutants, and determine the need and feasibility of future in-vehicle studies.

METHODS – In September and October of 1997, researchers collected a number of 2-hour pollutant concentration measurements inside vehicles during 13 "commutes" in Sacramento and 16 in Los Angeles. Similar measurements were made simultaneously outside the vehicles, along the roadways, and at the nearest ambient air monitoring stations. A variety of scenarios were studied based on variables such as roadway type, traffic congestion, ventilation setting, and vehicle type. Two runs, one in the morning and one in the afternoon, were typically conducted for each scenario. The study also included several in-vehicle special driving scenarios: 1) a California school bus following a student route in Sacramento, 2) comparison of a sedan traveling in an LA carpool lane versus one traveling in a congested right hand lane, and 3) a sedan encountering situations that would maximize the in-vehicle pollutant concentration levels.

A driving protocol was followed that highlighted trailing behind heavy duty diesel (HDD) vehicles and diesel city buses when possible, to estimate their contributions to the measured pollutants. This focus on trailing specific polluting vehicles provided potentially "high end" estimates of the in-vehicle concentrations for particle count and black carbon.

Two-hour integrated samples for $PM_{2.5}$ and PM_{10} were collected by MSP personal impactors on Teflon filters. The filters were weighed for particle mass and later analyzed for elemental concentrations by XRF. Except for formaldehyde, all the VOC's were collected by

SUMMA evacuated canisters and were analyzed by GC/MS. Formaldehyde was collected by DNPH cartridges for subsequent HPLC analysis. Continuous CO monitoring was measured by Draeger monitors. Real-time black carbon concentrations were measured with an Aethalometer, while particle counts were measured with a LAS-X optical particle counter. The continuous data were reduced to both 1 minute and 120 minute "commute" averages.

RESULTS – Pollutant levels measured inside vehicles traveling in a carpool lane were much lower than those in the right-hand, slower lane. As expected, in-vehicle pollutant concentrations obtained from freeway rush drives were higher than those from freeway non-rush drives. Under the study conditions, factors such as vehicle type, and vehicle ventilation settings were shown to have little effect on the in-vehicle pollutant levels. Other factors such as roadway type, and time-of-day appeared to have some indirect influence on the in-vehicle pollutant levels. Elevated levels of both fine particles and black carbon were measured inside the test vehicle when it followed diesel-powered vehicles. Other pollutant measurement highlights included: (a) most pollutant levels, especially the VOC's, were elevated inside and outside the vehicles, relative to either the roadside or ambient station concentrations, (b) most pollutant levels were extremely low at the rural site near Sacramento, relative to any of the arterial or freeway locations, (c) most pollutant levels were somewhat higher in Los Angeles than in Sacramento, (d) particle concentrations were typically significantly higher outside the vehicles than inside, presumably due to losses in the vehicle ventilation systems (and other factors) - while significant differences were not observed between inside and outside levels of gas phase pollutants for the same vehicle, (e) in-vehicle pollutant concentrations for some individual commutes were substantially influenced by the tailpipe emissions from single polluting "target" lead vehicles, and (f) total in-vehicle LAS-X particle count/cm^3 (0.15 to 2.5 μm) was a fair predictor of integrated $PM_{2.5}$ mass concentration.

The mean ranges of selected in-vehicle pollutant concentrations (both integrated and continuous measures) by location are summarized as follows:

Pollutant	Sacramento In-Vehicle*	Sacramento Ambient*	Los Angeles In-Vehicle*	Los Angeles Ambient*
MTBE, μg/m^3	3 to 36	2 to 7	20 to 90	10 to 26
Benzene, μg/m^3	3 to 15	1 to 3	10 to 22	3 to 7
Toluene, μg/m^3	7 to 46	4 to 8	22 to 54	10 to 40
$PM_{2.5}$, μg/m^3	6 to 22	6 to 11	29 to 107	32 to 64
PM_{10}, μg/m^3	6 to 22	20 to 30	29 to 107	54 to 103
Formaldehyde, μg/m^3	5 to 14	2 to 4	<MQL to 22	<7 to 19
CO, ppm	<MQL to 3	<MQL	3 to 6	<MQL
Black Carbon, μg/m^3	<MQL to 10	na	3 to 40	na
LAS-X, tot. particles/cm^3	10 to 1,100	na	2,200 to 4,600	na

Table Notes: *means of 2 to 4 commutes; <MQL – below quantification limit; na – not avail.

The methodology highlights for this study included demonstrating that: (a) in-vehicle VOC's, $PM_{2.5}$ and PM_{10} gravimetric mass concentrations could be successfully determined, even though the samples were integrated over very short 2 hour periods, (b) real-time black carbon monitoring was feasible inside A commuting vehicle, (c) useable, integrated 2-hr in-vehicle samples for NO_2 and PAH's could not be collected , (d) the relatively low levels of CO currently found in commuting California vehicles, posed a substantial measurement problem for low-cost monitors with elevated MQL's, and (e) continuous monitoring of in-vehicle particle count (<2.5 μm) and black carbon concentrations could be readily be associated with emission of diesel-powered and poorly tuned gasoline-powered vehicles just ahead of the study vehicles.

CONCLUSIONS – This study provided, for the first time, a variety of in-vehicle pollutant concentration levels for California vehicles. The study design also provided an indication of the potential influence of specific tested factors on in-vehicle concentration levels for selected pollutants. However, because the number of drives designed for testing a specific factor was typically small, some of the results should be confirmed by future studies with larger sample sizes and enhanced study designs. In addition, some of the possible confounding variables that may affect the results include: (a) the experimental driving protocol (trailing specific polluting target vehicles), (b) the high air exchange rate between the cabin and outside air during all the runs, (c) the local meteorology (e.g. wind speed), (d) the potential influence of emissions from the lead vehicle, and (e) the distance between the test vehicle and the lead vehicle.

Other significant conclusions were: (a) the influence of individual polluting vehicles immediately in front of the test vehicles was substantial on in-vehicle levels, even for short periods, occasionally accounting for 30 to 50 % of the total in-vehicle commute concentrations, (b) the inside-to-outside ratio of particle mass for particles <2.5 μm ranged from 0.6 to 0.8, (c) concentrations inside a California school bus were very low in Sacramento, reflecting the generally low concentrations in the residential neighborhood, (d) LA non-carpool lane commutes generally have substantially higher in-vehicle pollutant concentrations by 30 to 60 %, as compared to the carpool lanes (the use of which additionally reduced total commute air exposures by reducing total commuting time), (e) maximum concentration situations during commutes (e.g. closely trailing a diesel city bus in a downtown street canyon) could readily double the short-term in-vehicle concentrations for selected pollutants, and (f) roadside pollutant measurements were low by a factor of at least two for predicting in-vehicle levels for many commuting scenarios, but provided significantly better indications of in-vehicle pollutant concentrations than did ambient sites, which were often low by a factor of three or more (especially for VOC's).

Recommendations for future work include: a) conducting a more in-depth analysis of the extensive data bases developed in this study – especially for the real-time measurements, b) obtaining more representative commute data, across different locations, seasons, traffic conditions, etc., c) improving the sampling equipment for real-time measurements of particles, d) developing suitable sampling methodologies for collecting measureable, short-term samples of NO_2 and PAH's, e) further quantifying the advantages of carpool commuting relative to reducing pollutant exposures, f) further evaluating the relative importance of single lead vehicles on in-vehicle exposures, especially when following heavy duty diesel vehicles and older, gasoline powered vehicles, and g) developing relationships between trailing distance and in-vehicle concentrations. The robust data base developed to meet study objectives undoubtedly contains a wealth of additional information that can be related to in-vehicle passenger exposures. Although the limited number of commutes conducted for each scenario cannot be construed as completely representative, the quality and consistency of the data strongly suggest that the proposed focused studies be considered.

PREFACE

This report summarizes the field monitoring and the data collected from a September/October, 1997 Main Study conducted at two locations to assess in-vehicle air concentrations in California vehicles for selected pollutants and driving scenarios. A Pilot Study report (attached as Appendix A) was previously prepared by RTI and submitted to ARB that summarized the findings of an earlier February, 1997 Sacramento study that was used to finalize methodologies, characterize their performance, and report expected concentration levels. Details on the performance of the methodologies from the pilot effort are not included in the main body of this report. The current report summarizes the Main Study findings for both Sacramento and Los Angeles field operations, involving a total of 29 in-vehicle commutes (13 in Sacramento, 16 in Los Angeles). The Main Study was primarily funded by ARB, with supplemental support provided by SCAQMD to provide more comprehensive sample and data analyses for the Los Angeles commutes. The latter additional work in LA included additional sampling days, more robust formaldehyde sampling, and detailed video-assisted associations of the continuous pollutant concentrations with the lead vehicle type. A co-project officer (Linda Sheldon) is currently employed with the U. S. Environmental Protection Agency (Research Triangle Park, NC).

1.0 INTRODUCTION

1.1 BACKGROUND:

The California Health and Safety Code (HSC) Section 39660.5 requires the California Air Resource Board (ARB) to assess human exposure to toxic pollutants. The ARB is also required to identify the relative contribution of indoor concentrations to total exposure, taking into account both ambient and indoor air environments. In order to assess a population's pollutant exposure, it is necessary to account for the important microenvironments where people spend their time. This requires information on how much time people spend in specific microenvironments and the corresponding pollutant air concentration in those microenvironments. Although the ARB has representative data on Californian's activity patterns (Wiley et al., 1991a, 1991b), very little pollutant concentration data are available for many microenvironments including vehicle passenger compartments.

A field measurement study was proposed by the ARB that would substantially enhance the current knowledge based for pollutants in vehicular settings. The experimental focus in the request for proposal could be more appropriately characterized as "range-finding" for a wide variety of commuter exposure scenarios, rather than an in-depth evaluation of a few situations. The results of this study would be used by ARB to determine the need for, and feasibility of, additional in-vehicle pollutant measurements in more focused future studies. The results of this project could also be used by the ARB to improve estimates of current Californian in-vehicle exposures to selected pollutants, and to assess the relative contribution of in-vehicle exposure to total air exposure for these pollutants. In addition, the results could be used to identify actions that driver and passengers may take to reduce their in-vehicle exposures to air pollutants.

An ARB contract (95-339) was issued to the Research Triangle Institute (RTI) in late 1996 to characterize the concentration levels of selected pollutants associated with an inter-related matrix of commuting scenarios, vehicle types, and ventilation settings. The driving scenarios were those most likely to produce a full range of probable in-vehicle concentrations, with emphasis given to commuting scenarios likely to result in elevated in-vehicle exposures. Measurements were to be obtained inside passenger vehicles, immediately outside the vehicles, along the roadway where the vehicles travel, and at ambient monitoring sites. The field data would be collected at two locations in California, Sacramento and Los Angeles, during a seasonal period likely to produce the highest in-vehicle exposures. The ARB contract was supplemented by the South Coast Air Quality Management District (SCAQMD) in late 1997, prior to the Main Study testing in Los Angeles. The SCAQMD requested that additional in-vehicle formaldehyde measurements be made in Los Angeles, additional commutes be added, and additional data analyses be conducted to provide more thorough characterization of the five highest particle concentration commutes in Los Angeles.

The workplan proposed by RTI[1], incorporated all of the requirements of the ARB proposal, and suggested the inclusion of continuous optical particle counting and black carbon concentration measurements. These continuous measures would serve as indices of shorter term particle exposures, and could provide links to possible contributing sources, including diesel vehicles. The potential methodological problems posed by sampling in a moving vehicle over relatively short sampling times (2 hours), strongly suggested that the bulk of the sampling be preceded by a Pilot Study. This pilot effort was conducted in February, 1997, in Sacramento, CA to fine tune the sampling procedures and approximate the concentration levels expected to be encountered. The

[1] The initial workplan to ARB initiated the project, while a supplemental effort with SCAQMD extended the scope of sampling and analysis in Los Angeles

analyses of samples and data from this study permitted the sampling methods to be optimized to maximize the quality of the data, as well as the data capture rate. The Main Study was initiated in late September, 1997, with 13 2-hr commutes over 7 sampling days in Sacramento. After a brief period to relocate the staff and equipment, the field study was resumed in Los Angeles, CA for an additional 16 2-hr commutes over 9 sampling days.

1.2 MAIN STUDY OBJECTIVES

Table 1-1 lists the pollutants selected by ARB for monitoring in the Main Study, as well as the elements inherent in the study design. A strong emphasis was placed on obtaining reliable concentration data for particles and methyl *t*-butyl ether (MTBE), as well as $PM_{2.5}$, PM_{10}, particle elements, VOC's, CO, and black carbon. Gravimetric particle concentration for only 2 hour periods are extremely difficult to accomplish, at the low flowrates required to minimize the influence of the sampler flowrates on the vehicle air exchange rates. The optimization testing required to make these particle measurements is described in the Pilot Study report (Appendix A). Measurements were obtained inside passenger vehicles, immediately outside the vehicles, along the roadway at two locations adjacent to where the vehicles traveled, and at a fixed ambient monitoring site in Sacramento and in Los Angeles. Measurements were obtained during driving scenarios that were likely to produce the full range of probable in-vehicle concentrations, but emphasis is given to scenarios likely to result in high in-vehicle exposures. Table 1-1 also lists the other data that may be collected in addition to the chemical measurements and the required driving scenarios.

A list of research design objectives were formulated taking into account ARB's program goals as well as the important factors that can affect in-vehicle pollutant concentrations. These research objectives were finalized based on inputs from the ARB, SCAQMD and results of the pilot testing. The finalized research objectives were used to define the data collection requirements and the data analysis approach for the Main Study. The design objectives incorporated into this program are given in Table 1-2 organized by influencing factors.

TABLE 1-1. Main Study Design Elements

Pollutants:	PM_{10} Particle Mass $PM_{2.5}$ Particle Mass Particle Elements for $PM_{2.5}$ and PM_{10}: Cadmium (Cd), Chromium (Cr), Lead (Pb), Manganese (Mn), Nickel (Ni), Sulfur (S), plus 34 other supporting elements VOC's: isobutylene, 1,3-butadiene, acetonitrile, dichloromethane [DCM], methyl-tertiary-butyl-ether [MTBE], ethyl-tertiary-butyl ether [ETBE], benzene, toluene, ethylbenzene, o-xylene, m,p-xylene, and, trichloro-fluoro-methane [TCFM]) CO Formaldehyde Total Particle Count/cm3 in 12 sizes, 0.15 µm - 2.5 µm Black (elemental soot) Carbon
Other Measurements:	Vehicular Characterization: vehicle speed, traffic density [Level of Congestion], vehicle spacing distance, commute video record Meteorology: ARB provided data: temperature, relative humidity, wind speed, and wind direction
Metropolitan Areas:	Sacramento, CA, Los Angeles, CA
Vehicle Types:	Sedans: 1991 Chev. Caprice, 1997 Ford Taurus Sport Utility Vehicle: 1997 Ford Explorer California diesel-powered school bus
Vehicle Ventilation Settings:	High: windows closed, outside vent open, medium fan speed Low: windows closed, outside vent closed, medium fan speed Note: window-open vent settings in the Pilot Study were not used in the Main Study
Driving Scenarios (roadway type and level of congestion:	Freeway Rush (FR) Freeway Rush Carpool (FRC) Freeway Non Rush (FNR) Arterial Rush (AR) Arterial Non-Rush (ANR) School Bus (SB) Maximum Concentration (MC)
Driving Periods (time of day):	AM, PM

TABLE 1-2. Specific Research Design Objectives Grouped By Influencing Factor Type For the Main Studies

<u>Data Base Development</u>

B1. Measure the concentrations of selected pollutants inside and outside California vehicles during commutes consisting of selected scenarios that define an expected range of concentrations from "best" to "worst" case.

<u>Driver Selected Ventilation Options</u>

C1. Evaluate the differences between inside and outside vehicle contaminant concentrations and their relationships to 2 driver (or passenger) adjusted ventilation control settings, to provide two levels of outside air exchange rates (high and low air exchange rates, AERs).

<u>Vehicle Factors</u>

D1. Evaluate the influence of four vehicle types (2 different sedans, a sport-utility vehicle (SUV), and a California school bus) on occupant exposure levels.

<u>Roadway Factors</u>

E1. Evaluate the influence of 3 roadway types (freeway, arterial, and rural) on in-vehicle concentrations.

E2. Evaluate the influence of freeway lane positions (carpool compared to normal lane) on in-vehicle concentrations.

E3. Evaluate the influence of "worst-case" roadway settings that may produce the maximum in-vehicle concentrations.

<u>Traffic Factors</u>

F1. Evaluate the influence of 2 freeway conditions (Rush hour and Non-Rush hour) on in-vehicle concentrations.

F2. Evaluate the influence of the average traffic speed, traffic density (Level of Congestion by visual observation), vehicle separation distance on in-vehicle concentrations.

<u>Meteorological Factors</u>

G1. Evaluate the influences of meteorological variables (wind speed, wind direction, temperature, relative humidity) on in-vehicle concentrations.

<u>Temporal Factors</u>

H1. Evaluate the influence of AM versus PM commutes on in-vehicle concentrations in Sacramento and Los Angeles

H2. Evaluate the variability of inside and outside concentrations of CO, particle count, and black carbon over the period of 120 minute commutes

<u>Spatial Factors</u>

I1. Evaluate the relative relationships of selected pollutant concentrations inside vehicles, outside vehicles, at contemporaneous roadside locations, and at fixed-site ambient monitoring locations.

1.3 Main Study Design

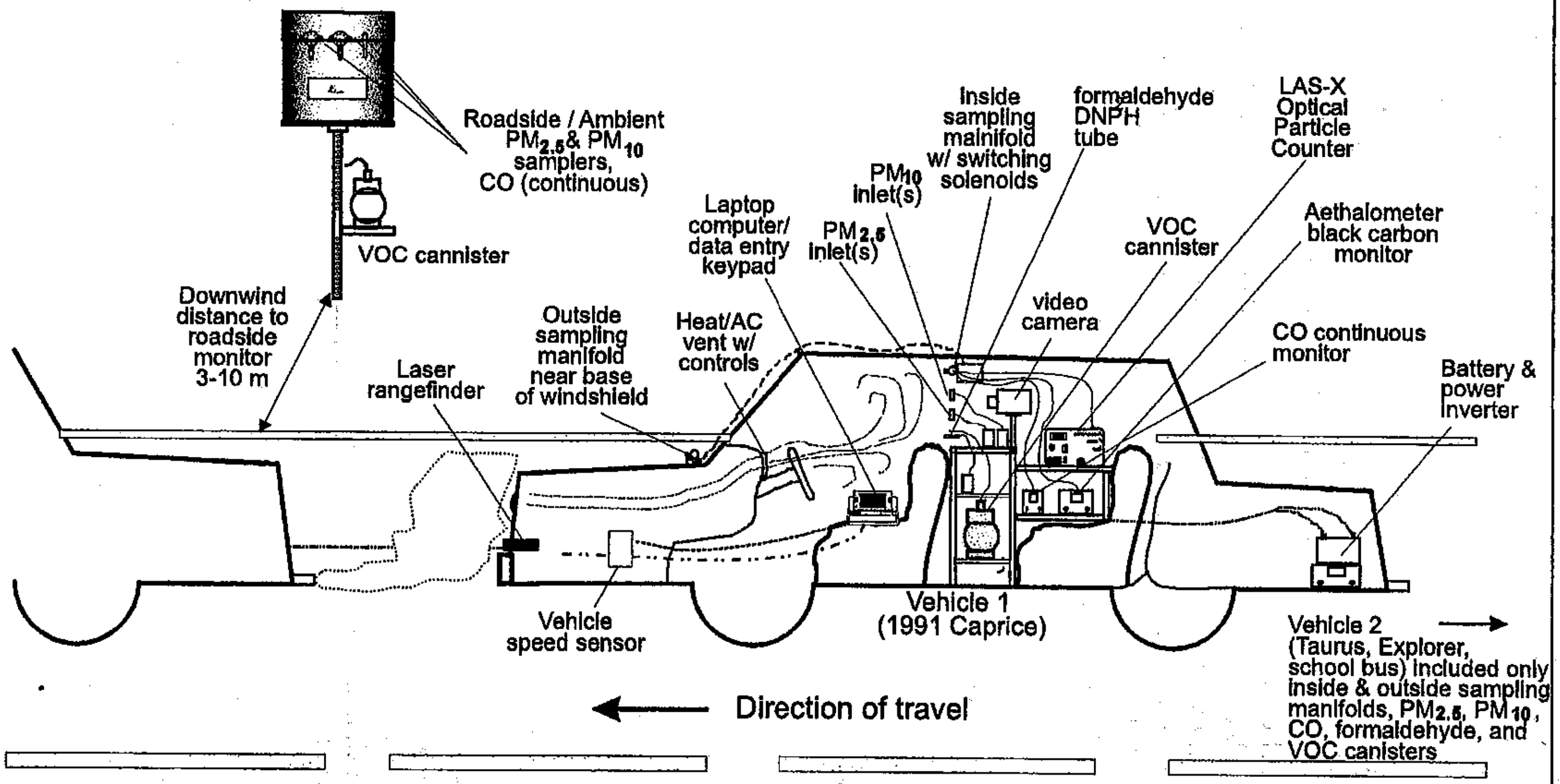
The overall in-vehicle program was conducted in two phases. Phase 1 was a Pilot Study and Phase 2 was the Main Study. The Pilot Study was designed to address four objectives: (1) evaluation of the monitoring methods proposed for the Main Study, (2) collection of limited pollutant monitoring data in Sacramento for the pollutants and other parameters proposed for the Main Study, (3) collection of real-time particle monitoring data in Sacramento for particle count and black carbon, plus a limited set of measurements for PAH's, and, (4) final definition of the research objectives for the Main Study. A brief summary of the findings from the separate Pilot Study report are given in Section 1.4.

The Main Study focused on pollutant and supplemental data collection during 2 hour in-vehicle commutes in Sacramento and Los Angeles. The primary vehicle was a heavily-instrumented sedan (1991 Chevrolet Caprice) provided by Sierra Research. As shown in Figure 1-1, the vehicle had a full complement of integrated and continuous pollutant measurement devices, plus traffic characterization equipment including a video camera. Secondary vehicles were selected to trail this "lead" vehicle during each commute, and consisted of a 1997 Ford Taurus sedan, a 1997 Ford Explorer (SUV), and a 30 foot diesel California school bus. The sedans and the SUV were gasoline-fueled, California vehicles. Even though the "typical" commute times in Sacramento and Los Angeles are for somewhat shorter periods, a 120 min (2 hour) driving time was selected, based primarily on the minimum time required to collect integrated samples (especially $PM_{2.5}$ particles) in sufficient quantities for subsequent analyses. This extended commute period was also expected to "smooth" the contribution of single high concentration events.

The 120 minute "commute" period was intended to allow the measurement of concentration levels representing typical driving scenarios. In some cases the commute route required "back-tracking" along the same route until 120 minutes had elapsed. In the case of more circular routes, the 120 minute drives continued in the same direction for the duration. In each run, the "commute" attempted (as much as possible) to drive in the direction of the predominant traffic flow. Note that the 29 different driving runs conducted during this study are referred to as "commutes", even though they are actually simulations.

While the number of commutes in the Main Study made it impossible to emulate all potential commuting scenarios, the ones selected represented a cross-section of freeway and arterial commute situations most likely to be encountered. The specific routes selected represented typical freeway and arterial settings in the two metropolitan areas, with an emphasis placed on routes that are typically heavily traveled. Selection of morning and evening Rush Hour commute periods (6:30 to 8:30 AM, and 4:30 to 6:30 PM) were compared against morning and afternoon Non-Rush Hour periods (8:30 to 10:30 AM, and 2:30 to 4:30 PM). Only a limited number of vehicle types could be evaluated concurrently in each commute, with the selection of specific vehicles to (a) represent commonly used vehicles in southern California, and (b) to simplify the acquisition of vehicles to test by using rental vehicles. Little information existed on the expected range of Air Exchange Rates by California vehicle type that might have assisted in the selection process. Measurement of the concentrations immediately outside each tested vehicle, provided the concentration levels that would be encountered, regardless of vehicle type or vent setting.

Figure 1-1. Inside, Outside and Roadside Vehicular Measurements for ARB Main Study



C. Rodes, RTI, 11/98, file: carb1d

Commute-average (120 min) concentration measurements were made for number of pollutants, including: $PM_{2.5}$ particle mass, PM_{10} particle mass, a suite of volatile organic compounds (VOC's), and formaldehyde. The $PM_{2.5}$ and PM_{10} filters were also analyzed for a suite of metals. The integrated samples were collected immediately behind the back seat to represent the inside concentration in each vehicle. The outside concentrations were determined from a sample drawn through a sample line with an intake on the hood of each vehicle, immediately in front of the windshield. Several continuous pollutant measurements were also made (primarily in the fully-instrumented Vehicle 1 (1991 Chevrolet Caprice) and reduced to 120 one minute averages for each commute, including: carbon monoxide (all vehicles), total particle count (Vehicle 1), and particle black carbon (Vehicle 1). A more detailed description of the pollutant measurements made and the analytical methodologies are provided subsequently in Section 2.1.

Pollutant measurements were concurrently made at 2 roadside locations along the route for most commutes to estimate the value of proximal monitoring to the roadway as a possible estimator of in-vehicle concentrations. In order to relate the in-vehicle pollutant measurements to the background concentrations, a nearby ARB ambient background monitoring location was selected at which to collect concurrent pollutant concentration measurements. Vehicular characterization measurements included Air Exchange Rate (AER), vehicle speed, vehicle spacing (to the vehicle immediately in front of Vehicle 1, and the subjectively determined Level of Congestion. The AER for each vehicle was determined at fixed speeds to generally characterize the influence of the ventilation settings. Even though these AER's were not commute averaged, they provided relative indications of the ventilation rates between vehicle types.

Several special studies were conducted in order to provide at least limited information on specific in-vehicle scenarios. A single rural commute was conducted in Sacramento (a "rural" commute location could not readily be identified for Los Angeles) to provide a general background comparison of concentration levels in a non-urban setting with very limited traffic. A pair of school bus commutes was conducted in a Sacramento neighborhood setting to estimate typical concentration levels inside and outside of a diesel school bus following a actual bus commuting route. A pair of carpool lane commutes was conducted in Los Angeles to compare the concentrations in the carpool lane with those simultaneously present in the non-carpool lanes. A pair of maximum concentration commutes was conducted in Los Angeles, focusing on the situations most likely to maximize particle and VOC concentrations (e.g. closely following a smoking diesel bus, incorporating a gasoline re-fueling stop). While very limited in scope, these special tests, provided information on several commuting scenarios for which no data had been available.

1.4 PILOT STUDY SUMMARY

The Pilot Study final report (see Appendix A) evaluated all methodologies used in the Main Study and made recommendations for changes in selected hardware and measurement methods. The details of this report will not be repeated here, but some of the most salient changes included:

- upgrading of the in-vehicle power supply in Vehicle 1 to provide fail-safe power for the Aethalometer and LAS-X continuous monitors,
- increasing the flowrate of the PM_{10} samplers from 2.0 to 4.0 lpm to provide enough sample mass to gravimetrically analyze,

- retaining the LAS-X and Aethalometer for the Main Study because of the added data value,
- retaining 2 of the 4 roadside monitors in the Main Study,
- modifying the sealing system of the $PM_{2.5}$ particle samplers to assure leak tightness,
- evaluating the $PM_{2.5}$ inlets against EPA reference samplers to assure comparability,
- moving the outside sampling line inlet from the front of the grill back to the base of the windshield to more closely sample the air entering the vehicle vent systems,
- switching the elemental analysis method from the more expensive ICP/MS to the less sensitive XRF to analyze all filters, instead of a subset,
- conducting limited vehicular air exchange rate tests at other vehicle speeds to estimate their influence on ventilation,
- more carefully synchronizing clock times during the field sampling to assist in inter-relating the continuous monitoring data.

The pollutants measured in the Pilot Study differed somewhat from those measured in the Main Study, and are summarized in Tables 2-1A, 2-1B, and 2-1C. Elevated winds during the Pilot Study produced extremely low concentration levels near or below the detection limits for most pollutants. The Pilot Study final report is attached in Appendix A.

Table 1-3A. Summary Table of Measurements Comparing Six Freeway Commutes (Mean) with One Rural Commute

	Commute	Ambient	Out-Car Mean	In-Car Mean	In-Car Range	Roadside Mean	Roadside Range
VOC's ($\mu g/m^3$)							
1,3-Butadiene	Freeway	0.53	2.63	2.57 (0.28)	1.4 - 3.1	1.24	0.83 - 1.63
	Rural	0.0	0.0	0.0 (0.0)		na	na
MTBE	Freeway	3.93	13.00	13.98 (9.03)	8.9 - 19.0	7.22	6.15 - 8.58
	Rural	1.0	1.4	1.6 (0.0)		na	na
ETBE	Freeway	0.0[3]	0.0	0.0	na	0.0	0.0
	Rural	0.0	0.0	0.0		na	na
Benzene	Freeway	na	na	na	1.7 - 4.6	na	na
	Rural	na	na	na		na	na
Toluene	Freeway	10.17	24.17	26.33 (29.83)	15 - 37	14.62	11.68 - 19.10
	Rural	3.2	4.6	5.8 (5.0)		na	na
m,p-Xylene	Freeway	4.38	15.00	16.83 (18.63)	10 - 21	7.67	5.68 - 9.83
	Rural	1.5	1.8	3.4 (3.3)		na	na
o-Xylene	Freeway	1.85	6.12	6.77 (6.47)	4.3 - 8.1	3.34	3.03 - 4.00
	Rural	0.8	0.9	1.5 (0.0)		na	na
Formaldehyde ($\mu g/m^3$	Freeway	na	na	9.5	4.3 - 11.0	na	na
	Rural	na	na	9.6		na	na
PM_{10} ($\mu g/m^3$)	Freeway	43.0	na	63.5	33 - 84	65.8	54.3 - 78.6
	Rural	28.0	na	18.0		na	na
$PM_{2.5}$ ($\mu g/m^3$)	Freeway	50.8	45.2 (49.0)	35.2 (44.6)	16 - 64	31.5	24.8 - 38.0
	Rural	31.0	13.0 (26.0)	24.0 (22.0)		na	na
Carbon ($\mu g/m^3$)	Freeway	na	5.96	7.08		na	na
	Rural	na	na	1.3		na	na
CO (ppm)	Freeway	0.1, 0.1[4]	2.7, 2.4	2.2, 1.7		0.4, 0.4	0.2 - 0.9, 0.2 - 0.7
	Rural	0, 0	0, 0	0, 0		na	na
NO_2 (ppb)	Freeway	42.2, 38.0	61.2, 41.0	78.3, 63.5		25.3, 33.5	25.3 - 86.0, 17.5 - 51.8
	Rural	9.0, 5.0	1.0, 1.0	0.0, 29.0		na	na

See table notes following Table 1-3C

Table 1-3B. Summary Table of Measurements Comparing Six Freeway Commutes (Mean) with One Rural Commute (cont'd)

	Commute	Ambient	Out-Car Mean	In-Car Mean	In-Car Range	Roadside Mean	Roadside Range
PAH's (ng/m3)							
Benzo[b]fluoranthene	Freeway	0.2	0.5	0.2	na	0.5	na
	Rural	0.1	0.3	0.0	na	na	na
Benzo[k]fluoranthene	Freeway	0.1	0.1	0.1	na	0.1	na
	Rural	0.1	0.2	0.0	na	na	na
Benzo[e]pyrene	Freeway	0.1	0.3	0.2	na	0.3	na
	Rural	0.0	0.0	0.0	na	na	na
Benzo[a]pyrene	Freeway	0.1	0.3	0.3	na	0.2	na
	Rural	0.1	0.1	0.1	na	na	na
Indeno[1,2,3-	Freeway	0.2	0.4	0.5	na	0.3	na
	Rural	0.0	0.2	0.1	na	na	na
Benzo[ghi]perylene	Freeway	0.2	0.8	1.0	na	0.6	na
	Rural	0.0	0.2	0.0	na	na	na
$PM_{2.5}$ Metals (ng/m3)							
Cadmium (Cd)	Freeway	0.16	0.23	0.09 (0.12)	0.0 - 0.12	0.24	0.0 - 0.46
	Rural	0.0	na	na	na		
Chromium (Cr)	Freeway	103.7	108.0	76 (122)	2.7 - 109	104	76.5 - 114
	Rural	0.0	na	na	na		
Manganese (Mn)	Freeway	14.6	5.6	6.4 (6.1)	.25 - 6.8	2.1	0.2 - 4.0
	Rural	0.0	na	na	na		
Nickel (Ni)	Freeway	0.0	0.0	25 (0.0)	na	10.3	0.0 - 29.0
	Rural	0.0	na	na	na		
Lead (Pb)	Freeway	9.2	7.6	15.7 (7.8)	11 - 24	5.3	3.1 - 9.0
	Rural	0.0	na	na	na		
Sulfur (S)	Freeway	293.3	356.0	342 (274)	231 - 575	299	166 - 392
	Rural	93.0	na	na	na	na	na

See footnotes following Table 1-3A and additional notes following Table 1-3C

Table 1-3C. Summary of Measurements Comparing Six Freeway Commutes with One Rural Commute (cont'd)

	Commute	Ambient	Out-Car Mean	In-Car Mean	In-Car Range	Roadside Mean	Roadside Range
PM_{10} Metals (ng/m3)							
	Freeway	0.17	na	0.62 (0.26)	0.37 - 0.86	0.28	0.0 - 0.75
	Rural	na	na	na	na	na	na
Chromium (Cr)	Freeway	262.0	na	161 (251)	9.5 - 239	176	67.7 - 239
	Rural	na	na	na	na	na	na
Manganese (Mn)	Freeway	24.2	na	18.8 (21)	9.3 - 25	24.3	2.5 - 46
	Rural	na	na	na	na	na	na
Nickel (Ni)	Freeway	13.3	na	28 (11)	na	0.0	na
	Rural	na	na	na	na	na	na
Lead (Pb)	Freeway	12.8	na	12.5 (8.3)	11 - 14	9.6	1.1 - 16.8
	Rural	na	na	na	na	na	na
Sulfur (S)	Freeway	466.2	na	478 (660)	265 - 639	398	256 - 507
	Rural	na	na	na	na	na	na
In-Traffic Data							
Commute speed, mph.	Freeway	na	na	35.0	na	na	na
	Rural	na	na	47.6	na	na	na
Total miles	Freeway	na	na	75.1	na	na	na
	Rural	na	na	107	na	na	na
Trailing Distance, ft	Freeway	na	na	94.8	na	na	na
	Rural	na	na	193.1	na	na	na
Level of Congestion	Freeway	na	na	3.6	na	na	na
	Rural	na	na	1.0	na	na	na

Content Notes for Tables 1-3A, B, and C:

- All data below the MDL were considered as and entered as 0.0 [see Table 5-1 for starred values that are below the detection limits]
- Means were computed even if the individual input data were below the MQL's
- Data are not necessarily paired, and inter-comparisons should be done with caution
- Some freeway means represent significantly fewer than 6 input values, especially for the metals
- No range is possible for rural data; many rural concentrations were below the MQL
- "Ambient" refers to study monitor data collected at ARB 13th and T St. monitoring site
- Carbon and carbon monoxide data are commute averages of 1.0 minute data
- Benzene data were not available from canister analyses; tabular results shown are from multisorb tubes
- No In-Car PAH analyses were above the MQL (no range reported)
- PAH samples were collected at only 1 roadside site (no range available)
- Only selected samples were analyzed for $PM_{2.5}$ and PM_{10} metals; see Table 5-2 to identify selected samples; means reported represent up to 4 samples for In-Car, but no more than 2 for Roadside
- Data separated by a comma (,) are individual Hour 1 and Hour 2 values
- Data in parentheses () are duplicate analyses
- The $PM_{2.5}$ data are uncertain due to a random leak (see Section 3)
- An "na" means that no data are available

2.0 MATERIALS AND METHODS

2.1 Overview

The Main Study field sampling was conducted from 9/9/97 to 9/15/97 in the Sacramento, California metropolitan area, and from 9/25/97 to 10/3/97 in the Los Angeles area. The field work was conducted by the Research Triangle Institute (RTI) and its subcontractor, Sierra Research. Sierra was responsible for route selection, obtaining the test vehicles, assimilating vehicle and traffic characterization data, and providing drivers and navigators. RTI personnel were responsible for all other aspects, including the collection and analysis of pollutant samples and data. As shown in Tables 2-1A and 2-1B (for Sacramento and LA), a total of 13 commutes were made in Sacramento and 16 commutes is Los Angeles. The balanced factorial design included the same types and number of non-specialized commutes in both metropolitan areas. All commute spanned a 2-hour period to provide a sufficiently long period to be representative of the commute scenario, while collecting sufficient sample materials for subsequent analyses. A variety of Freeway and Arterial commutes were driven, under Rush and Non-Rush hour traffic conditions, and covering both AM and PM periods in both cities. The desire to cover a range of driving scenarios was accompanied by a tradeoff in the limited number of duplicate commutes representing a specific scenario. Only two commutes were made for each factorial scenario, providing information on the estimated pollutant concentration levels, but limiting the ability to conduct robust statistical analyses. Several special purpose commutes were also driven to gather concentration data on specific scenarios, including: (a) a Sacramento rural commute, (b) two Sacramento school bus route commutes, (c) two Los Angeles carpool lane commutes, and (d) two Los Angeles maximum concentration commutes.

Table 2-1A. In-Vehicle Study Commute Scenarios for Sacramento (SAC)

Commute #	Commute Day	Date 1997	Day Week	City	Test Type	Time Period	Roadway Type	Rush Period	Vent Settings	Ambient Data?	Roadside Data?
1	1	9/9	Tu	SAC		AM	Freeway	Non-Rush	High	Yes	Yes
2	1	9/9	Tu	SAC		PM	Freeway	Non-Rush	High	Yes	Yes
3	2	9/10	We	SAC		AM	Freeway	Rush	High	Yes	Yes
4	2	9/10	We	SAC		PM	Freeway.	Rush	High	Yes	Yes
5	3	9/11	Th	SAC		AM	Freeway	Rush	Low	Yes	Yes
6	3	9/11	Th	SAC		PM	Freeway	Rush	Low	Yes	Yes
7	4	9/12	Fr	SAC		AM	Arterial	Rush	High	Yes	Yes
8	4	9/12	Fr	SAC		PM	Arterial	Rush	High	Yes	Yes
9	5	9/13	Sa	SAC	Rural	midday	Rural	Rush	High	No	Yes
10	6	9/15	Mo	SAC		AM	Arterial	Rush	Low	Yes	No
11	6	9/15	Mo	SAC		PM	Arterial	Rush	Low	Yes	No
12	7	9/16	Tu	SAC	School Bus	AM	Resid.	Rush	High	Yes	No
13	7	9/16	Tu	SAC	School Bus	PM	Resid.	Rush	High	Yes	No

Table 2-1B. In-Vehicle Study Commute Scenarios for Los Angeles (LA)											
Commute #	Commute Day	Date 1997	Day Week	City	Test Type	Time Period	Roadway Type	Rush Period	AER Level	Ambient Data?	Roadside Data?
14	8	9/25	Th	LA		AM	Freeway	Non-Rush	High	Yes	No
15	8	9/26	Fr	LA		AM	Freeway	Rush	High	Yes	Yes
16	9	9/26	Fr	LA		PM	Freeway	Rush	High	Yes	Yes
17	10	9/27	Sa	LA		PM	Arterial	Non-Rush	High	Yes	No
18	11	9/28	Su	LA		AM	Arterial	Non-Rush	High	Yes	No
19	11	9/28	Su	LA		PM	Freeway	Non-Rush	High	Yes	No
20	12	9/29	Mo	LA		AM	Freeway	Rush	Low	Yes	Yes
21	12	9/29	Mo	LA		PM	Freeway	Rush	Low	Yes	Yes
22	13	9/30	Tu	LA	Carpool	AM	Freeway	Rush	High	Yes	Yes
23	13	9/30	Tu	LA	Carpool	PM	Freeway	Rush	High	Yes	Yes
24	14	10/1	We	LA		AM	Arterial	Rush	Low	Yes	Yes
25	14	10/1	We	LA		PM	Arterial	Rush	Low	Yes	Yes
26	15	10/2	Th	LA		AM	Arterial	Rush	High	Yes	Yes
27	15	10/2	Th	LA		PM	Arterial	Rush	High	Yes	Yes
28	16	10/3	Fr	LA	Max Conc.	AM	Freeway	Rush	High	Yes	No
29	16	10/3	Fr	LA	Max Conc.	PM	Freeway	Rush	High	Yes	No

Almost all commutes were led[2] by the specially-equipped test sedan (a 1991 Chevrolet Caprice, designated as Vehicle 1 for all commutes) that was utilized as a mobile sampling platform. This test vehicle was outfitted by RTI to collect inside and outside vehicle integrated samples and continuous measurements for most of the selected pollutants (PM_{10} particle mass and formaldehyde were collected inside only). The inside measurements were made near the driver's breathing zone to estimate the exposure concentrations. Outside samples were collected by drawing air through a sampling line from a point at the base of the windshield at ~16 lpm to a distribution manifold inside the car. The lead vehicle had also been modified by Sierra Research to record vehicular information in 1 minute averages for vehicle speed, spacing to the vehicle in front, and subjective judgments (trained observer) of the Level of Congestion and the type of "target" diesel vehicle leading Vehicle 1. A second vehicle (sedan, SUV, or school bus) typically trailed immediately behind the lead vehicle. The driving protocol was extremely important in defining the primary sources of the concentration levels encountered during the various commutes. An effort was made by the lead vehicle to drive behind a diesel vehicle as often as practical to "over-sample" this emission source *in-situ*. The significance of the lead vehicle was addressed by a detailed review of the driver's view, video tapes for 5 high particle concentration events in Los

[2] Except for the PM school bus commute in which the Caprice trailed the bus, and the carpool lane commutes, where Vehicle 1 traveled the carpool lane and Vehicle 2 traveled the non-carpool slower lanes.

Angeles. Supplemental data were collected by ARB (not part of this study) during the commutes on the fuel analyses used by the test vehicles. These data are given in Appendix B.

Simultaneous integrated samples and measurements for most of the same pollutants were collected in each vehicle, at 2 Roadside sites, and at the most proximal fixed-site Ambient air monitoring station. The Sacramento site was operated by ARB, while the Los Angeles site was maintained by the SCAQMD. The continuous particle counts and black carbon measures were only available in Vehicle 1. Access permits were obtained for Sacramento and Los Angeles from CalTrans to install and service the 2 Roadway sites at the selected locations along the freeway commuting routes. The Roadside monitors were located within 20 feet of the pavement, on the predominantly downwind side of freeway.

Two ventilation control settings in each of the vehicles[3] were standardized to demonstrate their influence on the in-vehicle pollutant concentrations. These settings provided "low" and "high" levels of ventilation with the windows closed. Air exchange rates were measured primarily at a constant speed of 55 mph, although additional tests at 0 and 35 mph were also conducted..

The pollutant measurements and their associated sample collection and analysis methods are given in Table 2-2. The associated supplemental measurements used to characterize the traffic and meteorology are provided in Table 2-3.

TABLE 2-2. Main Study Pollutant Sample Collection and Analysis Method Summaries

Pollutant	Sample Collection	Sample Analysis
PM_{10} Particles (integrated)	MSP 200 4.0 LPM PM_{10} inlets, particle on 37 mm, 3.0 µm porosity Gelman Teflo filters	Gravimetric, on a modified Mettler AT20 microbalance, with computer control
$PM_{2.5}$ Particles (integrated)	MSP 200 4.0 LPM $PM_{2.5}$ inlets, particle on 37 mm, 3.0 µm porosity Gelman Teflo filters	Gravimetric, on a modified Mettler AT20 microbalance, with computer control
Particle Count by size (total counts per minute)	Particle Measurement Systems (PMS) Model LAS-X optical particle counter	Computer data collection and size distribution analyses
Black Carbon	McGee Scientific Aethalometer	5 LPM on quartz fiber tape readings by optical absorption
VOC's	SUMMA passivated 6 liter evacuated canisters, sample rate of 25 cc/min; Multisorbent tubes	GC/MS with SIM enhancement
Formaldehyde	DNPH cartridges, 170 cc/min	Thermal desorption followed by HPLC analysis
CO	Draeger Model 190, diffusion sensing (not pumped)	electro-chemical
Metals in PM_{10} /$PM_{2.5}$ particles	PM_{10} /$PM_{2.5}$ Teflon filters	X-Ray Fluorescence (XRF), energy dispersive

[3] The school bus ventilation was dominated by opening 3 windows half way down on each side of the bus during the commutes - typical of student settings

TABLE 2-3. Supplemental Measurement Method Summaries

Measurement	Sensor	Data Collection/Media
Vehicle 1 Traffic speed in mph	Digital speedometer, mph	Computer, real time, trip averaged
Level of Congestion (traffic density), unitless	Navigator categorical judgment, manual input	Computer storage of binary data
"Target" vehicle type: Diesel Bus, Heavy Duty Diesel Truck, Other Diesel, on Other Vehicle	Navigator categorical judgment, manual input	Computer storage of binary data
Lead vehicle spacing to Vehicle 1 in feet	Laser distance meter in grill	Computer, real time, trip averaged
Vehicles 1 and 2 miles driven	odometers	manual log entry
Video commute record - VHS	Automatic camera with front windshield view field	manual viewing
Air Exchange Rate (at constant 55 mph vehicle speed - not determined during commutes), and selected speeds (0, 35, and 55 mph)	Draeger CO monitor (method of Ott & Willits, 1981)	Internal logger/computer
Meteorology - wind speed, wind direction, relative humidity, and temperature	Obtained from nearest ARB weather station	Computer file, hourly
Commute route narrative characterization - unusual events	Prepared by navigator to supplement video	manual interpretation

2.2 Commuting Routes/Protocols

The selection process for freeway, arterial, carpool lane, school bus, and rural commute routes carefully considered the development of a range of expected exposure concentrations, while being representative of typical Sacramento and Los Angeles commutes. Historical CalTrans count data were examined to identify the potential routes with the highest traffic densities. Highlighted maps of the Sacramento and Los Angeles commute routes are shown in Appendix C. Also shown are the Roadside sites (R1 and R2) and the Ambient sites (A). Commute trips were 120 minutes in length over the selected route, with measurements terminated at the 120 minute point. Each route was driven repeatedly as needed to constitute the total number of miles driven in each 120 minute commute. In all cases the commute route could be driven more than once during the 2 hour period. For non-loop routes, the driver turned around at the ends and retraced the route repeatedly until 120 minutes had elapsed. For loop routes, the driver maintained the same direction for the duration of the commute. The starting direction for each commute was selected based on the travelling with (in the same direction as) the heaviest traffic flow expected for the period for the longest period of time.

2.2.1 Sacramento Routes

- The Freeway commuting route for Sacramento was identical to that used during the Pilot Study. It began at the Clarion Hotel parking lot at 700 16th St., proceeded to the J St. on-ramp on I-5, proceeded South onto East/North bound Bus. 80, merged with I-80, and terminated (vehicles turned around and retraced linearly) at the Madison St. exit.
- The Arterial commute began at the Clarion Hotel parking lot at 700 16th St., proceeded east on H St. thru Fair Oaks Blvd., turning around at El Camino Ave. for the linear retrace return on the same route.
- The School Bus commutes followed a randomly selected Sacramento school system route, starting from the Abe Lincoln school. The AM route pattern was complex (typical, with many bus stops) and is described in detail in Appendix C. The route was driven repetitively for a 120 minute commute. The PM route was somewhat different, but ended at the same school. The bus followed Vehicle 1 (Caprice) for the AM commute, with the order reversed in the PM commute (Caprice following the bus). Passenger ingress and egress was simulated at the regular bus stops by a study technician exiting and then re-entering the bus. No roadside monitoring sites were used during the school bus commutes.
- The Rural commute was a loop located NW of Davis, CA, and began at the small regional airport parking area on Road 95, proceeded North to Road 27, east on Road 27 to Road 98, south on Road 98 to Road 31, west on Road 31 to Road 95, and back to the airport, plus repeats.

2.2.2 Los Angeles Routes

- The Freeway route in Los Angeles covered a large loop, proceeding east (clockwise) in the AM at the Rosemead on-ramp on I-10, South on I-110, East on I-405, North on I-710, East on I-91, North on I-605, and West on I-10 to complete the loop. The PM loop was driven in the reverse direction, starting counter-clockwise.
- The Arterial route in Los Angeles started North on Rosemead from the I-10 underpass, West on Valley Dr., merging with Mission Rd., West on Beverly Blvd., South on Broadway, East on Firestone, South on Avalon, East on Sepulveda Blvd., merging with Willow Rd., North on Lakewood Blvd., and merging with Rosemead at the I-10 underpass.
- The Freeway Carpool route started West on I-10 at the Rosemead on-ramp, proceeding South on I-110 to the Carson, turning around at the I-405 interchange and returning.

2.3 Commute Driving Protocol

The commute driving protocol is a key component, defining the vehicular sources most likely to influence the observed pollutant concentration levels. An important driving factor for all commutes was a focus by the lead vehicle driver to be positioned behind obviously polluting "target" vehicles, whenever possible, to incorporate their influences on in-vehicle concentrations. The guidelines provided to the lead car driver and navigator, included:

1) follow the pre-selected route and position behind a target vehicle whenever possible; the target vehicle was defined as a heavy duty vehicle with diesel exhaust, or other obvious visible (or odorous) vehicular emissions;
2) drive the right hand lane, except when changing lanes to follow or acquire a target vehicle;

3) break off target vehicle pursuit if target vehicle turns off route, can't be followed, drives erratically or unsafely, or appears to modify behavior due to following;
4) change target vehicle if a vehicle with higher exhaust emissions becomes available;
5) drive with normal following distances (like other nearby cars) but not further than about 100 feet behind target vehicle.

Although a few gasoline powered "target" vehicles were noted as being "emitters" (by eye or nose) during the study, the most prevalent visible emitters were diesel vehicles - primarily city buses and heavy duty trucks. This bias toward "high-end" scenarios was intentional. In several cases, however, this proved to be a confounding factor, since the emissions of the vehicle immediately in front of the test vehicles were observed to have a pronounced influence on the commute-average in-vehicle concentrations. A brief 10-minute period (in a 120 minute commute) behind a single, visibly heavily-emitting, diesel city bus can dominate the particle levels for an entire commute average, especially during periods of lower traffic volume (e.g. arterial non-rush). This influence was determined subsequently for a few commutes by a careful review of the in-vehicle video tapes (see section 4.4.1), matched with the continuous pollutant monitoring data. A manual switchbox entry was also tabulated by the Vehicle 1 navigator, which included the category of "target" vehicle immediately in front. The fraction of time (relative to the total commute) that the target switch was set in each position was stored and computed. This permitted compiling the percentage of time behind heavy-duty diesels (HDD) for each commute.

The ability of the driver of Vehicle 1 to select and follow a "target" vehicle was generally much easier in low traffic density settings, especially the ANR and FNR commutes. Conversely, higher traffic density situations, especially the FR commutes, proved much more difficult for the driver to maneuver in traffic. Commutes with minimal traffic (e.g. arterial non-rush) were easier to select a target vehicle, and are the most likely to have the commute-average concentrations influenced by single vehicles. These factors, combined with the substantial contributions for some pollutants made by some "target" vehicles to the inside concentrations, suggests that the non-rush commutes are perhaps the most influenced by the targeted driving protocol. Consequently, some commutes cannot necessarily be considered as "typical" of specific scenarios, but as less probable "high-end" cases.

Another important related consideration in reviewing the concentration results was the tandem nature of the commutes, with a fully instrumented lead vehicle (Vehicle 1) always trailed by Vehicle 2 (sedan, SUV, or school bus). This is especially significant when a "target" vehicle is being followed by Vehicle 1, with Vehicle 2 trailing at some greater distance. Two factors should be kept in mind in this situation, (1) the emissions from the "target" vehicle are typically diluting continuously after emission, such that Vehicle 1 may be more likely to be exposed to higher concentrations than Vehicle 2, and (2) the exhaust emissions from Vehicle 1 were typically sampled by Vehicle 2 (but not vice-versa). The degree to which Vehicle 1 may have been more exposed to target vehicles than Vehicle 2 was not determined (not a study objective). Similarly, determining the influence of Vehicle 1 on Vehicle 2 was not a study objective.

2.4 Pollutant Measurement Method Descriptions and Performance Data

2.4.1 In-Vehicle / Outside-Vehicle Sampling

Inside sampling in each vehicle was conducted at a location immediately behind the center of the front seat. All samplers with pumped systems were exhausted external to the vehicle. While this had some impact on the AER (the influence from the total flow of these samplers (~10 lpm) was estimated to be less than 1%, based on the interior volumes of the vehicles and the relatively high AER's during commuting. Outside sampling required the use of a sampling line operating with sufficient flow (~16 lpm) to rapidly transport the air from near the base of the windshield to the distribution manifold. Large-bore solenoid valves were used to switch the air stream from inside to outside, controlled by a time signal from the onboard laptop computer. The same program stored zeros (inside) and ones (outside) along with the LAS-X count data to simplify data reduction. While gas phase pollutants were not expected to have significant losses through the inlet line, it was expected that some particle losses would occur, as a function of particle size. A particle loss test for the inlet system is described in section 2.4.8.1.

2.4.2 Roadside and Ambient Sampling

Roadside sampling during freeway commutes required encroachment permits from CalTrans. Since the sampling stations were supported on a simple signpost, the impact of the stations on the local landscape was imperceptible. Permission to locate the units during arterial commutes was informal, and required only verbal permission in all cases. Access to the ambient stations was obtained by the ARB project officer, from the local ARB group responsible for the station. Roadside and ambient site sampling units were completely battery-powered and self-contained. This permitted the units to be prepared and checked at the central work station (motel) prior to transporting to the sampling site. The initiation and termination of sampling for each measurement were manual, however, and required that the field staff arrive at the roadside or ambient site very close to the start or end time to define the nominal 120 minute sampling period. An acceptance window of 10 minutes was allowed for the start and end times, suggesting that a maximum allow clock time error would be 20 minutes out of 120, or approximately 15 %. In almost all cases, the actually deviation from the commute start and end was less than 10 %.

2.4.3 Volatile Organic Compounds (VOC's)

2.4.3.1 Method Description - Air samples for monitoring the target VOC's were collected in both 1.8 L and 6 L SUMMA passivated stainless steel canisters. Restrictive orifices were used to control air flow into the canisters at ~25 ml/min during the 2-hour sampling period. Canister samples were returned to the laboratory. Canister samples were analyzed within 8 days of collection.

Prior to use, canisters were cleaned by heating to 130 °C in an oven for 4 hours while connected to a vacuum manifold. Canisters were then evacuated to 0.05 mm Hg vacuum. Restrictive orifices constructed and calibrated at RTI were attached to each canister in the field. During sample collection, a rotameter was used to verify air flow rates.

VOC's in canister samples were cryofocused then analyzed by gas chromatography/ mass spectrometry (GC/MS). Selected ion monitoring (SIM) was used to enhance method sensitivity. Analytical conditions were described in detail in the Pilot Study report. During analysis, a portion (200 ml) of the sample plus a known concentration of the external quantitation standard were cryogenically trapped then injected into the GC column for separation and analysis. VOC identifications were based on chromatographic retention times relative to the external quantitation standard and relative abundance's of the selected ion fragments. Ion fragments were selected based on previous project work with the target chemicals. Quantitation was performed using chromatographic peak areas derived from the selected ion profiles. Specifically, relative response factors (RRF's), or first order linear regression, for each target compound were generated from injections of canister standards prepared at 5 different concentrations (~0.5 to 50 ng/L).

Mean values and standard deviations of the RRF's were calculated for each target VOC. The calibration curve was considered acceptable if the standard deviation for each relative response factor was less than 25%. During each day of analysis, an additional medium level calibration standard was analyzed. If the RRF values for this standard was within ±25% of the average RRF, the GC/MS system was considered "in control" and the mean RRF's was used to calculate the concentration of the target VOC's in a sample (C_{TS}).

During this study, the following quality control (QC) samples were prepared and analyzed to demonstrate method performance.

- Field controls (FC) were used to evaluate method recovery. These are canisters spiked with target VOC's at known concentrations. These samples are shipped to the field and handled exactly as field samples except that the valves are not opened.
- Field blanks (FB) were used to evaluate background contamination. These are unspiked canisters that are prepared by filling clean evacuated canisters with a volume of approximately 4.5 liters of VOC-free humidified nitrogen. These canisters are shipped to the field and handled exactly as field samples except that the valves are not opened.
- Field duplicates were field samples collected side-by-side to assess sampling precision.
- Method quantitation limits have been set to the concentration of the lowest calibration standard.

2.4.3.2 VOC Performance Data

TABLE 2-4. Method Performance Data for VOC Canister Samples

Analyte	Method Quantitation Limit, MQL ($\mu g/m^3$)		Field Blank Concentration ($\mu g/m^3$)		Field Control % Recovery (n = 3)		% RSD Duplicate Samples	
	SAC[a]	LA	SAC (n=6)	LA (n=6)	SAC (n=3)	LA (n=3)	SAC (n=5)	LA (n=4)
Isobutylene	0.22 (0.44)	0.22	NR[b]	0.45	c	-	4.5	6.3
1,3-Butadiene	0.30 (0.60)	0.30	NR	<MQL	91	103	7.9	6.9
Acetonitrile	0.70 (1.4)	0.70	NR	<MQL	-	-	6.6	12
DCM	1.1 (2.2)	1.1	NR	<MQL	-	-	30	9.3
MTBE	1.0 (2.0)	1.0	NR	<MQL	96	111	6.1	6.5
ETBE	1.0 (2.0)	1.0	NR	<MQL	92	113	na	na
Benzene	1.1 (2.2)	1.1	NR	<MQL	95	116	5.5	4.9
Toluene	1.1 (2.2)	1.1	NR	2.5	101	105	8.4	4.5
Ethylbenzene	0.80 (1.6)	0.80	NR	<MQL	-	-	3.0	3.1
o-Xylene	1.2 (2.4)	1.2	NR	<MQL	108	116	3.8	4.1
m,p-Xylene	1.1 (2.2)	1.1	NR	<MQL	107	110	3.3	3.4
TCFM	0.37 (0.70)	0.37	NR	<MQL	-	-	na	na

Notes: a MQL based on lowest calibration standard. Lowest calibration standard varied for Sacramento data. Numbers in parenthesis indicate lowest calibration for some sets of data.
b NR - not reported, field blanks contaminated during preparation process.
c (or no entry) - no data, compounds were not included in control mixture or not detected in sample.
na – insufficient data above the MQL to compute

The two slightly elevated LA field blanks (isobutylene and toluene) were unexpected, and attributed to a possible field contamination problem. Note also in Table 2-4, that two different values are listed for the MQL for the Sacramento VOC samples. This is due to instrument problems experienced during the analysis of some of the Sacramento canister samples. A leak in the valve system supplying the calibration gas to the GC/MS cryo-focusing interface unit resulted in the loss of calibration gas while switched to the off-line position. This leak only affected the total number of runs that could be made from each calibration cylinder and not the accuracy of delivery, as long as the cylinder pressure was sufficient to drive the flow controller. However, this did require more frequent calibration of the system since the calibration cylinder had to be replaced more often. During one of these calibrations, the lowest calibration point was erroneously omitted from the calibration curve. Since the MQL was determined by the lowest calibration point, this necessitated that the MQL for that set of data be increased above the MQL for the other sets. All affected samples were not reanalyzed due to time constraints for recycling the canisters for shipment to the field for collection of additional samples.

2.4.4 Particle Mass

2.4.4.1 Method Description - The filter collection and weighing methods for gravimetrically-based PM_{10} and $PM_{2.5}$ particles measurements are based on methods that have been used previously at RTI. The methods have been validated during the past three years on two large-scale exposure studies conducted for the U.S. EPA and a commercial client. The extremely short sampling periods proved very challenging, especially for the $PM_{2.5}$ and PM_{10} samplers. This had not been attempted before, and required extremely close attention to the performance of the electronic balance during the weighing process by the data computer software. This was complicated by the need to weigh filters on-site in only a modestly temperature and humidity controlled environment (the motel room). It had already been demonstrated that the Teflon sampling substrates did not significantly change tare weights (< 2 μg) with even large changes in relative humidity changes (20 to 80% Rh). It was observed, however, that the electronic balances worst enemies were static charge and ambient temperature effects on the electronic circuitry. Previous redesign of the balance chamber had successfully resolved the static charge effects, but several successive efforts in redesigning the balance control software to accommodate ambient temperature fluctuations (especially those caused by drafts) were required to adequately bring the replicate weighing precision below 2 μg.

Detailed specifications for the RTI PM_{10} and $PM_{2.5}$ particle exposure monitoring systems are provided in Table 2-5. The MSP model 200 Personal Exposure Monitor (PEM) inlets for PM_{10} and $PM_{2.5}$ are based on standard impactor theory, and demonstrate excellent cut point sharpness. In order to verify that leaks in the PEM inlets observed in the Pilot Study had been corrected, a brief collocated field test was conducted at the RTI facility in North Carolina. Six PEM units were operated simultaneously with 3 collocated EPA $PM_{2.5}$ reference samplers, and demonstrated no leaks, excellent precision, and excellent agreement with the EPA devices. The report of this comparison test in provided in Appendix D.

Although $PM_{2.5}$ cut point impactors can exhibit substrate overloading during extended use, the combination of an additional "scalping" stage, and the short duration of sampling proposed in this study eliminated this concern. The MSP inlets are relatively wind speed insensitive, but the turbulence outside a moving vehicle is undoubtedly too harsh an environment for accurate coarse particle sampling. Thus, the inlets were not used external to a moving vehicle. Outside PM_{10} measurements were not made. $PM_{2.5}$ inlets collected particles off of the manifold after air was drawn in from the outside.

The inlets incorporate 10 holes for the 4 lpm version that directs the inlet flow toward an oil-coated, sintered metal impactor ring. After impaction to achieve the design cut point, the remaining particles are drawn to the membrane filter substrate located in the inlet base. The oiled surface is clean and replenished prior to each sampling event. The inlets are placed in Ziplok bags after preparation to prevent stray particles from entering through the jet holes.

During monitoring, an electronically flow-controlled battery operated pump (modified BGI model AFC123) was used to sample air through the portable impactors. The impactor contained a 37-mm diameter Teflon filter having a 3-μm pore size. For both the PM_{10} impactor, and the $PM_{2.5}$ impactor, a constant flow rate of 4.0 lpm was used.

Flow rate checks were performed with a specially-designed orifice that seals over the MSP inlet. The pressure drop across the orifice is monitored with a Magnehelic gauge. The pressure drop versus flow rate calibration for the orifice is established against a NIST-traceable Gilibrator bubble flow meter. System performance data are provided in Table 2-6.

Filters were weighed both before and after sample collection using a Mettler AT20 balance with a ±2 µg weighing precision in a single measurement. The balance was connected to a microcomputer with weighing software developed for gravimetric analysis of filters. All weighings were conducted in the field in the motel work room. Although this room was only equipped with a standard heating/air conditioning unit, this degree of conditioning was determined to be adequate to conduct the gravimetric analyses. The Pilot Study had demonstrated that accurate and reproducible gravimetric analyses could be accomplished outside a stringently controlled environment by, (a) using the hydrophobic Gelman Teflo® filters, (b) maintaining the relative humidity below 40 % Rh, (c) eliminating room drafts that confound the electronic temperature control circuitry of the Mettler balance, (d) using Teflo® lab blanks to evaluate substrate changes with time. Filters were equilibrated in the work room for at least 12 hours before weighing. Once tared, all filters were inspected for holes or other imperfections prior to use and were kept in a barcode-labeled petri dish.

Filters were weighed in sets of ten as follows: 1. The balance was zeroed and the calibration checked using a NIST-traceable, class S-3 weight (200 mg). If the zero check was within ±0.004 mg and the 200 mg weight within ±0.002 mg then the balance was "in control" and filters were weighed. If these specifications were not met the balance was recalibrated. 2. Each filter was weighed and the weight recorded once the computer recognized a stable reading (1-2 min). 3. After each set of ten filters was weighed, the zero was checked to within ±4 µg and a 200 mg weight to within ±0.002 mg. If either the zero or the 200 mg weighing failed their test, then the zero/calibration was repeated and the previous set of filters was reweighed.
QC checks included multiple weighing tests with a dedicated filter, and spot checks (reweighing every 20th) of filter weights.

Outside $PM_{2.5}$ sampling was accomplished by connecting the inlet to the outside sampling manifold (see section 2.4.1) using the standard flow calibration adapter provided by MSP. Minimal losses were expected using this approach, as compared with trying to place the inlet on the outside of a moving vehicle. Losses in the sample line and manifold for the outside $PM_{2.5}$ samples were crudely estimated to be 19 to 21%, based on LAS-X count data (see Section 2.4.8.1). These correction calculations based on particle count data are only approximate, however, and were not considered sufficiently accurate to use as subsequent corrections for the gravimetric data. The reported outside $PM_{2.5}$ data in all tables (and the $PM_{2.5}$ data used in all analyses) are consequently not loss-corrected.

TABLE 2-5. RTI PM_{10} and $PM_{2.5}$ Particle Monitoring System Specifications

Parameter	Specification
Inlet type	MSP, Corp. model 200
Aerodynamic Cutpoints (D_{50})	PM_{10} & $PM_{2.5}$
Cutpoint accuracy	+/- 0.2 µm
Impactor coatings	Silicone oil
Filter type	Gelman 37 mm, 3.0 µm porosity Teflon
Pump Source	modified BGI model AFC123 w/ feedback flow
Flowrate	PM_{10} - 4.0 liters/min; $PM_{2.5}$ - 4.0 liters/min
Flowrate stability	+/- 5% up to 25 inches of H_2O
Battery Type	4 alkaline AA
Battery life, continuous	~30 hrs at 70 °F

2.4.4.2 Particle Mass Performance Data

TABLE 2-6. Summary of Method Performance Data for Particle Mass Samples (PM_{10} and $PM_{2.5}$)

	Sacramento	Los Angeles
% of samples collected within flowrate specifications (external flow into inlets)	PM_{10} - 100 % $PM_{2.5}$ - 100 %	PM_{10} - 100 % $PM_{2.5}$ - 100 %
% of samples collected under acceptable conditions	PM_{10} - 100 % $PM_{2.5}$ - 100 %	PM_{10} - 100 % $PM_{2.5}$ - 100 %
% of sample weighed with "in control" calibration	100 %	100 %
Precision of every 10th filter replicate weighing (bases for MDL):	s = 3.6 µg	s = 2.2 µg
% CV of duplicate field samples (above MQL)	PM_{10} - 20.3 % $PM_{2.5}$ - 10.3 %	PM_{10} - 4.0 % $PM_{2.5}$ - 8.5 %
Mean mass on field blanks	+ 0.5 µg	- 0.5 µg
Estimated Method Quantitation Limits (MQL's)[b] in µg/m^3	PM_{10} - 19.7 $PM_{2.5}$ - 19.7	PM_{10} - 13.0 $PM_{2.5}$ - 13.0
% of samples with concentrations greater than MQL	PM_{10} - 64 % $PM_{2.5}$ - 13 %	PM_{10} - 100 % $PM_{2.5}$ - 97 %

Notes: MQL computed as 3 times MDL

[b]% CV for $PM_{2.5}$ in Sacramento estimated, since collocated pairs concentrations were above the MDL, but below the MQL

2.4.5 Formaldehyde

2.4.5.1 Method Description - Formaldehyde was monitored inside the vehicles, at roadside sites, and at the ambient station during each test drive. Formaldehyde in air samples were collected by passing air through DNPH-coated Sep-Pak cartridges (Water Associates, Milford, MA). Samples were collected at a flow rate of approximately 300 ml/min using a battery-powered low volume pump. Samples were collected for a 2-hour period to give a nominal volume of 36 L. Flow rates at the cartridge inlet were measured before and after sample collection using calibrated rotameters with a fixed-orifice bypass tube. System performance data are given in Table 2-7.

DNPH/formaldehyde derivatives on sample cartridges were extracted by eluting each cartridge with 5 ml of HPLC grade acetonitrile into a 5 ml volumetric flask. The final volume is adjusted to 5.0 ml and the sample aliquoted for analysis. DNPH/formaldehyde derivative in sample extracts were analyzed by HPLC with UV detection. Certified solutions of the DNPH/formaldehyde derivative were used to prepare the calibration solutions. DNPH/formaldehyde derivatives in sample extracts were identified by comparison of their chromatographic retention times with those of the purified standards. Quantitation was accomplished by the external standard method using calibration standards prepared in the range of 0.02 to 15 ng/µl of the derivative. Standards were analyzed singly for the formaldehyde/DNPH derivative and a calibration curve calculated by linear regression of the concentration and chromatographic response data. To be acceptable the calibration curve needed to give an R^2 greater than 0.998.

To demonstrate on-going analytical performance, a calibration standard was analyzed each day prior to the analysis of any sample and after every 10 samples. The calibration was considered "in control" if the measured concentration of the formaldehyde derivative in the standard was 85 to 115% of the prepared concentration.

2.4.5.2 Formaldehyde Performance Data

TABLE 2-7. Method Performance for Formaldehyde Samples

	SAC	LA
Estimated Method Quantitation Limit, MQL	3.1 µg/m^3	3.1 µg/m^3
% of Samples with formaldehyde levels > MQL	96 %	98 %
% Recovery from Field Controls (n=3, 3)	± 104 %	± 105 %
Amount on Field Blanks (n=4, 4)	0.16 µg/m^3 for a 24 L sample	1.3 µg/m^3 for a 24 L sample
% CV of Duplicate samples (n=3, 4)	5.0 %	9.6 %

2.4.6 Carbon Monoxide

2.4.6.1 Method Description - Carbon monoxide was measured inside of the vehicles, outside of the vehicles, at the roadside sites and at the ambient sites using Draeger Model 190 carbon monoxide monitors/data loggers with extended memory. The monitors are pocket size, sensing and logging devices with accuracy reported by the manufacturer as ±2 ppm CO. The monitors are powered by a single 9 V alkaline battery. The monitors utilizes a three-electrode electrochemical sensor for continuous measurement of CO. A scrubber containing charcoal and Purafil is used on the monitor inlet to reduce interferences. An integral data logger records sensor measurements 120 times per minute. These values are averaged by the monitor and 1 minute average values are stored by the monitor data logger. Stored values are downloaded at the end of the monitoring period via an RS-232 interface to a portable computer using software supplied by National Draeger, Inc.. Results will be reported as 120 one- minute data files, one hour averages, and peak CO concentrations.

Two CO monitors were used for each vehicle to monitor inside and outside CO concentrations simultaneously. Teflon sampling lines were used to draw air sequentially, first near the driver's breathing zone, and then from the vehicle exterior via a sampling manifold. A computer controller electronic timer was used to switch solenoid positions between the interior and exterior sample line every 5 minutes. Fixed site CO monitors were placed in "weather tight", insulated sampling boxes to minimize effects due to ambient outdoor temperatures and moisture.

Prior to initial use in the field, each CO monitor was calibrated using certified carbon monoxide gas standards at concentrations of 0, 2, 10 and 21.5 ppm. In addition to the weekly checks, a zero and span (21.5 ppm) check was performed at the start and the end of each test drive. At the start of the test drive, the zero and span of the monitor was adjusted to give readings of zero and 21.5, respectively. At the end of the test drive, no adjustments were made for the zero and span, rather reading were recorded on log sheets prepared for this purpose.

2.4.6.2 Performance Data

The CO monitors worked well during the study, with two missing data files resulting from an computer file loss during data transfer. No data required modifications resulting from zero and span drifts (all monitors were calibrated prior to each commuted). The MQL for the Draeger monitor of 2.0 ppm provided a relatively high percentage of data above the MQL in Sacramento (42 %), as compared to Los Angeles (74 %). The majority of the data below the MQL were at the Ambient sites.

2.4.7 Particle Elements

2.4.7.1 Method Description

The $PM_{2.5}$ and PM_{10} Teflon filter samples for Sacramento and Los Angeles were submitted to the Desert Research Institute (DRI) for energy-dispersive X-Ray Fluorescence (XRF) analysis. The standard analysis protocol (A) with a counting time of 8 hours/filter was utilized, since it was determined that longer, more expensive protocols would not be cost effective with the small loadings present from the in-vehicle samples. A determination was made that the reported MQL for these samples was reasonable for this study and would be cost-effective for quantifying the concentration levels of the target metals - Cd, Cr, Mn, Ni, Pb, and S. The $PM_{2.5}$ and PM_{10} filter samples were analyzed by DRI for a complete suite of elements, Al, Br, Ca, Cd, Cl, Cr, Cu, Fe, K, Mn, Ni, P, Pb, S, Si, Sr, Ti, and Zn. The summaries in section 3 and the data analyses in section 4, focus only on the target metals.

Concentrations were provided by the Desert Research Institute in $\mu g/m^3$, based on a measured deposit area of 7.57 cm^2 and using the sampled volume and deposited mass data. Concentrations for Al, Si, P, Cl, K, and Ca values determined by XRF on PM_{10} samples were adjusted for large particle self-absorption using a theoretical self absorption correction. This adjustment is a function of particle size distribution and composition. Since the actual particle size distribution and composition is unknown, the uncertainty of these adjustments is up to 25%, and is reflected in the reported uncertainty. Particle size effects for Na and Mg were so large and variable that accurate corrections for these two elements could not be made. Their raw, uncorrected concentrations were reported, but they should not be considered quantitative. Four of the 28 samples that were submitted for replicate analysis did not pass DRI's normal criteria for replicate analyses. Examination of the filters and the data showed that this was due to an uneven distribution of fine particles on the filters, and concentrations near the detection limit. The overall method performance data are given in Table 2-8.

2.4.7.2 XRF Elemental Performance Data

TABLE 2-8. Method Performance Data for XRF Elemental Particle Sample Analyses

		PM10			PM2.5			Filter Blanks (ng/sample) (ng/m³)
Analyte	Method	MDL (µg/m³)	MQL (µg/m³)	%>MDL	MDL (µg/m³)	MQL (µg/m³)	%>MDL	
Pb	XRF	0.06	na	2%	0.06	na	1%	< 0.7 ng/filter <0.01 ng/m³
Cd	XRF	0.2	na	0%	0.2	na	0%	< 0.2 <0.003 ng/m³
Cr	XRF	0.8	na	0%	0.8	na	0%	< 0.4 < 0.008 ng/m³
Mn	XRF	0.07	na	0%	0.07	na	0%	< 1.0 < 0.02 ng/m³
Ni	XRF	0.045	na	1%	0.045	na	0%	< 2.0 < 0.04 ng/m³
S	XRF	0.08	na	100%	0.08	na	99%	na[5]

Notes: 1. Method Detection Limit is calculated as 3x the standard deviation of a background count for each filter. These detection limits varied; the median value is shown above.

2. The only significant elemental analysis data were obtained for sulfur, which was present in virtually all the filters. Table 2-7 shows the percentage of samples above the MDL. The MDL was determined as three times the standard deviation of the background on each individual filter. Since these were different for each sample, the value shown in Table 2-7 is an estimate based on the median value. The uncertainty in the sulfur concentrations is given by the laboratory as approximately 5% of the concentration value.

3. One $PM_{2.5}$ sample was flagged in the laboratory as having large particles visible on it. Three PM10 samples were flagged as having visible metallic particles on them. However, the data from these samples did not change any reported results.

4. Blank levels determined using ICP/MS; see lab report in Appendix E

5. Blank level for S by ICP/MS not available - inadvertently not determined

2.4.8 Total Particle Count

2.4.8.1 Method Description - The LAS-X optical particle counter (Particle Measuring Systems, Boulder, Colorado) was mounted on a specially-designed platform immediately behind the front seat in Vehicle 1. The instrument was operated off of the power inverter that was located in the trunk of the test vehicle. The total counts of fine particles both inside and outside of the vehicle were measured continuously in the size range from 0.15 to 2.5 μm, by summing the twelve individual size bins in this range[4]. Measurements were made with the inlet cycling between the inside and the outside of the vehicle. Collected data was output in 60 one-minute total particle count values for each bin, as count totals for each minute (inside and outside), plus the integrated bin and commute averages. Mean total particle counts/minute were computed and reported for each 2 hour commute. The particle concentration in particles/cc can be computed by dividing the one minute count totals by the sampled volume of 60 cm^3. Particle count size distributions were reported by plotting calibrated bin size in micrometers versus the one minute average bin counts.

Outside air was drawn through the sampling manifold. An initial test was performed to estimate the particle fractional losses through the outside inlet line and manifold for each bin size. These loss data are shown in Appendix F, and permitted LAS-X bin count corrections to be made subsequently. The individual bin losses through the sampling line werecomputedapproximately(based on count) over the 0.15 to 2.5 μm size range varied from 5 to 27 %. The LAS-X "outside" count data reported in all subsequent summaries were corrected for line losses by particle size.

A crude estimate of the mass lost during gravimetric sampling was also made, using the LAS-X particle penetration data in Appendix F. Based on the min to max range of measured particles/cm^3 (by bin size) from all of the size distributions shown subsequently in Section 4, composite mass losses from 0.15 to 2.5 μm for integrated $PM_{2.5}$ particles passing through the sampling line were crudely computed to be approximately 19 - 21 %. The computation proceeded as: (a) (particles/cm^3) x (1 – fractional penetration) = particles lost/cm^3 ; (b) (volume in cm^3 of a single particle of the mean bin diameter computed) x (a representative density by size (1.7 g/cm^3) = mass of a single particle, g; (c) (particles lost/cm^3) x (sampled volume, cm^3) = total particles lost/bin; (d) (total particles lost/bin) x (single particle mass/particle, g) x 10^6 = mass lost/bin, μg for bin X; (e) sum mass lost over all bins; (f) repeat the calculations to determine total mass for 100% collection across all bins; and (g) dividing total mass lost by estimated total $PM_{2.5}$ mass collected, expressed as a % . This loss estimate was based on conversion of total particle volume to mass using the same estimated ambient particle density (1.7 g/cm^3), for all particle sizes (as a worst case). Since in reality the sampled ambient distributions and particle densities vary from sample to sample, the accuracy of this mass loss estimate is considered reasonable, but uncertain. Thus, this estimated mass correction was not used to correct the actual gravimetric results.

Prior to the study, the LAS-X instrument was calibrated in the laboratory at Aerosol Dynamics Inc. The individual optical channel bin calibrations were performed using a differential mobility optical particle size spectrometer (DMOPSS) system, which was developed and deployed for two atmospheric visibility studies to provide*in- in-situ* calibration of optical counters for precise size distribution measurement (Stolzenburg et al., 1995) with ambient Berkeley, CA

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[4] The upper bin size limits for the LAS-X in this range are nominally: 0.15, 0.18, 0.23, 0.28, 0.35, 0.45, 0.58, 0.73, 0.90, 1.13, 1.38, 1.75, 2.25, and 2.58 μm, for a total of 14 bins.

aerosols and with dioctyl sebacate aerosols. Calibrations were conducted using both dioctyl sebacate, an aerosol with a refractive index of 1.45, with size-classified ambient Berkeley aerosols, andsize- size-classified California vehicular aerosols from a local Berkeley tunnel study. The technical details of these calibrations were provided in a separate report (Kreisberg et al., 1997) to the ARB project officer as part of the final subcontract report prepared by Aerosol Dynamics.

During the study, fine particle measurements were made by sampling with a single LAS-X optical counter both inside and outside the vehicle. Data were collected with 15 s time resolution, then combined into 1 min averages. The total count data for each of the one minute intervals were computed by summing the bin counts from 0.15 to 2.5 μm. The 1 min. count totals were averaged for each commute to provide means inside and an outside (Vehicle 1) in units of total particle counts/min. These are reported subsequently in the summary tables in Section 3. Mean total particles/cm^3 /min was determined by dividing the total interval count by the 60 second sampled volume of 60 cm^3 .

Particle count size distributions were constructed by using the individual bin counts and their associated particle diameters (optical, not aerodynamic). The Aerosol Dynamics bin calibrations (see Appendix F) for ambient California aerosol was used for distributions collected when no specific "target" was immediately in front of Vehicle 1. When a vehicular target was identified (especially by an elevated back carbon level), the bin calibration for vehicular aerosol was also provided graphically. The LAS-X response to ambient aerosol versus vehicular aerosol is substantially different, especially in the (optical) particle size range (<~0.8 μm) reported by Birch and Cary (1996) for carbonaceous diesel emissions. Since diesel exhaust aerosol tend to be lighter, long chain agglomerates, their sizing by an optical particle counter must be viewed cautiously, especially as compared to their aerodynamic diameter.

Integrated mass concentrations were estimated from the LAS-X count data in the Pilot Study report by applying a composite density, based on the calibrations from the "real" California ambient and vehicular aerosols. The proportion of ambient and vehicular aerosol was adjusted based on the comparison with the gravimetric $PM_{2.5}$ mass concentration data. From these computations, it was crudely estimated that on a commute-average basis, the sampled in-vehicle aerosol was ~25 % vehicular and 75 % ambient. The close proximity of Vehicle 1 when following a "target" vehicle in the Main Study, combined with the elevated black carbon levels, suggested that this estimating procedure for mass concentrations was not sufficiently robust to merit repeating.

2.4.8.2 Performance Data

The flow calibration of the LAS-X sample flow rotameter was checked with a bubble flow meter at the start of field sampling in both Sacramento and Los Angeles, and found to be within 10%. Daily tests were not done. The particle bin size calibrations performed by Aerosol Dynamics prior to the Pilot Study were the only accuracy tests performed for this unit. Field accuracy checks were not possible. Prior to the start of each commute, a HEPA filter was applied to the sampler inlet to verify that the total particle counts returned to zero for all commutes (they did). This test also permitted a time synchronization check against the built-in clock. Overall, the unit worked flawlessly, except for the five Sacramento commutes (#'s 4, 6, 7, 8, and 11) when the inverter power from Vehicle 1 failed.

2.4.9 Black Carbon

2.4.9.1 Method Description - The concentration of elemental, or "black" carbon was measured semi-continuously using an Aethalometer (Magee Scientific, Berkeley, CA). This is a commercial instrument that examines the blackness of a filter as the sample is collected. A prototype developed at Lawrence Berkeley Laboratories was used in the 1986 ARB-sponsored Carbon Species Method Comparison Study, and was able to resolve single diesel trucks in the parking lot next to the sampling site. The Aethalometer was mounted on a specially-designed platform immediately behind the front seat in Vehicle 1. The instrument was operated off of the power inverter that was located in the trunk of the test vehicle. The instrument was operated using the manufacturer's calibration and internal software. Measurements were taken with a 1 min time resolution. Measurements were made with the inlet cycled between inside and outside of the vehicle to give the inside/outside ratios as a function of time and vehicle driving conditions. Data output is 60 one-minute values for each commute (inside and outside), plus commute averages. Outside air was drawn through the sampling manifold.

2.4.9.2 Performance Data

The instrument operational software automatically tests internal performance parameters including lamp voltage and sampling flowrate, and compares the parameters against acceptance limits. These internal tests were summarized as part of the electronic data files, and indicated that no data were collected outside the manufacturer's limits. No field calibration of the instrument was attempted, nor were flow rate test done, other than those done by the instrument as self-tests. While it is assumed that the internal calibration is reasonable for predicting mass concentrations of black carbon, the most important aspect of these data are the relative concentrations with time. Overall, the unit worked well, except for one commute (#6) when the inverter power from Vehicle 1 failed, and one commute (#23) in which the test HEPA filter was inadvertently left in place for the entire commute.

2.4.10 Air Exchange Rate (AER)

2.4.10.1 Method Description - Air exchange rates for the test car under the three ventilation settings were measured using a modification of the CO decay method of Ott and Willits (1981). The procedure was implemented as follows:

- travel to an isolated location with minimal traffic ;
- set the selected ventilation setting in the test car and begin to drive the car at the desired speed (0 to 45 mph);
- release CO into the cabin of the automobile to a concentration of approximately 20 to 30 ppm;
- maintain the desired speed of the car (0, 35, or 55 mph);
- monitor CO concentrations in the cabin of the car with the Draeger CO monitor; and
- compute the AER [air changes / hour], as: $AER = (1/t) \ln (C_i / C_f)$

where t = decay time (h), and C_i, C_f are the initial, final concentration of CO in ppm.

2.4.10.2 AER Performance Data

The precision of the air exchange rate method is a function of the precision of the Draeger CO monitor used in the tests. Since the released CO concentrations were all substantially above the MQL (a 50 ppm CO blend was released), the detection limit of the monitor was not a factor.

The estimated coefficient of variation for air exchange rate measurements based on successive determinations at the same constant speed and vent setting was 9.6 %.

2.5 Vehicular Data

2.5.1 Method Description - Vehicle speed was recorded using a digital sender mounted on the drive-shaft for Sedan 1 and custom signal-conditioning circuitry. The signal from the OEM speed sender was also recorded as a backup. A grill-mounted laser range finder made to custom order for Sierra Research by Laser Atlanta, measured following distance from the car ahead. Accuracy of the measurement is approximately two feet. Lateral and longitudinal accelerometers were used to automatically record total acceleration (not a reported variable for this study). All data were recorded once per second. Note that in-vehicle traffic data represent the vehicular conditions that Vehicle 1 (and Vehicle 2, when traveling together) were actually "exposed to" during each commute, as opposed to fixed-location, traffic loop counters that define the count (and occasionally speed) at one point). In-vehicle measures can only indirectly provide relationships with traffic count (not a study design objective – see Table 1-2), but are more desirable than the incomplete pictures provided by CalTrans loop counter locations for a given commute route.

During on-road data collection, the test vehicle was driven by a two-member team that is familiar with the on-board equipment and drive protocols. The principal responsibility of the driver was, of course, to drive safely. The second technician served as a navigator and "observer," and used a manual data entry switch box to log information of the selected parameters. These manual data included: Level of Congestion[5] [a subjective categorical traffic density rating made by the Sierra navigator with 1 as no congestion, and 6 as extremely congested;] and Target Vehicle Type [subjective categorical identification as: 0 – no target, 1 – light duty vehicle, Heavy Duty Diesel (HDD) truck,2 – smoking light duty vehicle, 3 - Other Heavy Duty Vehicle, 4 - Light Duty Diesel, 5 - Diesel Bus, 6 - Heavy Duty Diesel (HDD) truck, or and the time trailing immediately behind each type]. When necessary, the navigator kept a manual record of unusual events during each test drive. All drives were videotaped for later examination of any unusual events or to ascertain additional information about the test drive. Only the video tapes from the five highest particle concentration commutes in LA were actually reviewed. The CalTrans hourly vehicle count data (from freeway loop counters) were found to be of limited value in the Pilot Study, since they are routinely collected only on an infrequent basis and don't necessarily represent the entire commute routes. This made it impossible to directly relate the CalTrans data to the vehicular data collected in the study. The only utility of the CalTrans data (see Appendix A, Pilot Study Report) was to demonstrate that the selected 2 hour commute periods reasonably defined the peak traffic periods. No CalTrans data were collected or evaluated during the Main Study. The limitations and caveats of using an instrumented platform to collect in-traffic vehicular data are summarized by Austin et al (1993).

The Sierra navigator notes (event log) for each commute are provided in Appendix G. These notes provided information of "unusual" events during each commute, and would be especially useful if further interpretations of the archived video records are attempted.

[5] The term "Level of Congestion" used in this report corresponds to the six US Department of Transportation level of service categories defined in the "Highway Capacity Manual", special report 209 by the Transportation Research Board of the NRC (Washington, DC) in 1985. Although level of service is strictly defined from a fixed and elevated observation point, Level of Congestion was used in this study from the mobile Sierra navigator's point of view. The guide illustrations for the 6 congestion levels is provided in Appendix G.

2.6 Meteorology

The meteorology data for Sacramento and Los Angeles were provided by ARB from the locations nearest to the Ambient site. In Sacramento, this was the 13th and T street location. In Los Angeles, the site was located at the SCAQMD ambient monitoring site at Pico Rivera. The summarized data included: temperature (°F), relative humidity (%), wind speed (mph), and wind direction (degrees).

3.0 RESULTS

The data presented in this section summarize the pollutant, vehicular, and meteorological measures for all commutes, grouped by scenario. The measurement data for each of the 29 individual commutes are provided in Appendix H (all measures except non-target metals) and Appendix I (non-target metals). These measures are reported as "censored" data with the censor levels determined using either the MDL or MQL, according to the guidelines shown in Appendix J. The composite data tables in Section 3.0 and 4.0 (typically means and mean differences) were computed using "uncensored" data. Uncensored data are generally all measurements above the MDL, and ½ the MDL if below this level. Since MDL's were not available for all measures, an exception data treatment table was prepared (included in Appendix J). Note that the Pilot Study data summaries (Appendix A) were computed slightly differently by replacing values below the MQL's with zeros.

3.1 Percent Measurable Data and Data Capture Rates

The percentage of samples above the reporting level (MQL) was significantly influenced by the desire to make pollutant measurements over very short time periods. While the "clean" ambient conditions in the Pilot Study posed substantial analytical difficulties, the higher background ambient levels in Sacramento during the Main Study significantly improved the percentages of data above the MQL's (see Table 3-1A and B). The ambient and in-vehicle pollutant levels in Los Angeles were generally 2-3 times higher than those in Sacramento, greatly reducing the uncertainties associated with measurements near the detection limits.

TABLE 3-1A. Percentage of Integrated Samples Above the Reporting Levels

Analyte	% Above Reporting Level SAC	LA	Reporting Level
Isobutylene	99	100	MQL
1,3-Butadiene	67	97	MQL
Acetonitrile	96	100	MQL
DCM	33	100	MQL
MTBE	92	100	MQL
ETBE	1	0	MQL
Benzene	79	100	MQL
Toluene	99	100	MQL
Ethylbenzene	73	100	MQL
m,p-Xylene	92	100	MQL
o-Xylene	70	100	MQL
TCFM	3	0	MQL
Formaldehyde	96	98	MQL
PM_{10}	64	100	MDL
$PM_{2.5}$	13	97	MDL
CO 1-h average	42	74	MQL
LAS-X Particle Count	100	100	MQL
Black Carbon	100	100	MQL

TABLE 3-1B. Percentage of Integrated Samples Above the Reporting Levels

Analyte	% Above Reporting Level SAC	LA	Reporting Level
$PM_{2.5}$ Pb	1	2	MDL
$PM_{2.5}$ Cd	0	0	MDL
$PM_{2.5}$ Cr	0	0	MDL
$PM_{2.5}$ Mn	0	0	MDL
$PM_{2.5}$ Ni	0	0	MDL
$PM_{2.5}$ S	98	100	MDL
PM_{10} Pb	2	3	MDL
PM_{10} Cd	0	0	MDL
PM_{10} Cr	0	0	MDL
PM_{10} Mn	0	0	MDL
PM_{10} Ni	0	2	MDL
PM_{10} S	100	100	MDL

The percent data capture goals for this program were generally 90% or better. The actual data capture levels for the integrated and continuous measurements shown in Tables 3-2A and 3-2B were excellent. The primary data losses were for the LAS-X and Aethalometer, which lost power several times in Sacramento and Los Angeles due to inverter system power failures in Vehicle 1. Two CO hourly data files were lost (commute #1, OUT 1 and commute #8, OUT 1) in Sacramento during data transfer.

3.2 Quality Assurance Data Summary

3.2.1 General

The quality of data for the project resulted from the uniform application of quality assurance goals in all phases of the project. Careful attention to detail in planning the study operations, combined with capable, well-trained (and dedicated) staff and equipment produced a data base of carefully defined quality, with a minimum of lost data. A preliminary Pilot Study (see Appendix A) to test the measurement methodologies proved invaluable in maximizing the data quality and the percent data capture in the Main Study. The Pilot Study was prompted by the research nature of the project, which required the measurement of pollutant concentrations in a mobile, field setting, over very short time periods.

An internal leak in the calibration standard transfer line, during the GC/MS calibration, resulted in a reporting problem (more than 1 MQL for some of the Sacramento samples), but otherwise the VOC data quality (see Table 2-4 for detailed result) were excellent. The target compound, MTBE, had a nominal MQL of 1.0 $\mu g/m^3$ in Sacramento and Los Angeles with a mean precision from duplicate field samples of only 6 %. The data for formaldehyde were similarly excellent, with an MQL of 3.1 $\mu g/m^3$ and a precision of 5 % in Sacramento and 10 % in Los Angeles.

The $PM_{2.5}$ and PM_{10} integrated mass concentrations exhibited relatively high MQL's, as a result of the extremely short sample times and minimal air volume collected (0.48 m^3). The field weighing performance was excellent for such small mass collections, resulting in acceptable precisions for $PM_{2.5}$ in both Sacramento (10.3 %) and Los Angeles (8.5 %). The very low percent data capture rates for all of the target elements, except sulfur, were expected, based on preliminary elemental data from the Pilot Study. While more sensitive analysis by ICP/MS may have been desirable, the much higher cost was beyond the resources of this project. Definition of the MDL values for the target elements by XRF, provided the ability to provide these limits in the data.

The mobile sampling platform designed to accommodate to continuous particle monitors (LAS-X and Aethalometer), normally used as laboratory tools, proved challenging. Except for in-vehicle power problems, however, the units functioned according to the manufacturers specifications.

3.2.2 Summary of Key Method Quality Measures

The MDL's (if applicable), MQL's, and replicate measure precisions, expressed as percent coefficients of variation, are tabulated in Table 3-3A thru D for Sacramento and Los Angeles. The MDL's and MQL's are the lowest levels reported for the individual sample data. The precision data were determined for collocated samples exceeding the MQL. Since none of the $PM_{2.5}$ collocated sample pairs in Sacramento exceeded the MQL of 19.7 $\mu g/m^3$, an estimated precision based on the replicates above the MDL is provided. Note that all of the precisions for data above the MQL are excellent and met study QA requirements.

Table 3-2A. ARB In-Vehicle Study Integrated Sample & Data Capture Matrix for Sacramento												
Integrated Sample Collection totals for 13 commutes: Planned/Valid												
	Vehicle 1		Vehicle 2				Total					
	Inside	Outside	Inside	Outside	Rdsde 1	Rdsde 2	Ambient	All	Total	Total	Total	Total
Code>	IN1	OUT1	IN2	OUT2	ROAD1	ROAD2	AMB	Dups	Planned	Valid	Quest.?	Invalid
Sample Type												
Particles, 2.5 µm (gravimetric)	13/13	13/13	13/13	13/13	9/9	9/9	12/12	4/4	86	86	0	0
Particles, 10 µm (gravimetric)	13/13	----	13/13	----	9/9	9/9	12/12	3/3	59	59	0	0
VOC's (canister collection, GC/MS analysis)	13/13	13/13	13/13	13/13	9/9	9/9	12/12	4/4	86	86	0	0
Formaldehyde (DNPH cartridge collection, HPLC analysis)	13/13	----	13/13		9/9	9/9	12/10	5/5	61	59	0	2
Carbon Monoxide (Draeger)	13/13	13/11	13/12	13/13	9/9	9/9	12/12	4/4	87	84		3
Black Carbon (Aethalometer)	13/13	13/13	----	----	----	----	----	----	26	26	0	0
Particle Count Total 0.15 - 2.5 µm (LAS-X)	13/8	13/8	----	----	----	----	----	----	26	16	0	10
Notes:	Field blanks and field controls not included in this table.											
	Carbon monoxide, black carbon, particle count data are means of 120 one-minute values/commute											

Table 3-2B. ARB In-Vehicle Study Integrated Sample & Data Capture Matrix for Los Angeles

Integrated Sample Collection totals for 16 commutes:												
	Vehicle 1		Vehicle 2				Total					
	Inside	**Outside**	**Inside**	**Outside**	**Rdsde 1**	**Rdsde 2**	**Ambient**	**All**	**Total**	**Total**	**Total**	**Total**
Code>	**IN1**	**OUT1**	**IN2**	**OUT2**	**ROAD1**	**ROAD2**	**AMB**	**Dups**	**Planned**	**Valid**	**Quest.?**	**Invalid**
Sample Type												
Particles, 2.5 µm (gravimetric)	16/16	16/16	16/16	16/16	12/12	12/12	16/12	4/4	108	108	0	0
Particles, 10 µm (gravimetric)	16/16	----	16/16	----	12/12	12/12	16/16	3/3	75	75	0	0
VOC's (canister collection, GC/MS analysis)	16/16	16/16	16/16	16/16	12/12	12/12	16/16	4/4	108	108	0	0
Formaldehyde (DNPH cartridge collection, HPLC analysis)	16/15	----	14/14	----	10/10	10/9	16/15	4/4	70	67	0	3
Carbon Monoxide (Draeger)	16/16	16/16	----	----	16	16	16	----	80	79	0	1
Black Carbon (Aethalometer)	16	16	----	----	----	----	----	----	32	32	0	0
Particle Count Total 0.15 - 2.5 µm (LAS-X)	16/16	16/15	----	----	----	----	----	----	32	31	0	1
Notes:	Field blanks and field controls not included in this table.											
	Carbon monoxide, black carbon, particle count data are means of 120 one-minute values/commute											

Table 3-3A. Summary of Key Sacramento Quality Assurance Data

Pollutant/Measure	MDL[a] (measure units)	MQL[b] (measure units)	Duplicate +/- Precision[c] (% CV)
Isobutylene, $\mu g/m^3$	na	0.22 (0.44)	4.5
1,3-Butadiene, $\mu g/m^3$	na	0.30 (0.60)	7.9
Acetonitrile, $\mu g/m^3$	na	0.70 (1.4)	6.6
Dichloromethane [DCM], $\mu g/m^3$	na	1.1 (2.2)	30
Methyl-Tertiary-Butyl-Ether [MTBE], $\mu g/m^3$	na	1.0 (2.0)	6.1
Ethyl-Tertiary-Butyl Ether [ETBE], $\mu g/m^3$	na	1.0 (2.0)	na
Benzene, $\mu g/m^3$	na	1.1 (2.2)	5.5
Toluene, $\mu g/m^3$	na	1.1 (2.2)	8.4
Ethylbenzene, $\mu g/m^3$	na	0.80 (1.6)	3.0
m,p-Xylene, $\mu g/m^3$	na	1.2 (2.4)	3.8
o-Xylene, $\mu g/m^3$	na	1.1 (2.2)	3.3
Trichloro-fluoro-methane [TCFM], $\mu g/m^3$	na	0.37 (0.70)	na
PM_{10}, $\mu g/m^3$	6.6	19.7	10.3
$PM_{2.5}$, $\mu g/m^3$	6.6	19.7	22.0[c]
Formaldehyde, $\mu g/m^3$	na	3.1	5.0
Carbon Monoxide [CO], ppm	na	2	20.5

Table 3-3 A thru D Notes:

[a] MDL's: Measurement Detection Limits not available for VOC's; gravimetric particle mass MDL's determined from replicate filter weighings; XRF elemental MDL's determined from count statistics uncertainties; MDL for CO monitor based on manufacturer's data; LAS-X and Aethalometer MDL's are judgmental estimates

[b] MQL's: Measurement Quantification Limits computed as 3 times MDL's, if MDL is available; MQL's for VOC's are based on lowest calibration point. Values in parentheses are based on the lowest calibration points for some sets of data (see section 2.4.3.2).

[c] Duplicate Precisions: precisions determined from collocated measurements (if available) as pooled means of standard deviations. judgment estimates are made of standard deviations, if collocated measure was not available. $PM_{2.5}$ CV for Sacramento based on replicates above the MDL, since no replicates were measured above the MQL.

Table 3-3B. Summary of Key Sacramento Quality Assurance Data (cont'd)

Pollutant/Measure	MDL[a] (measure units)	MQL[b] (measure units)	Duplicate +/- Precision[c] (% CV)
Particle Count by Size [PMS LAS-X], count 0.15 mm to 2.5 μm	+/- 3 % or 1 particle (higher number	+/- 10 % or 3 particles (higher number	na
Black Carbon [McGee Scientific Aethalometer] μg/m3	0.2 μg/m³ (est.)	0.6 μg/m³ (est.)	na
$PM_{2.5}$ Cadmium [Cd], μg/m³	0.2	na	na
$PM_{2.5}$ Chromium [Cr], μg/m³	0.8	na	na
$PM_{2.5}$ Manganese [Mn], μg/m³	0.07	na	na
$PM_{2.5}$ Lead [Pb], μg/m³	0.06	na	na
$PM_{2.5}$ Nickel [Ni], μg/m³	0.05	na	na
$PM_{2.5}$ Sulfur [S], μg/m³	0.08	na	11.6
PM_{10} Cadmium [Cd], μg/m³	0.2	na	na
PM_{10} Chromium [Cr], μg/m³	0.8	na	na
PM_{10} Manganese [Mn], μg/m³	0.07	na	na
PM_{10} Lead [Pb], μg/m³	0.06	na	na
PM_{10} Nickel [Ni], μg/m³	0.05	na	na
PM_{10} Sulfur [S], μg/m³	0.08	na	6.6
Air Exchange Rate [Constant Speed], /hr	na	na	10.2
Vehicle Speed, mph	0.4 mph	0.8 mph	na
Vehicle Spacing, feet	0.5 feet	1.5 feet	na
Level of Congestion, unitless	na	na	na

Table notes following Table 3-3 A apply

Table 3-3C. Summary of Key Los Angeles Quality Assurance Data

Pollutant/Measure	MDL[a] (measure units)	MQL[b] (measure units)	Duplicate +/- Precision[c] (% CV)
Isobutylene, $\mu g/m^3$	na	0.22	6.3
1,3-Butadiene, $\mu g/m^3$	na	0.30	6.9
Acetonitrile, $\mu g/m^3$	na	0.70	12
Dichloromethane [DCM], $\mu g/m^3$	na	1.1	9.3
Methyl-Tertiary-Butyl-Ether [MTBE], $\mu g/m^3$	na	1.0	6.5
Ethyl-Tertiary-Butyl Ether [ETBE], $\mu g/m^3$	na	1.0	na
Benzene, $\mu g/m^3$	na	1.1	4.9
Toluene, $\mu g/m^3$	na	1.1	4.5
Ethylbenzene, $\mu g/m^3$	na	0.80	3.1
m,p-Xylene, $\mu g/m^3$	na	1.2	4.1
o-Xylene, $\mu g/m^3$	na	1.1	3.4
Trichloro-fluoro-methane [TCFM], $\mu g/m^3$	na	0.37	na
PM_{10}, $\mu g/m^3$	4.3	13.0	4.0
$PM_{2.5}$, $\mu g/m^3$	4.3	13.0	8.5
Formaldehyde, $\mu g/m^3$	na	3.1	9.6
Carbon Monoxide [CO], ppm	na	2.0	10.2

Table notes following Table 3-3 A apply

Table 3-3D. Summary of Key Los Angeles Quality Assurance Data (cont'd)

Pollutant/Measure	MDL[a] (measure units)	MQL[b] (measure units)	Duplicate +/- Precision[c] (% CV)
Particle Count by Size [PMS LAS-X], count 0.15 mm to 2.5 mm	+/- 3 % or 1 particle (whichever is higher)	+/- 10 % or 3 particles (whichever is higher)	na
Black Carbon [McGee Scientific Aethalometer] μg/m3	0.2 mg/m³ (est.)	0.6 mg/m³ (est.)	na
$PM_{2.5}$ Cadmium [Cd], μg/m³	0.2	na	na
$PM_{2.5}$ Chromium [Cr], μg/m³	0.8	na	na
$PM_{2.5}$ Manganese [Mn], μg/m³	0.07	na	na
$PM_{2.5}$ Lead [Pb], μg/m³	0.06	na	na
$PM_{2.5}$ Nickel [Ni], μg/m³	0.05	na	na
$PM_{2.5}$ Sulfur [S], μg/m³	0.08	na	4.7
PM_{10} Cadmium [Cd], μg/m³	0.2	na	na
PM_{10} Chromium [Cr], μg/m³	0.8	na	na
PM_{10} Manganese [Mn], μg/m³	0.07	na	na
PM_{10} Lead [Pb], μg/m³	0.06	na	na
PM_{10} Nickel [Ni], μg/m³	0.05	na	na
PM_{10} Sulfur [S], μg/m³	0.08	na	2.0
Air Exchange Rate [Constant Speed], /hr	na	na	10.2
Vehicle Speed, mph	0.4 mph	0.8 mph	na
Vehicle Spacing, feet	0.5 feet	1.5 feet	na
Level of Congestion, unitless	na	na	na

Table notes following Table 3-3 A apply

3.3 Pollutant Data Summaries

3.3.1 General Organization

The concentration mean data for all pollutant measures is summarized by commute scenario (type) for Sacramento in Tables 3-4A thru 3-4F, and for Los Angeles in Tables 3-5A thru 3-5F. These tables are organized generally by pollutant category and measurement type, by commutes for each city, and provide means and ranges of pollutant concentrations for the following locations:

Ambient site (**AMB**),
Inside vehicles 1 and 2 (**IN 1** and **IN 2**),
Outside vehicles 1 and 2 (**OUT 1** and **OUT 2**), and at the
Roadside sites (**ROAD 1** and **ROAD 2**).

The commute scenario codes are:

Arterial Rush (**AR**),
Arterial Non-Rush (**ANR**),
Freeway Rush (**FR**),
Freeway Non-Rush (**FNR**),
Rural (**R**),
School Bus (**SB**),
Freeway Rush Carpool (**FRC**), and
Maximum Commute (**MC**).

Not all measurements were made at each location and commute type (e.g. PM_{10} was not determined immediately outside any vehicle; formaldehyde samples were collected at only a subset of locations), resulting in **na** (not available) entries. A list of individual pollutant measures for all 29 commutes is given in Appendix H (except for the non-target elements by XRF). Tables 3-4E and 3-5E summarize the associated vehicular characterization measurements made in Vehicle 1 in Sacramento and LA, while the meteorology data collected for both cities at the ambient site, in given in Tables 3-4F and 3-5F, respectively. Note that wind direction (a vector quantity) is not summarized here, but is discussed subsequently in Section 3.5. More detailed data analysis and inter-comparisons between commute types, vehicle, etc. are addressed in the discussion Section 4, which evaluate the research design objectives proposed in Table 1-2. The non-target elements for each commute for $PM_{2.5}$ and PM_{10} are provided in Appendix I.

Table 3-4A. Summary of Organic Pollutant Commute-Average Concentration Data for Sacramento

		Concentrations in Measure units								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
Isobutylene	AR	2.7	11.6	10.5 - 14.1	10.4	9.5	8.4 - 10.5	9.2	5.1	3.3 - 6.5
μg/m3	FNR	1.2	6.0	5.3 - 6.6	5.7	5.0	4.5 - 5.5	4.6	1.5	1.1 - 2.1
	FR	1.9	10.4	6.8 - 14.1	10.3	12.4	8.7 - 17.7	9.7	3.2	1.6 - 6.2
	R	na	3.6	3.6 - 3.6	1.7	1.1	1.1 - 1.1	1.3	0.8	0.7 - 0.9
	SB	1.2	3.2	3.1 - 3.3	2.8	2.2	1.4 - 3.1	2.2	na	na - na
1,3-Butadiene	AR	0.5	2.8	2.4 - 3.5	2.4	1.7	1.6 - 1.9	2.0	1.0	0.7 - 1.1
μg/m3	FNR	0.1	1.9	1.6 - 2.2	1.3	1.4	1.3 - 1.5	1.3	0.2	0.1 - 0.2
	FR	0.1	2.7	1.6 - 4.1	2.8	2.8	1.7 - 4.4	2.3	0.4	0.0 - 1.1
	R	na	0.6	0.6 - 0.6	0.3	0.2	0.2 - 0.2	0.2	0.2	0.2 - 0.2
	SB	0.2	0.7	0.6 - 0.7	0.5	0.5	0.3 - 0.8	0.5	na	na - na
Acetonitrile	AR	36.7	174.1	53 - 345	2.0	170.2	52 - 456	94.3	39.4	10 - 109
μg/m3	FNR	22.5	44.7	27 - 62	2.0	40.4	37 - 44	44.0	53.7	10 - 101
	FR	45.3	116.7	18 - 279	1.8	222.5	42 - 627	107.8	48.8	4 - 93
	R	na	29.8	30 - 30	3.0	39.9	40 - 40	12.4	2.8	2 - 3
	SB	66.7	34.1	30 - 38	2.6	17.6	10 - 25	29.0	na	na - na
DCM	AR	4.1	2.2	1.1 - 3.7	1.6	1.6	1.1 - 2.0	2.5	4.1	2.7 - 5.5
μg/m3	FNR	1.1	0.9	0.9 - 0.9	1.1	0.8	0.6 - 1.0	1.2	1.2	0.5 - 2.3
	FR	1.9	0.9	0.5 - 1.3	1.1	1.6	0.5 - 3.4	1.9	1.7	0.5 - 4.4
	R	na	1.4	1.4 - 1.4	0.7	2.6	2.6 - 2.6	1.4	2.6	2.4 - 2.8
	SB	5.1	1.0	0.3 - 1.6	1.1	0.9	0.4 - 1.5	1.6	na	na - na
MTBE	AR	6.7	30.3	25.9 - 36.3	26.5	22.0	18.9 - 24.3	20.7	11.2	8.5 - 14.1
μg/m3	FNR	2.0	10.6	9.3 - 12.0	13.3	11.4	7.5 - 15.3	11.7	2.9	1.1 - 3.9
	FR	3.2	23.0	16.3 - 29.4	21.2	20.9	10.9 - 26.8	18.6	6.5	1.7 - 11.8
	R	na	2.6	2.6 - 2.6	2.2	1.4	1.4 - 1.4	1.4	1.1	1.1 - 1.2
	SB	2.2	7.3	6.0 - 8.7	6.2	5.2	3.1 - 7.4	4.7	na	na - na
ETBE	AR	0.8	0.3	0.0 - 0.4	0.4	0.4	0.3 - 0.4	0.9	0.9	0.2 - 1.6
μg/m3	FNR	0.0	0.0	0.0 - 0.0	0.0	0.0	0.0 - 0.0	0.0	0.0	0.0 - 0.1
	FR	0.1	0.0	0.0 - 0.1	0.0	0.0	0.0 - 0.0	0.0	0.0	0.0 - 0.2
	R	na	0.1	0.1 - 0.1	0.0	0.1	0.1 - 0.1	0.2	0.6	0.5 - 0.7
	SB	0.2	0.0	0.0 - 0.0	0.1	0.1	0.0 - 0.2	0.1	na	na - na
TCFM	AR	4.2	8.9	2.9 - 24.6	3.1	3.0	2.8 - 3.1	4.7	4.3	2.1 - 6.7
μg/m3	FNR	1.8	1.6	1.6 - 1.7	1.7	1.5	1.4 - 1.6	1.6	1.7	1.5 - 1.8
	FR	2.2	2.4	1.6 - 3.0	2.3	3.0	2.1 - 5.0	2.8	2.2	1.8 - 2.6
	R	na	2.2	2.2 - 2.2	1.9	2.2	2.2 - 2.2	2.2	3.0	2.8 - 3.2
	SB	2.1	1.6	1.3 - 1.9	1.8	1.6	1.3 - 1.9	1.6	na	na - na
Benzene	AR	2.9	12.1	10.2 - 15.2	10.0	11.2	9.4 - 13.9	10.9	5.0	4.2 - 5.9
μg/m3	FNR	0.9	6.5	5.7 - 7.4	6.5	7.2	6.9 - 7.6	7.2	1.0	0.6 - 1.4
	FR	1.4	10.3	7.4 - 13.9	11.2	13.9	11.7 - 15.9	12.3	2.6	0.8 - 5.3
	R	na	3.1	3.1 - 3.1	1.6	2.0	2.0 - 2.0	1.7	1.0	0.9 - 1.1
	SB	1.1	3.5	3.2 - 3.7	2.8	2.5	1.4 - 3.6	2.2	na	na - na
Toluene	AR	8.2	35.4	26.3 - 45.9	25.5	24.4	19.8 - 27.7	23.3	12.3	9.4 - 14.8
μg/m3	FNR	5.8	13.1	9.3 - 17.0	14.1	15.3	14.8 - 15.7	18.3	6.2	3.7 - 9.3
	FR	4.6	32.0	23.7 - 38.4	24.1	27.6	20.2 - 35.8	25.2	7.3	3.1 - 10.6
	R	na	7.4	7.4 - 7.4	4.1	3.2	3.2 - 3.2	3.0	2.2	2.1 - 2.2
	SB	3.7	12.2	11.0 - 13.3	8.0	6.0	3.8 - 8.1	6.0	na	na - na
Ethylbenzene	AR	1.8	8.2	6.4 - 10.1	6.4	5.7	4.8 - 6.2	5.7	3.0	2.5 - 3.3
μg/m3	FNR	3.2	2.9	2.8 - 3.0	2.5	2.5	2.4 - 2.5	2.4	0.7	0.3 - 0.9
	FR	0.7	5.5	3.7 - 7.1	4.5	5.0	3.8 - 6.0	4.4	1.2	0.3 - 2.2
	R	na	1.6	1.6 - 1.6	0.8	0.6	0.6 - 0.6	0.6	0.6	0.5 - 0.7
	SB	0.6	2.5	2.3 - 2.8	1.7	1.3	0.7 - 1.9	1.2	na	na - na
M,P-Xylene	AR	5.0	31.0	22.9 - 38.2	22.7	19.8	16.7 - 22.1	19.3	8.9	6.5 - 10.9
μg/m3	FNR	1.8	12.6	12.5 - 12.7	10.8	11.0	11.0 - 11.1	10.8	2.6	1.3 - 3.5
	FR	2.7	24.7	17.0 - 30.1	19.4	21.1	16.9 - 26.7	18.8	4.9	1.4 - 8.0
	R	na	5.3	5.3 - 5.3	2.6	1.8	1.8 - 1.8	1.6	1.2	1.1 - 1.3
	SB	1.8	8.9	7.8 - 9.9	5.8	4.3	2.4 - 6.1	3.9	na	na - na
O-Xylene	AR	2.3	10.7	8.3 - 13.0	8.3	7.1	5.9 - 7.8	7.4	3.6	3.2 - 3.8
μg/m3	FNR	0.7	4.4	4.4 - 4.5	3.8	3.9	3.8 - 4.0	3.7	1.0	0.6 - 1.3
	FR	1.5	8.4	5.9 - 9.8	6.7	7.2	6.0 - 9.0	6.6	2.2	0.6 - 3.6
	R	na	2.0	2.0 - 2.0	1.0	0.7	0.7 - 0.7	0.7	0.8	0.7 - 0.8
	SB	0.8	3.2	2.8 - 3.7	2.2	1.7	0.9 - 2.4	1.5	na	na - na
Formaldehyde	AR	4.1	11.9	10.2 - 13.9	NA	11.9	8.8 - 18.5	na	6.3	5.2 - 7.4
μg/m3	FNR	2.0	8.0	7.7 - 8.4	NA	7.9	7.5 - 8.4	na	5.2	4.9 - 5.7
	FR	3.0	11.9	11.3 - 12.3	NA	12.4	9.3 - 17.4	na	5.4	3.0 - 8.3
	R	na	4.9	4.9 - 4.9	NA	5.8	5.8 - 5.8	na	4.6	4.3 - 5.0
	SB	2.8	7.0	4.6 - 9.5	NA	8.6	6.4 - 10.9	na	na	na - na

See table notes following Table 3-4B

Table 3-4B. Summary of Continuous Pollutant Commute-Average Concentration Data for Sacramento

		Concentrations in Measure units								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
CO Average ppm	AR	0.0	2.3	2.0 - 2.6	2.8	3.0	2.1 - 5.1	4.1	0.4	0.2 - 0.7
	FNR	0.0	1.4	1.2 - 1.7	2.2	3.5	2.8 - 4.2	3.9	0.0	0.0 - 0.1
	FR	0.0	2.1	1.8 - 2.3	2.2	3.1	2.6 - 4.1	4.2	0.3	0.0 - 1.2
	R	na	0.7	0.7 - 0.7	0.2	0.4	0.4 - 0.4	0.6	0.0	0.0 - 0.0
	SB	0.0	0.4	0.3 - 0.5	0.3	0.3	0.3 - 0.3	0.3	na	0.0 - 0.0
CO Peak ppm	AR	0.8	10.8	8.0 - 16.0	23.7	9.5	4.0 - 14.0	13.5	4.5	2.0 - 8.0
	FNR	0.0	13.0	7.0 - 19.0	14.0	12.5	10.0 - 15.0	13.0	0.5	0.0 - 1.0
	FR	0.0	10.5	3.0 - 17.0	11.5	22.3	7.0 - 52.0	25.8	2.0	0.0 - 4.0
	R	na	22.0	22.0 - 22.0	8.0	6.0	6.0 - 6.0	11.0	0.5	0.0 - 1.0
	SB	0.0	2.5	2.0 - 3.0	2.5	3.0	3.0 - 3.0	2.5	na	0.0 - 0.0
Black Carbon Aethalometer µg/m3	AR	na	1.2	-0.1 - 3.3	3.1	na	na - na	na	na	na - na
	FNR	na	8.3	7.6 - 9.0	4.0	na	na - na	na	na	na - na
	FR	na	6.7	3.3 - 9.5	7.9	na	na - na	na	na	na - na
	R	na	-0.3	-0.3 - -0.3	1.4	na	na - na	na	na	na - na
	SB	na	4.9	0.9 - 8.9	7.0	na	na - na	na	na	na - na
LASX mean total particle counts/cm3	AR	na	33	33 - 33	139	na	na - na	na	na	na - na
	FNR	na	991	818 - 1,164	1,857	na	na - na	na	na	na - na
	FR	na	759	542 - 976	1,942	na	na - na	na	na	na - na
	R	na	10	10 - 10	32	na	na - na	na	na	na - na
	SB	na	24	18 - 29	96	na	na - na	na	na	na - na

Notes: a Expected n values by Sacramento commute scenario Type are: AR (4), FNR(2), FR(4), R(1), and SB(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

Ambient data not available to correct black carbon or LAS-X data

LAS-X OUT data corrected for sampling line losses

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-4C. Summary of PM10 Pollutant Commute-Average Concentration Data for Sacramento

		Concentrations in Measure units								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
PM 10 mass µg/m3	AR	20.3	16.5	14.1 - 20.7	na	10.7	6.3 - 16.5	na	30.9	18.9 - 43.0
	FNR	29.4	29.6	28.7 - 30.6	na	13.4	8.4 - 18.3	na	34.4	23.7 - 57.7
	FR	22.7	30.3	19.9 - 39.4	na	10.0	2.1 - 17.9	na	27.3	10.2 - 42.5
	R	na	26.2	26.2 - 26.2	na	14.0	14.0 - 14.0	na	57.2	29.8 - 84.6
	SB	29.5	26.2	20.4 - 31.9	na	32.1	20.7 - 43.4	na	NA	0.0 - 0.0
PM10 Cr µg/m3	AR	0.02	0.01	0.00 - 0.03	na	0.02	0.00 - 0.05	na	0.00	0.00 - 0.01
	FNR	0.02	0.03	0.03 - 0.03	na	0.00	0.00 - 0.00	na	0.03	0.01 - 0.06
	FR	0.03	0.03	0.00 - 0.05	na	0.02	0.00 - 0.04	na	0.02	0.00 - 0.04
	R	na	0.05	0.05 - 0.05	na	0.00	0.00 - 0.00	na	0.03	0.01 - 0.04
	SB	0.01	0.01	0.01 - 0.01	na	0.04	0.01 - 0.06	na	NA	0.00 - 0.00
PM10 Mn µg/m3	AR	0.02	0.03	0.00 - 0.07	na	0.01	0.00 - 0.02	na	0.03	0.00 - 0.05
	FNR	0.03	0.01	0.00 - 0.02	na	0.02	0.00 - 0.03	na	0.02	0.01 - 0.05
	FR	0.02	0.03	0.01 - 0.05	na	0.02	0.00 - 0.03	na	0.04	0.00 - 0.06
	R	na	0.00	0.00 - 0.00	na	0.00	0.00 - 0.00	na	0.02	0.01 - 0.04
	SB	0.04	0.01	0.00 - 0.02	na	0.03	0.00 - 0.06	na	NA	0.00 - 0.00
PM10 Ni µg/m3	AR	0.01	0.01	0.01 - 0.02	na	0.01	0.00 - 0.02	na	0.00	0.00 - 0.01
	FNR	0.01	0.01	0.00 - 0.02	na	0.00	0.00 - 0.00	na	0.00	0.00 - 0.02
	FR	0.00	0.00	0.00 - 0.00	na	0.01	0.00 - 0.03	na	0.00	0.00 - 0.01
	R	na	0.01	0.01 - 0.01	na	0.01	0.01 - 0.01	na	0.01	0.01 - 0.02
	SB	0.01	0.00	0.00 - 0.01	na	0.02	0.02 - 0.03	na	NA	0.00 - 0.00
PM10 Pb µg/m3	AR	0.02	0.04	0.02 - 0.08	na	0.01	0.00 - 0.04	na	0.03	0.00 - 0.06
	FNR	0.01	0.02	0.01 - 0.02	na	0.01	0.00 - 0.02	na	0.00	0.00 - 0.01
	FR	0.01	0.02	0.00 - 0.03	na	0.01	0.00 - 0.05	na	0.02	0.00 - 0.04
	R	na	0.02	0.02 - 0.02	na	0.00	0.00 - 0.00	na	0.02	0.00 - 0.04
	SB	0.00	0.01	0.00 - 0.02	na	0.01	0.00 - 0.03	na	NA	0.00 - 0.00
PM10 S µg/m3	AR	0.44	0.37	0.09 - 0.74	na	0.28	0.13 - 0.55	na	0.64	0.45 - 0.84
	FNR	0.68	0.61	0.42 - 0.80	na	0.48	0.27 - 0.70	na	0.73	0.43 - 1.12
	FR	0.48	0.47	0.21 - 0.88	na	0.30	0.16 - 0.59	na	0.53	0.24 - 1.04
	R	na	0.29	0.29 - 0.29	na	0.24	0.24 - 0.24	na	0.35	0.30 - 0.39
	SB	0.26	0.29	0.24 - 0.33	na	0.22	0.16 - 0.28	na	NA	0.00 - 0.00

Notes: a Expected n values by Sacramento commute scenario Type are: AR (4), FNR(2), FR(4), R(1), and SB(2); exceptions to the n values in parentheses.
b Means and ranges computed from uncensored data
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-4D. Summary of PM2.5 Pollutant Commute-Average Concentration Data for Sacramento

		Concentrations in Measure units								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
PM 2.5 mass µg/m3	AR	10.8	9.6	8.0 - 10.3	17.4	9.7	2.1 - 16.4	12.7	5.8	-2.1 - 18.7
	FNR	10.3	14.4	12.2 - 16.6	23.0	12.4	10.6 - 14.2	15.4	9.6	0.0 - 19.9
	FR	5.7	14.7	3.9 - 21.8	20.5	6.6	2.1 - 16.2	12.2	5.9	-6.1 - 18.2
	R	na	6.1	6.1 - 6.1	2.0	2.0	2.0 - 2.0	9.8	3.1	1.9 - 4.2
	SB	6.2	17.0	12.0 - 22.0	13.5	19.8	16.9 - 22.8	16.2	na	na - na
PM2.5 Cd µg/m3	AR	0.04	0.04	0.00 - 0.10	0.04	0.07	0.00 - 0.17	0.03	0.06	0.00 - 0.16
	FNR	0.05	0.01	0.00 - 0.03	0.01	0.07	0.04 - 0.10	0.04	0.04	0.00 - 0.09
	FR	0.02	0.08	0.00 - 0.14	0.05	0.05	0.00 - 0.12	0.01	0.04	0.00 - 0.16
	R	na	0.02	0.02 - 0.02	0.02	0.00	0.00 - 0.00	0.00	0.03	0.00 - 0.07
	SB	0.09	0.06	0.06 - 0.07	0.15	0.01	0.00 - 0.01	0.00	na	na - na
PM2.5 Cr µg/m3	AR	0.01	0.01	0.00 - 0.03	0.01	0.01	0.00 - 0.03	0.03	0.03	0.01 - 0.05
	FNR	0.00	0.02	0.02 - 0.03	0.03	0.04	0.04 - 0.04	0.00	0.01	0.00 - 0.03
	FR	0.02	0.01	0.00 - 0.03	0.01	0.02	0.00 - 0.04	0.01	0.02	0.00 - 0.04
	R	na	0.04	0.04 - 0.04	0.03	0.02	0.02 - 0.02	0.00	0.01	0.01 - 0.01
	SB	0.03	0.03	0.00 - 0.05	0.00	0.00	0.00 - 0.00	0.01	na	na - na
PM2.5 Mn µg/m3	AR	0.01	0.02	0.00 - 0.04	0.01	0.01	0.00 - 0.02	0.02	0.01	0.00 - 0.03
	FNR	0.03	0.02	0.00 - 0.03	0.03	0.01	0.00 - 0.01	0.01	0.02	0.01 - 0.02
	FR	0.00	0.01	0.00 - 0.04	0.01	0.03	0.01 - 0.05	0.01	0.01	0.00 - 0.03
	R	na	0.02	0.02 - 0.02	0.00	0.00	0.00 - 0.00	0.00	0.02	0.01 - 0.04
	SB	0.01	0.01	0.00 - 0.02	0.01	0.02	0.00 - 0.04	0.00	na	na - na
PM2.5 Ni µg/m3	AR	0.00	0.00	0.00 - 0.01	0.01	0.01	0.00 - 0.02	0.01	0.00	0.00 - 0.02
	FNR	0.01	0.01	0.01 - 0.02	0.01	0.00	0.00 - 0.00	0.01	0.00	0.00 - 0.01
	FR	0.00	0.01	0.00 - 0.03	0.01	0.00	0.00 - 0.00	0.00	0.00	0.00 - 0.02
	R	na	0.03	0.03 - 0.03	0.01	0.00	0.00 - 0.00	0.00	0.00	0.00 - 0.00
	SB	0.01	0.00	0.00 - 0.00	0.01	0.01	0.00 - 0.01	0.01	na	na - na
PM2.5 Pb µg/m3	AR	0.02	0.02	0.00 - 0.05	0.03	0.01	0.00 - 0.04	0.02	0.01	0.00 - 0.03
	FNR	0.02	0.04	0.03 - 0.04	0.02	0.02	0.00 - 0.03	0.03	0.01	0.00 - 0.01
	FR	0.01	0.02	0.01 - 0.05	0.03	0.02	0.02 - 0.03	0.01	0.02	0.00 - 0.04
	R	na	0.00	0.00 - 0.00	0.00	0.01	0.01 - 0.01	0.01	0.02	0.02 - 0.03
	SB	0.01	0.00	0.00 - 0.00	0.01	0.01	0.00 - 0.02	0.01	na	na - na
PM2.5 S µg/m3	AR	0.39	0.33	0.09 - 0.61	0.40	0.21	0.08 - 0.39	0.27	0.42	0.12 - 0.68
	FNR	0.59	0.67	0.46 - 0.88	0.67	0.52	0.46 - 0.58	0.65	0.59	0.39 - 0.80
	FR	0.40	0.42	0.14 - 0.83	0.46	0.29	0.09 - 0.68	0.41	0.43	0.16 - 0.81
	R	na	0.23	0.23 - 0.23	0.23	0.10	0.10 - 0.10	0.29	0.24	0.19 - 0.29
	SB	0.23	0.24	0.24 - 0.24	0.15	0.21	0.21 - 0.22	0.18	na	na - na

Notes: a Expected n values by Sacramento commute scenario Type are: AR (4), FNR(2), FR(4), R(1), and SB(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

na Not Available (no samples scheduled)

MDL's for PM2.5 elements found in Table 3-3B

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-4E. Summary of Associated Commute-Average Measurement Data for Sacramento

		Other Measures in specified units								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
Vehicle Speed (mph)	AR	na	23.8	22.2 - 25.1	na	na	na - na	na	na	na - na
	FNR	na	48.6	47.0 - 50.2	na	na	na - na	na	na	na - na
	FR	na	32.5	23.4 - 44.0	na	na	na - na	na	na	na - na
	R	na	53.2	53.2 - 53.2	na	na	na - na	na	na	na - na
	SB	na	14.0	13.3 - 14.6	na	na	na - na	na	na	na - na
Spacing Range (feet)	AR	na	74.4	52.6 - 91.8	na	na	na - na	na	na	na - na
	FNR	na	90.4	83.7 - 97.0	na	na	na - na	na	na	na - na
	FR	na	68.9	56.2 - 79.1	na	na	na - na	na	na	na - na
	R	na	122.1	122.1 - 122.1	na	na	na - na	na	na	na - na
	SB	na	103.6	78.1 - 129.1	na	na	na - na	na	na	na - na
Level of Congestion (unitless)	AR	na	2.5	1.0 - 3.8	na	na	na - na	na	na	na - na
	FNR	na	2.5	2.5 - 2.6	na	na	na - na	na	na	na - na
	FR	na	3.9	2.8 - 5.2	na	na	na - na	na	na	na - na
	R	na	1.0	1.0 - 1.0	na	na	na - na	na	na	na - na
	SB	na	1.4	1.0 - 1.7	na	na	na - na	na	na	na - na
Miles Traveled	AR	na	49.1	45.8 - 52.1	na	na	na - na	na	na	na - na
	FNR	na	99.1	94.0 - 104.2	na	na	na - na	na	na	na - na
	FR	na	68.3	53.9 - 88.5	na	na	na - na	na	na	na - na
	R	na	152.0	152.0 - 152.0	na	na	na - na	na	na	na - na
	SB	na	0.0	0.0 - 0.0	na	na	na - na	na	na	na - na
Heavy Duty Diesel Bus Influence (% of commute)	AR	na	4%	0% - 14%	na	na	na - na	na	na	na - na
	FNR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	FR	na	22%	0% - 89%	na	na	na - na	na	na	na - na
	R	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	SB	na	0%	0% - 0%	na	na	na - na	na	na	na - na
Heavy Duty Diesel Truck Influence (% of commute)	AR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	FNR	na	66%	50% - 83%	na	na	na - na	na	na	na - na
	FR	na	47%	13% - 90%	na	na	na - na	na	na	na - na
	R	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	SB	na	0%	0% - 0%	na	na	na - na	na	na	na - na
Diesel Influence (other types) (% of commute)	AR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	FNR	na	18%	0% - 36%	na	na	na - na	na	na	na - na
	FR	na	7%	0% - 25%	na	na	na - na	na	na	na - na
	R	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	SB	na	50%	0% - 99%	na	na	na - na	na	na	na - na

Notes: a Expected n values by Sacramento commute scenario Type are: AR (4), FNR(2), FR(4), R(1), and SB(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-4F. Summary of Commute-Average Meteorological Data for Sacramento (Ambient Site Only)

Measure	Type	AMB Mean	IN 1 Mean	AMB Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
Windspeed (mph)	AR	4.8	na	4.8 - 4.8	na	na	na - na	na	na	na - na
	FNR	6.3	na	6.0 - 6.5	na	na	na - na	na	na	na - na
	FR	3.6	na	3.5 - 3.8	na	na	na - na	na	na	na - na
	R	na	na	NA - NA	na	na	na - na	na	na	na - na
	SB	2.8	na	2.5 - 3.0	na	na	na - na	na	na	na - na
Ambient Temperature (deg F)	AR	72.1	na	71.6 - 72.5	na	na	na - na	na	na	na - na
	FNR	82.4	na	82.4 - 82.4	na	na	na - na	na	na	na - na
	FR	73.9	na	73.4 - 74.3	na	na	na - na	na	na	na - na
	R	na	na	na - na	na	na	na - na	na	na	na - na
	SB	71.2	na	70.7 - 71.6	na	na	na - na	na	na	na - na
Relative Humidity (%)	AR	58.8	na	30.0 - 85.0	na	na	na - na	na	na	na - na
	FNR	36.5	na	23.0 - 53.0	na	na	na - na	na	na	na - na
	FR	55.3	na	24.0 - 83.0	na	na	na - na	na	na	na - na
	R	29.0	na	29.0 - 29.0	na	na	na - na	na	na	na - na
	SB	65.0	na	36.0 - 94.0	na	na	na - na	na	na	na - na
Predominant Wind Direction (degrees)	AR	none	na	na - na	na	na	na - na	na	na	na - na
	FNR	209	na	na - na	na	na	na - na	na	na	na - na
	FR	none	na	na - na	na	na	na - na	na	na	na - na
	R	na	na	na - na	na	na	na - na	na	na	na - na
	SB	323	na	na - na	na	na	na - na	na	na	na - na

Notes: a Expected n values by Sacramento commute scenario Type are: AR (4), FNR(2), FR(4), R(1), and SB(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-5A1. Summary of Organic Pollutant Commute-Average Concentration Data for Los Angeles (p.1)

Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
Isobutylene	ANR	5.8	21.5	19.5 - 23.5	21.7	18.0	17.1 - 19.0	17.4	na	0.0 - 0.0
μg/m3	AR	4.3	17.6	13.1 - 23.3	17.2	16.6	13.5 - 20.5	15.8	7.1	3.2 - 10.4
	FNR	5.8	17.3	15.3 - 19.2	17.8	14.7	13.4 - 16.0	17.1	na	0.0 - 0.0
	FR	5.2	16.5	11.6 - 25.0	17.7	17.7	14.1 - 25.0	17.3	13.7	6.0 - 22.7
	FRC	3.8	14.2	12.1 - 16.4	14.2	19.4	18.5 - 20.3	20.1	13.0	10.9 - 14.6
	MC	4.3	21.5	19.1 - 23.9	19.6	na	na - na	na	na	na - na
1,3-Butadiene	ANR	0.5	3.5	3.4 - 3.7	3.5	2.4	2.3 - 2.4	2.3	na	0.0 - 0.0
μg/m3	AR	0.4	3.4	2.1 - 4.5	3.4	2.7	2.1 - 3.5	2.7	1.0	0.4 - 1.7
	FNR	0.4	4.1	4.1 - 4.1	4.0	3.2	3.1 - 3.4	3.6	na	0.0 - 0.0
	FR	0.7	3.8	2.8 - 5.7	4.1	3.7	2.6 - 5.1	3.7	2.9	1.2 - 4.9
	FRC	0.4	3.0	2.2 - 3.8	2.9	4.0	3.7 - 4.4	3.9	2.6	2.1 - 3.3
	MC	0.4	4.7	4.4 - 5.0	4.4	na	na - na	na	na	na - na
Acetonitrile	ANR	8.4	63.9	27.7 - 100.1	3.1	37.4	24.2 - 50.7	33.9	na	0.0 - 0.0
μg/m3	AR	30.1	205.1	38.9 - 495.9	2.1	277.4	23.1 - 520.0	168.2	40.5	2.4 - 167.2
	FNR	9.7	25.1	6.3 - 43.9	3.5	46.0	27.8 - 64.1	39.7	na	0.0 - 0.0
	FR	19.9	150.7	42.1 - 375.3	5.7	181.3	39.3 - 374.8	96.8	19.9	3.0 - 111.7
	FRC	76.9	46.2	41.6 - 50.8	2.1	69.1	62.9 - 75.3	48.4	5.7	1.9 - 14.4
	MC	52.8	28.0	27.3 - 28.6	2.4	na	na - na	na	na	na - na
DCM	ANR	3.7	2.7	2.1 - 3.3	2.5	2.7	2.5 - 3.0	2.8	na	0.0 - 0.0
μg/m3	AR	3.6	3.1	2.7 - 3.4	3.1	3.5	2.4 - 5.0	3.2	4.9	2.5 - 13.9
	FNR	16.9	3.5	1.9 - 5.1	3.4	3.7	2.5 - 4.8	3.6	na	0.0 - 0.0
	FR	3.0	2.6	1.2 - 4.3	3.3	3.0	1.5 - 4.6	3.1	2.5	1.4 - 3.9
	FRC	2.4	2.6	1.9 - 3.4	2.5	3.3	3.2 - 3.5	4.0	3.7	1.4 - 7.7
	MC	5.5	4.5	3.7 - 5.4	4.0	na	na - na	na	na	na - na
MTBE	ANR	26.3	59.9	41.8 - 78.1	59.2	42.9	33.5 - 52.2	42.8	na	0.0 - 0.0
μg/m3	AR	9.7	36.0	24.3 - 50.3	36.1	30.6	24.9 - 38.6	29.4	15.0	6.9 - 22.4
	FNR	15.3	41.4	32.1 - 50.7	41.7	34.4	28.1 - 40.7	40.4	na	0.0 - 0.0
	FR	13.5	37.7	19.7 - 64.1	41.5	36.5	28.8 - 54.6	36.3	32.2	15.3 - 58.5
	FRC	10.2	31.2	27.4 - 35.0	31.2	47.0	46.5 - 47.5	47.8	27.6	22.2 - 30.8
	MC	10.7	60.2	30.3 - 90.0	50.9	na	na - na	na	na	na - na
ETBE	ANR	0.2	0.0	0.0 - 0.1	0.0	0.1	0.1 - 0.1	0.0	na	0.0 - 0.0
μg/m3	AR	0.0	0.0	0.0 - 0.1	0.0	0.0	0.0 - 0.0	0.0	0.0	0.0 - 0.3
	FNR	0.1	0.0	0.0 - 0.0	0.0	0.0	0.0 - 0.0	0.0	na	0.0 - 0.0
	FR	0.1	0.0	0.0 - 0.0	0.0	0.0	0.0 - 0.0	0.0	0.1	0.0 - 0.4
	FRC	0.2	0.0	0.0 - 0.0	0.0	0.0	0.0 - 0.0	0.0	0.0	0.0 - 0.1
	MC	0.0	0.0	0.0 - 0.0	0.0	na	na - na	na	na	na - na
TCFM	ANR	2.0	1.8	1.8 - 1.8	1.8	1.9	1.8 - 2.1	1.8	na	0.0 - 0.0
μg/m3	AR	1.7	1.5	1.4 - 1.7	1.6	1.6	1.4 - 1.7	1.6	1.7	1.5 - 1.8
	FNR	1.4	1.7	1.6 - 1.7	1.7	1.7	1.7 - 1.7	1.8	na	0.0 - 0.0
	FR	1.8	1.6	0.9 - 2.2	1.9	1.7	1.3 - 2.1	1.7	1.8	1.8 - 2.0
	FRC	1.5	1.5	1.5 - 1.5	1.5	1.5	1.5 - 1.5	1.6	1.8	1.4 - 2.4
	MC	1.7	2.1	1.8 - 2.5	2.0	na	na - na	na	na	na - na
Benzene	ANR	6.6	16.7	14.3 - 19.0	16.0	13.9	13.0 - 14.7	13.2	na	0.0 - 0.0
μg/m3	AR	2.8	14.5	10.2 - 20.7	14.6	12.5	10.5 - 14.9	12.1	5.2	2.3 - 8.5
	FNR	3.9	14.4	13.8 - 15.1	14.5	12.5	12.2 - 12.8	14.0	na	0.0 - 0.0
	FR	4.0	14.4	9.8 - 21.9	15.0	15.5	11.9 - 20.2	15.1	11.8	5.4 - 19.5
	FRC	3.0	12.7	10.6 - 14.8	12.3	17.4	16.1 - 18.6	17.4	11.2	9.2 - 12.5
	MC	2.9	17.2	16.2 - 18.1	15.6	na	na - na	na	na	na - na
Toluene	ANR	23.2	44.4	35.0 - 53.9	42.3	32.8	27.5 - 38.2	31.9	na	0.0 - 0.0
μg/m3	AR	9.6	37.0	28.1 - 49.6	36.0	30.1	26.8 - 34.0	29.7	16.4	6.9 - 27.4
	FNR	39.9	38.8	35.3 - 42.3	39.2	33.0	28.4 - 37.5	38.7	na	0.0 - 0.0
	FR	19.0	34.0	22.6 - 52.4	34.4	31.2	23.7 - 39.7	32.0	43.9	22.5 - 70.5
	FRC	10.3	31.5	26.8 - 36.1	29.8	50.8	44.0 - 57.6	46.3	26.4	21.2 - 28.8
	MC	10.2	37.8	33.6 - 42.0	36.8	na	na - na	na	na	na - na

Notes: a Expected n values by Los Angeles commute scenario Type are: ANR(2), FNR(2), AR(4), FR(4), FRC(2), and MC(2); exceptions to the n values in parentheses.
b Means and ranges computed from uncensored data
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-5A2. Summary of Organic Pollutant Commute-Average Concentration Data for Los Angeles (p.2)

Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
Ethylbenzene µg/m3	ANR	3.5	9.7	7.6 - 11.8	9.3	6.5	5.5 - 7.5	6.4	na	0.0 - 0.0
	AR	1.6	7.5	5.5 - 10.2	7.1	5.7	5.1 - 6.2	5.7	2.7	1.2 - 4.0
	FNR	2.1	7.3	7.2 - 7.5	7.3	6.1	5.8 - 6.3	6.8	na	0.0 - 0.0
	FR	2.2	7.4	4.7 - 11.5	7.2	6.2	4.5 - 7.7	6.3	5.6	2.7 - 9.7
	FRC	1.7	6.1	4.9 - 7.2	5.6	8.0	8.0 - 8.0	7.6	4.9	3.8 - 5.4
	MC	1.6	8.0	6.7 - 9.3	7.5	na	na - na	na	na	na - na
M,P-Xylene µg/m3	ANR	9.4	35.5	27.5 - 43.6	33.9	23.7	20.1 - 27.3	22.7	na	0.0 - 0.0
	AR	5.3	28.8	19.4 - 40.6	28.6	22.4	19.9 - 24.9	22.3	9.9	4.3 - 14.8
	FNR	5.7	26.9	26.1 - 27.7	26.6	21.5	19.6 - 23.4	24.5	na	0.0 - 0.0
	FR	7.4	28.2	17.3 - 45.4	27.7	23.4	16.7 - 28.9	23.9	20.2	9.0 - 36.9
	FRC	5.2	23.6	18.3 - 28.9	21.9	31.0	30.9 - 31.0	29.3	18.3	13.7 - 20.6
	MC	5.2	32.5	25.6 - 39.5	29.7	na	na - na	na	na	na - na
O-Xylene µg/m3	ANR	4.0	12.9	9.8 - 15.9	12.7	8.9	7.4 - 10.3	8.3	na	0.0 - 0.0
	AR	2.0	10.1	7.1 - 14.1	10.1	8.2	7.2 - 8.9	8.1	3.7	1.6 - 5.6
	FNR	2.5	9.7	9.6 - 9.7	9.5	7.8	7.3 - 8.2	8.9	na	0.0 - 0.0
	FR	2.8	10.0	6.1 - 15.9	9.9	8.5	6.3 - 10.7	8.6	7.5	3.4 - 13.2
	FRC	2.0	8.5	6.7 - 10.3	7.9	11.1	11.1 - 11.2	10.5	6.7	5.1 - 7.6
	MC	2.1	11.5	9.1 - 13.9	10.6	na	na - na	na	na	na - na
Formaldehyde µg/m3	ANR	19.1	19.7	17.3 - 22.2	na	15.4	7.2 - 23.6	na	na	0.0 - 0.0
	AR	7.3	15.5	12.7 - 19.6	na	16.8	11.3 - 22.6	na	11.2	4.4 - 18.8
	FNR	21.1	7.2	0.0 - 14.4	na	13.3	10.4 - 16.2	na	na	0.0 - 0.0
	FR	6.7	16.3	14.7 - 17.0	na	18.0	16.3 - 20.7	na	12.1	0.0 - 16.9
	FRC	8.9	14.0	13.9 - 14.1	na	17.0	15.4 - 18.6	na	15.4	11.0 - 20.3
	MC	10.1	15.6	14.3 - 16.9	na	na	na - na	na	na	na - na

Notes: a Expected n values by Los Angeles commute scenario Type are: ANR(2), FNR(2), AR(4), FR(4), FRC(2), and MC(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-5B. Summary of Continuous Commute-Average Pollutant Concentration Data for Los Angeles

		Concentrations								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
CO Average ppm	ANR	0.8	4.2	3.1 - 5.2	4.5	4.6	4.1 - 5.0	5.5	NA	0.0 - 0.0
	AR	0.0	4.2	3.0 - 6.0	4.4	4.4	3.6 - 5.0	4.9	0.6	0.0 - 1.3
	FNR	1.3	4.4	4.1 - 4.6	4.4	4.5	3.9 - 5.0	4.7	NA	0.0 - 0.0
	FR	0.5	5.1	4.0 - 6.0	5.3	5.4	4.4 - 7.6	5.6	3.1	0.7 - 5.2
	FRC	0.0	3.5	2.9 - 4.2	2.8	4.9	4.9 - 4.9	5.6	3.6	2.8 - 4.2
	MC	0.1	4.5	4.4 - 4.6	4.5	na	na - na	na	na	na - na
CO Peak ppm	ANR	2.0	24.0	17.0 - 31.0	28.5	12.5	12.0 - 13.0	17.0	NA	0.0 - 0.0
	AR	0.5	23.3	7.0 - 48.0	40.3	9.0	6.0 - 11.0	14.5	3.5	1.0 - 7.0
	FNR	3.0	26.5	14.0 - 39.0	44.5	17.5	15.0 - 20.0	20.0	NA	0.0 - 0.0
	FR	1.3	34.0	7.0 - 67.0	31.5	12.8	7.0 - 22.0	14.8	6.6	3.0 - 11.0
	FRC	0.0	9.0	6.0 - 12.0	11.0	18.5	15.0 - 22.0	24.0	8.5	7.0 - 10.0
	MC	1.0	25.5	21.0 - 30.0	27.0	na	na - na	na	na	na - na
Black Carbon Aethalometer μg/m3	ANR	NA	15.2	7.6 - 22.9	12.1	na	na - na	na	na	na - na
	AR	NA	7.5	4.1 - 12.9	13.7	na	na - na	na	na	na - na
	FNR	NA	12.1	9.4 - 14.7	16.4	na	na - na	na	na	na - na
	FR	NA	10.4	7.9 - 13.4	17.7	na	na - na	na	na	na - na
	FRC	NA	4.4	3.3 - 5.5	8.4	na	na - na	na	na	na - na
	MC	NA	20.9	20.4 - 21.4	19.9	na	na - na	na	na	na - na
LASX mean total particle counts/cm3	ANR	NA	3,614	2,621 - 4,606	6,033	na	na - na	na	na	na - na
	AR	NA	2,690	2,253 - 2,868	5,170	na	na - na	na	na	na - na
	FNR	NA	4,037	3,733 - 4,341	8,528	na	na - na	na	na	na - na
	FR	NA	2,960	2,258 - 3,606	6,724	na	na - na	na	na	na - na
	FRC	NA	2,817	2,817 - 2,817	5,289	na	na - na	na	na	na - na
	MC	NA	4,325	4,237 - 4,413	7,333	na	na - na	na	na	na - na

Notes: a Expected n values by Los Angeles commute scenario Type are: ANR(2), FNR(2), AR(4), FR(4), FRC(2), and MC(2); exceptions to the n values in parentheses.
b Means and ranges computed from uncensored data
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-5C. Summary of PM10 Commute-Average Pollutant Concentration Data for Los Angeles

		Concentrations								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
PM 10 mass µg/m3	ANR	99.2	69.6	53.7 - 85.5	na	58.4	37.1 - 79.7	na	na	0.0 - 0.0
	AR	77.3	45.6	34.6 - 53.1	na	51.4	26.6 - 111.0	na	82.2	31.0 - 166.0
	FNR	53.8	66.6	61.0 - 72.1	na	62.9	58.6 - 67.3	na	NA	0.0 - 0.0
	FR	59.5	54.9	46.0 - 64.8	na	36.2	22.9 - 45.2	na	77.3	43.9 - 129.8
	FRC	102.6	61.1	49.1 - 73.2	na	71.0	67.5 - 74.6	na	122.5	119.2 - 126.1
	MC	56.9	89.1	73.2 - 105.0	na	na	na - na	na	na	na - na
PM10 Cd µg/m3	ANR	0.03	0.06	0.00 - 0.12	na	0.07	0.00 - 0.13	na	na	0.00 - 0.00
	AR	0.08	0.05	0.00 - 0.14	na	0.06	0.01 - 0.16	na	0.02	0.00 - 0.08
	FNR	0.03	0.05	0.04 - 0.06	na	0.02	0.00 - 0.03	na	NA	0.00 - 0.00
	FR	0.00	0.05	0.00 - 0.17	na	0.00	0.00 - 0.00	na	0.02	0.00 - 0.09
	FRC	0.02	0.09	0.06 - 0.12	na	0.00	0.00 - 0.00	na	0.03	0.00 - 0.06
	MC	0.08	0.00	0.00 - 0.00	na	na	na - na	na	na	na - na
PM10 Cr µg/m3	ANR	0.01	0.02	0.00 - 0.04	na	0.00	0.00 - 0.01	na	na	0.00 - 0.00
	AR	0.03	0.01	0.00 - 0.01	na	0.01	0.00 - 0.02	na	0.01	0.00 - 0.03
	FNR	0.02	0.01	0.00 - 0.02	na	0.01	0.01 - 0.02	na	NA	0.00 - 0.00
	FR	0.01	0.02	0.00 - 0.04	na	0.01	0.00 - 0.03	na	0.01	0.00 - 0.05
	FRC	0.00	0.01	0.00 - 0.01	na	0.01	0.00 - 0.03	na	0.03	0.00 - 0.04
	MC	0.02	0.02	0.01 - 0.02	na	na	na - na	na	na	na - na
PM10 Mn µg/m3	ANR	0.02	0.00	0.00 - 0.01	na	0.00	0.00 - 0.00	na	na	0.00 - 0.00
	AR	0.00	0.01	0.00 - 0.02	na	0.01	0.00 - 0.01	na	0.00	0.00 - 0.02
	FNR	0.02	0.00	0.00 - 0.01	na	0.01	0.00 - 0.02	na	NA	0.00 - 0.00
	FR	0.01	0.02	0.00 - 0.05	na	0.01	0.00 - 0.03	na	0.02	0.00 - 0.05
	FRC	0.04	0.01	0.00 - 0.03	na	0.01	0.00 - 0.02	na	0.02	0.01 - 0.03
	MC	0.01	0.00	0.00 - 0.00	na	na	na - na	na	na	na - na
PM10 Ni µg/m3	ANR	0.01	0.02	0.01 - 0.03	na	0.00	0.00 - 0.00	na	na	0.00 - 0.00
	AR	0.02	0.01	0.00 - 0.03	na	0.01	0.00 - 0.01	na	0.00	0.00 - 0.01
	FNR	0.01	0.01	0.01 - 0.01	na	0.01	0.01 - 0.01	na	NA	0.00 - 0.00
	FR	0.01	0.01	0.00 - 0.02	na	0.01	0.00 - 0.03	na	0.00	0.00 - 0.01
	FRC	0.01	0.02	0.00 - 0.04	na	0.01	0.00 - 0.01	na	0.01	0.00 - 0.03
	MC	0.02	0.01	0.01 - 0.02	na	na	na - na	na	na	na - na
PM10 Pb µg/m3	ANR	0.02	0.02	0.00 - 0.05	na	0.00	0.00 - 0.01	na	na	0.00 - 0.00
	AR	0.00	0.00	0.00 - 0.01	na	0.01	0.00 - 0.02	na	0.02	0.00 - 0.06
	FNR	0.00	0.00	0.00 - 0.00	na	0.00	0.00 - 0.00	na	NA	0.00 - 0.00
	FR	0.00	0.00	0.00 - 0.01	na	0.01	0.00 - 0.02	na	0.00	0.00 - 0.02
	FRC	0.00	0.01	0.00 - 0.01	na	0.00	0.00 - 0.00	na	0.03	0.00 - 0.06
	MC	0.03	0.01	0.00 - 0.01	na	na	na - na	na	na	na - na
PM10 S µg/m3	ANR	2.26	1.72	1.63 - 1.80	na	1.62	1.51 - 1.73	na	na	0.00 - 0.00
	AR	3.62	2.63	1.63 - 3.45	na	2.77	1.68 - 4.05	na	3.73	1.59 - 5.24
	FNR	1.69	1.65	0.72 - 2.57	na	1.74	0.76 - 2.73	na	NA	0.00 - 0.00
	FR	1.56	1.33	0.88 - 1.53	na	1.09	0.71 - 1.35	na	1.68	1.29 - 2.19
	FRC	4.73	3.17	2.19 - 4.15	na	3.07	2.20 - 3.94	na	4.15	3.20 - 5.13
	MC	2.75	2.30	2.02 - 2.58	na	na	na - na	na	na	na - na

Notes: a Expected n values by Los Angeles commute scenario Type are: ANR(2), FNR(2), AR(4), FR(4), FRC(2), and MC(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-5D. Summary of PM2.5 Pollutant Commute-Average Concentration Data for Los Angeles

		Concentrations								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
PM 2.5 mass µg/m3	ANR	63.5	67.7	49.3 - 86.0	73.1	56.4	41.1 - 71.7	49.2	NA	0.0 - 0.0
	AR	48.0	41.0	28.5 - 53.1	64.0	32.9	22.6 - 45.1	38.6	52.9	10.3 - 102.8
	FNR	33.3	54.7	50.5 - 59.0	68.3	44.9	42.8 - 47.0	47.2	NA	0.0 - 0.0
	FR	32.1	45.4	36.1 - 56.0	53.7	32.1	22.7 - 38.9	42.1	44.7	35.3 - 76.0
	FRC	58.1	46.9	39.3 - 54.6	41.2	43.3	39.1 - 47.5	78.9	69.7	61.8 - 78.1
	MC	21.3	83.0	59.3 - 106.7	88.9	na	na - na	na	na	na - na
PM2.5 Cd µg/m3	ANR	0.01	0.06	0.01 - 0.11	0.00	0.01	0.00 - 0.02	0.06	NA	0.00 - 0.00
	AR	0.03	0.02	0.00 - 0.08	0.07	0.09	0.00 - 0.15	0.03	0.03	0.00 - 0.08
	FNR	0.09	0.01	0.00 - 0.02	0.04	0.05	0.00 - 0.10	0.08	NA	0.00 - 0.00
	FR	0.01	0.00	0.00 - 0.00	0.06	0.04	0.01 - 0.07	0.01	0.04	0.00 - 0.10
	FRC	0.09	0.01	0.00 - 0.02	0.07	0.07	0.07 - 0.08	0.00	0.03	0.00 - 0.09
	MC	0.05	0.00	0.00 - 0.00	0.00	na	na - na	na	na	na - na
PM2.5 Cr µg/m3	ANR	0.02	0.01	0.00 - 0.03	0.01	0.03	0.03 - 0.03	0.04	NA	0.00 - 0.00
	AR	0.00	0.02	0.01 - 0.04	0.00	0.00	0.00 - 0.00	0.02	0.01	0.00 - 0.04
	FNR	0.03	0.00	0.00 - 0.00	0.01	0.00	0.00 - 0.00	0.01	NA	0.00 - 0.00
	FR	0.02	0.01	0.00 - 0.03	0.01	0.00	0.00 - 0.02	0.00	0.02	0.00 - 0.05
	FRC	0.03	0.00	0.00 - 0.00	0.00	0.02	0.01 - 0.02	0.03	0.03	0.00 - 0.05
	MC	0.01	0.01	0.00 - 0.02	0.03	na	na - na	na	na	na - na
PM2.5 Mn µg/m3	ANR	0.00	0.01	0.00 - 0.01	0.02	0.03	0.02 - 0.04	0.00	NA	0.00 - 0.00
	AR	0.00	0.01	0.00 - 0.02	0.00	0.00	0.00 - 0.01	0.01	0.00	0.00 - 0.03
	FNR	0.03	0.00	0.00 - 0.00	0.00	0.00	0.00 - 0.01	0.00	NA	0.00 - 0.00
	FR	0.00	0.01	0.00 - 0.02	0.01	0.00	0.00 - 0.01	0.01	0.01	0.00 - 0.03
	FRC	0.00	0.01	0.00 - 0.03	0.00	0.00	0.00 - 0.00	0.00	0.00	0.00 - 0.01
	MC	0.01	0.00	0.00 - 0.01	0.00	na	na - na	na	na	0.00 - 0.00
PM2.5 Ni µg/m3	ANR	0.00	0.01	0.00 - 0.02	0.01	0.02	0.01 - 0.03	0.00	NA	0.00 - 0.00
	AR	0.01	0.00	0.00 - 0.02	0.00	0.00	0.00 - 0.01	0.01	0.01	0.00 - 0.03
	FNR	0.00	0.01	0.01 - 0.02	0.01	0.00	0.00 - 0.01	0.02	NA	0.00 - 0.00
	FR	0.01	0.00	0.00 - 0.01	0.00	0.00	0.00 - 0.01	0.01	0.00	0.00 - 0.01
	FRC	0.01	0.00	0.00 - 0.01	0.01	0.01	0.00 - 0.02	0.01	0.01	0.00 - 0.02
	MC	0.00	0.02	0.02 - 0.02	0.00	na	na - na	na	na	na - na
PM2.5 Pb µg/m3	ANR	0.02	0.03	0.00 - 0.06	0.04	0.02	0.02 - 0.03	0.01	NA	0.00 - 0.00
	AR	0.00	0.01	0.00 - 0.03	0.00	0.01	0.00 - 0.02	0.01	0.01	0.00 - 0.02
	FNR	0.02	0.01	0.00 - 0.01	0.04	0.01	0.00 - 0.02	0.03	NA	0.00 - 0.00
	FR	0.01	0.02	0.00 - 0.03	0.01	0.01	0.00 - 0.03	0.00	0.02	0.00 - 0.04
	FRC	0.01	0.02	0.01 - 0.02	0.01	0.01	0.00 - 0.03	0.02	0.02	0.00 - 0.06
	MC	0.00	0.00	0.00 - 0.00	0.00	na	na - na	na	na	na - na
PM2.5 S µg/m3	ANR	1.97	1.73	1.69 - 1.77	1.76	1.62	1.47 - 1.77	1.50	NA	0.00 - 0.00
	AR	3.09	2.44	1.68 - 2.98	3.02	2.27	1.49 - 2.60	2.37	3.20	1.38 - 4.30
	FNR	1.71	1.60	0.74 - 2.47	1.79	1.34	0.80 - 1.89	1.82	NA	0.00 - 0.00
	FR	1.34	1.33	0.97 - 1.54	1.41	1.18	0.73 - 1.49	1.24	1.49	0.99 - 1.85
	FRC	4.08	3.08	2.22 - 3.94	2.33	2.82	2.03 - 3.62	3.23	3.62	2.55 - 4.65
	MC	2.06	2.10	2.03 - 2.17	2.29	na	na - na	na	na	na - na

Notes: a Expected n values by Los Angeles commute scenario Type are: ANR(2), FNR(2), AR(4), FR(4), FRC(2), and MC(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-5E. Summary of Commute-Average Associated Data for Los Angeles

		Other Measures								
Measure	Type	AMB Mean	IN 1 Mean	IN 1 Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
Vehicle Speed (mph)	ANR	na	29.1	11.0 - 47.1	na	na	na - na	na	na	na - na
	AR	na	21.5	18.1 - 25.1	na	na	na - na	na	na	na - na
	FNR	na	47.6	37.0 - 58.2	na	na	na - na	na	na	na - na
	FR	na	42.1	37.4 - 46.7	na	na	na - na	na	na	na - na
	FRC	na	48.5	47.9 - 49.2	na	na	na - na	na	na	na - na
	MC	na	20.4	19.3 - 21.6	na	na	na - na	na	na	na - na
Spacing Range (feet)	ANR	na	55.5	54.2 - 56.7	na	na	na - na	na	na	na - na
	AR	na	55.2	49.2 - 67.3	na	na	na - na	na	na	na - na
	FNR	na	45.7	18.9 - 72.6	na	na	na - na	na	na	na - na
	FR	na	50.4	5.2 - 66.4	na	na	na - na	na	na	na - na
	FRC	na	88.1	87.1 - 89.0	na	na	na - na	na	na	na - na
	MC	na	67.8	64.4 - 71.2	na	na	na - na	na	na	na - na
Level of Congestion (unitless)	ANR	na	1.5	1.0 - 2.1	na	na	na - na	na	na	na - na
	AR	na	2.7	2.4 - 3.0	na	na	na - na	na	na	na - na
	FNR	na	3.6	3.0 - 4.3	na	na	na - na	na	na	na - na
	FR	na	3.3	2.9 - 3.7	na	na	na - na	na	na	na - na
	FRC	na	2.8	2.8 - 2.8	na	na	na - na	na	na	na - na
	MC	na	3.2	2.9 - 3.5	na	na	na - na	na	na	na - na
Miles Traveled	ANR	na	58.1	22.0 - 94.2	na	na	na - na	na	na	na - na
	AR	na	43.0	36.1 - 50.2	na	na	na - na	na	na	na - na
	FNR	na	95.2	74.1 - 116.4	na	na	na - na	na	na	na - na
	FR	na	84.2	74.8 - 93.4	na	na	na - na	na	na	na - na
	FRC	na	97.1	95.9 - 98.3	na	na	na - na	na	na	na - na
	MC	na	40.9	38.6 - 43.1	na	na	na - na	na	na	na - na
Heavy Duty Diesel Bus Influence (% of commute	ANR	na	6%	5% - 8%	na	na	na - na	na	na	na - na
	AR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	FNR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	FR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	FRC	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	MC	na	15%	0% - 30%	na	na	na - na	na	na	na - na
Heavy Duty Diesel Truck Influence (% of commute	ANR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	AR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	FNR	na	45%	0% - 91%	na	na	na - na	na	na	na - na
	FR	na	77%	71% - 87%	na	na	na - na	na	na	na - na
	FRC	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	MC	na	7%	0% - 14%	na	na	na - na	na	na	na - na
Diesel Influence (other types) (% of commute	ANR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	AR	na	1%	0% - 2%	na	na	na - na	na	na	na - na
	FNR	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	FR	na	5%	0% - 20%	na	na	na - na	na	na	na - na
	FRC	na	0%	0% - 0%	na	na	na - na	na	na	na - na
	MC	na	5%	0% - 10%	na	na	na - na	na	na	na - na

Notes: a Expected n values by Los Angeles commute scenario Type are: ANR(2), FNR(2), AR(4), FR(4), FRC(2), and MC(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 3-5F. Summary of Commute-Average Meteorological Data for Los Angeles (Ambient Site Only)

Measure	Type	AMB Mean	IN 1 Mean	AMB Range	OUT 1 Mean	IN 2 Mean	IN 2 Range	OUT 2 Mean	ROAD Mean	ROAD Range
Windspeed (mph)	ANR	5.5	na	2 - 9	na	na	na - na	na	na	na - na
	AR	5.6	na	3 - 9	na	na	na - na	na	na	na - na
	FNR	6.5	na	4 - 9	na	na	na - na	na	na	na - na
	FR	4.8	na	3 - 8	na	na	na - na	na	na	na - na
	FRC	5.3	na	3 - 8	na	na	na - na	na	na	na - na
	MC	6.5	na	4 - 10	na	na	na - na	na	na	na - na
Temp (deg. F)	ANR	86.8	na	87.0 - 87.0	na	na	na - na	na	na	na - na
	AR	71.9	na	72.0 - 72.0	na	na	na - na	na	na	na - na
	FNR	82.8	na	82.0 - 84.0	na	na	na - na	na	na	na - na
	FR	75.4	na	75.0 - 76.0	na	na	na - na	na	na	na - na
	FRC	73.8	na	74.0 - 74.0	na	na	na - na	na	na	na - na
	MC	73.3	na	73.0 - 74.0	na	na	na - na	na	na	na - na
Relative Humidity, %	ANR	36.8	na	31.0 - 42.5	na	na	na - na	na	na	na - na
	AR	54.6	na	53.0 - 56.5	na	na	na - na	na	na	na - na
	FNR	45.3	na	36.0 - 54.5	na	na	na - na	na	na	na - na
	FR	50.9	na	46.0 - 55.0	na	na	na - na	na	na	na - na
	FRC	54.0	na	53.5 - 54.5	na	na	na - na	na	na	na - na
	MC	51.0	na	47.5 - 54.5	na	na	na - na	na	na	na - na
Predominant Wind Direction (degrees)	ANR	225	na	na - na	na	na	na - na	na	na	na - na
	AR	none	na	na - na	na	na	na - na	na	na	na - na
	FNR	314	na	na - na	na	na	na - na	na	na	na - na
	FR	none	na	na - na	na	na	na - na	na	na	na - na
	FRC	252	na	na - na	na	na	na - na	na	na	na - na
	MC	none	na	na - na	na	na	na - na	na	na	na - na

Notes: a Expected n values by Los Angeles commute scenario Type are: ANR(2), FNR(2), AR(4), FR(4), FRC(2), and MC(2); exceptions to the n values in parentheses.

b Means and ranges computed from uncensored data

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

3.3.2 Pollutant Concentrations

A number of pollutants in several categories were quantified in this study. A suite of VOC's associated with vehicular emissions was identified by GC/MS analysis, as well as a suite of elements from integrated particle samples analyzed by X-Ray Fluorescence. Formaldehyde was quantified as the representative aldehyde. Additional measures included gravimetric mass concentrations for integrated $PM_{2.5}$ and PM_{10} samples, and integrated 2 hour averages from continuous CO, black carbon, and particle count by size.

In order to provide a summary description of the pollutant levels, not all of the pollutants will be discussed in detail on an individual basis. To simplify and focus the discussions of pollutants summaries, this report addresses primarily "target" pollutants selected to represent pollutant classes, specifically, MTBE for the VOC's, $PM_{2.5}$ and PM_{10} integrated mass, $PM_{2.5}$ and PM_{10} elemental sulfur, formaldehyde, CO, black carbon, and particle count by size (total <2.5 µm). In general, several observations apply to almost all pollutants:

- most pollutant levels were elevated inside and outside the vehicles, relative to either the roadside or ambient concentrations (see section 4.4.4),
- most pollutant levels were extremely low at the rural site, relative to any of the vehicular or roadway locations (see section 4.3.1),
- most pollutant levels were at least somewhat higher in Los Angeles than in Sacramento, undoubtedly due in part to the larger base of vehicular emissions (see Tables 3-4A-F and-5A-F),
- while insignificant differences were observed for gas phase pollutants inside and outside of the same vehicle, particle concentrations were typically significantly higher outside - attributed to losses in the vehicle ventilation systems (see section 4.4.3), overlaid on inherent mass losses (estimated as ~20%) for the outside samples drawn through the inlet line,
- the inside vehicle pollutant concentrations for some individual commutes were substantially influenced by the tailpipe exhaust emissions from single polluting lead vehicles (see section 4.4.1), and
- the difficulty in following a selected "target" vehicle was least likely to occur for an extended period during freeway rush commutes, suggesting that these commutes produced scenarios and concentration levels that were the most representative (see section 2.2.3).

The ranges of in-vehicle concentrations (not background-corrected) for target pollutants are summarized as follows:

VOC's (tables 3-4A & 3-5A)

The in-vehicle concentrations of isobutylene, 1,3-butadiene, DCM, MTBE, benzene, toluene, ethylbenzene, m,p-xylene, and o-xylene were all significantly higher in Los Angeles than in Sacramento. The generally higher ambient concentrations of VOC's in Los Angeles must be considered to place the microenvironmental contributions into perspective (see section 3.3.3). Both TCFM and ETBE levels were too near (or below) the MQL for adequate quantification. Acetonitrile concentrations showed no consistent patterns and may have been confounded by unknown sources inside one or more of the vehicles. While the field and lab blank data ruled Theout any possible laboratory contamination, cross-contamination between the exhausts of the acetonile-prepared DNPH cartridges and the VOC canister inlets may have periodically occurred.

In general, the in-vehicle levels for VOC's were very similar between Vehicle 1 and Vehicle 2.

The target fuel additive MTBE ranged from ~6 to 36 µg/m³ in Sacramento (excluding the rural commute), while the comparable in-vehicle range in Los Angeles was from ~24 to 90 µg/m³. Since most of the other quantified VOC's have sources outside the vehicular microenvironment, MTBE is perhaps the most robust VOC "tracer" for exhaust emissions and fuel losses.

Other in-vehicle VOC concentration ranges were:

- Isobutylene range from 3 to 14 µg/m3 in SAC, and 12 to 25 µg/m3 in LA,
- 1,3-Butadyiene range from 1 to 4 µg/m3 in SAC, and 2 to 6 µg/m3 in LA,
- Acetonitrile range from 18 to 345 µg/m3 in SAC, and 6 to 375 □µg/m3 in LA,
- TCFM was <MQL in SAC, and in LA,
- DCM range from 1 to 4 µµg/m3 in SAC, and 1 to 5 µg/m3 in LA,
- ETBE range from 0 to <1 µg/m3 in SAC, and 0 to <1 µg/m3 in LA,
- Benzene range from 3 to 15 µg/m3 in SAC, and 10 to 22 µg/m3 in LA,
- Toluene range from 7 to 46 µg/m3 in SAC, and 22 to 54 µg/m3 in LA,
- Ethylbenzene range from 2 to 10 µg/m3 in SAC, and 5 to 12 µg/m3 in LA,
- m,p-Xylene range from 5 to 38 µg/m3 in SAC, and 18 to 45 µg/m3 in LA,
- o-xylene range from 2 to 13 µg/m3 in SAC, and 6 to 16 µg/m3 in LA.

Formaldehyde (tables 3-4A & 3-5A)

Formaldehyde was also dramatically higher inside Los Angeles vehicles than those in Sacramento. Sacramento levels ranged from ~5 to 14 µg/m³ , while the range in LA was ~14 to 22 µg/m³ . Similar to the VOC's, however, the ambient background levels provided a large portion of this difference.

Carbon Monoxide (CO) (tables 3-4B & 3-5B)

The MQL of the study CO monitor (2 ppm) produced no measurable results at the ambient sites, but showed much higher levels inside the vehicles. The CO concentrations ranged from less than 1 to 2.6 ppm in Sacramento, and from 3 to 6 ppm in Los Angeles.

Black Carbon (tables 3-4B & 3-5B)

Black (soot) carbon is produced primarily from incomplete fuel combustion (most notably from diesel engines). The black carbon particles are typically <0.5 µm in size, and may contribute significantly to particle count, but minimally to particle mass (e.g. $PM_{2.5}$) unless a strong source is nearby. The continuous measures for black carbon and particle count by size were made inside and outside Vehicle 1 only, such that no comparison could be made with other locations, especially the ambient background. Black carbon concentrations ranged from zero to ~10 µg/m³ in Sacramento, and from ~3 to 23 µg/m³ in LA. This measure appeared to be strongly influenced by the presence of the diesel "target" vehicles.

Particle Count (by size) (tables 3-4B & 3-5B)

The total particle count (between 0.15 and 2.5 μm) is strongly influenced by vehicular emissions, but is also dependent on other sources, including the level of photochemistry. Thus, the background (not measured) particle count levels in Los Angeles would be expected to be significantly higher than Sacramento, based on only the generally higher level of photochemical activity. The total particle counts/cm^3 (multiply by 60 to obtain total particles counted/minute) ranged from ~20 to 1,200 in Sacramento (excluding rural), while those in LA ranged from ~ 2,200 to 4,600. Although estimates of integrated particle mass can be made (see Pilot Study report in Appendix A) by computing particle volumes and applying composite densities, it was decided for this report that the number and validity of the assumptions required for these computations did not merit going beyond count for the Main Study.

$PM_{2.5}$ and PM_{10} Mass (tables 3-4C, 3-4D & 3-5C, 3-5D)

Particle concentrations inside vehicles were substantially lower in Sacramento compared to Los Angeles. The $PM_{2.5}$ mass in-vehicle concentrations ranged from ~4 to 22 μg/m³ in Sacramento, and ~29 to 107 μg/m³ in LA. Similarly, the PM_{10} mass concentrations ranged from ~14 to 39 μg/m³ in Sacramento, compared to ~46 to 105 μg/m³ in LA. Comparisons between inside and outside concentration levels for $PM_{2.5}$ should consider the approximate 20% line loss during sampling for the OUT samples. This is discussed subsequently in sections 4.4.3 and 4.4.4. No outside samples were collected for PM_{10}. The substantial contributions of localized, nearby source (e.g. turbulent resuspension, construction activities, etc.) to PM_{10} concentrations severely reduces the validity of subtracting the Ambient site measure as a representative "background". Ambient $PM_{2.5}$ concentrations are expected to be much more uniformly distributed.

$PM_{2.5}$ and PM_{10} Elements (tables 3-4C, 3-4D & 3-5C, 3-5D)

The limited total mass collections at 4 lpm for 2 hours, greatly reduced the ability of XRF to provide concentration >MDL for many elements. Of the "target" elements, only elemental sulfur showed measurable concentrations for almost all commutes. These data provide an upper limit for particle elements, based on the MDL's provided in tables 3-3B and 3-3D. The ranges of $PM_{2.5}$ elemental sulfur were ~0.1 to 0.9 in Sacramento, and ~0.7 to 3.0 in Los Angeles. PM_{10} sulfur levels were nearly identical to $PM_{2.5}$, suggesting that almost all of the sulfur was <2.5 μm. Since most ambient elemental sulfur is reported to be sulfate, the elemental sulfur concentrations can be multiplied by 3 to approximate the SO_4 concentrations. For the non-target elements (see Appendix I), only Fe, K, Na, Si, Cu, and P were routinely elevated above the MQL for $PM_{2.5}$ for Sacramento or LA. Similarly, Na, Mg, Al, Si, P, K, Ca, Fe, Cu, and Zn were frequently elevated above the MQL for PM_{10}.

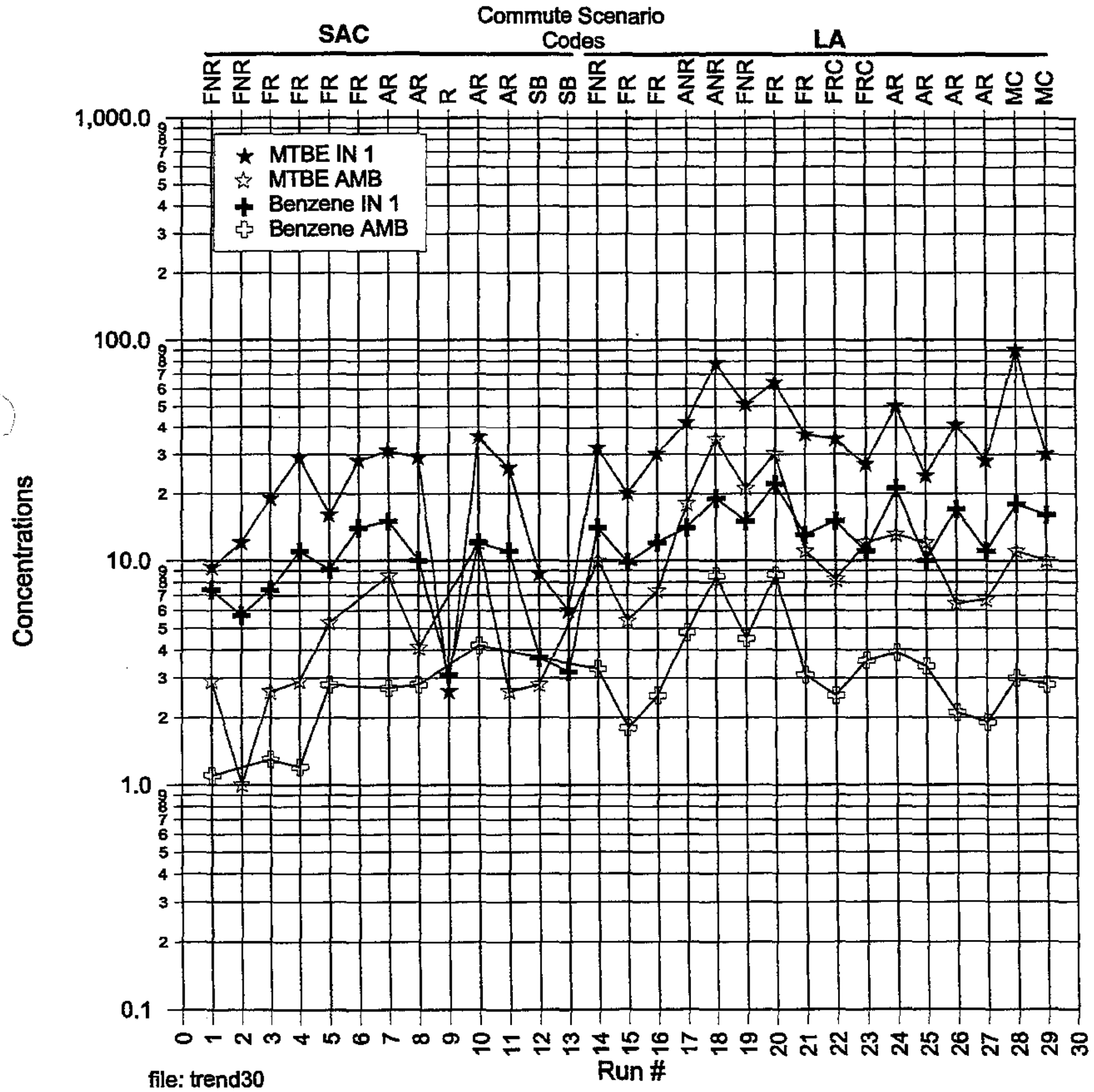
3.3.3 Ambient Background Influence

A review of the pollutant data for this study indicated that the ambient background concentrations in both Sacramento and Los Angeles were very important contributors to the observed concentrations measured inside and immediately outside the vehicles, and at the roadside locations. Evaluation of the influences of specific commuting factors (e.g. roadway type, time of day), suggests that the "background" be subtracted from the microenvironmental concentration - i.e. these factors were expected to influence the commuting microenvironment, not the background. The research objectives for this study, however, did not require that the representativeness of the ambient site data of the true background for each pollutant be established. While it is recognized that the ambient data are not necessarily unbiased estimates of the true background during every commute, they represent the most reasonable data available. While gaseous pollutants and fine particles (e.g. $PM_{2.5}$) are generally assumed to be relatively uniform across a modest distance in a metropolitan area, PM_{10} could be expected to be much less uniform. Estimating the representativeness of the ambient data for PM_{10} , however, is beyond the scope of this effort.

The simplest way to assess the contribution of the commuting microenvironment was to subtract the ambient site data (if available) from the observed concentrations for each measure to estimate the vehicular contributions. An example of this data review is shown in Figure 3-1 plotting the trend data for all commutes for MTBE and benzene inside Vehicle 1 (IN 1) along with their ambient (AMB) concentrations. These plots tended to show that the in-vehicle number were typically higher than the ambient and correlated. Further analysis for selected pollutants (see Figure 3-2) showed that scatter plotting AMB (X) against the IN 1 values (Y) confirmed the increase in concentrations above background for most pollutants. It was noted (and discussed subsequently in Section 4.4.3) that the inside particle concentrations in all vehicles (IN1 or IN2, except in the school bus with the windows open) were substantially less than the associated outside concentrations (OUT1, OUT2), apparently resulting from particle losses while penetrating the vehicle ventilation system. Plotting AMB versus outside for Vehicle 1 (OUT 1) in Figure 3-3 represents the microenvironmental concentration immediately outside the vehicle, but is also biased from the estimated 19 to 21 % loss in the sampling line. Note also that the roadside $PM_{2.5}$ (ROAD 1) values plotted on this graph show higher concentrations than the ambient. A review of all the pollutant data with significant ambient concentration (CO background levels were below the MQL), showed that the ambient levels represented a significant and relatively consistent portion of the vehicular measurements. This suggested that it was important to estimate the incremental contribution of the commuting microenvironment to the existing background levels. It was also apparent that several other factors influence the in-vehicle concentrations, even after compensating for the ambient background. Figure 3-4 plots the daily MTBE and benzene levels, corrected for ambient (IN 1 - AMB) along with the ambient windspeed. Note that excluding the MTBE data point representing the special study school bus (SB) day, the vehicular contributions in Sacramento and Los Angeles are relative consistent, with Los Angeles being similarly consistent, but slightly higher. More importantly, as the wind speed decreased in Los Angeles, the vehicular contribution consistently increased (as might be expected).

An ambient site is located to represent the concentrations for a defined spatial area of the population. It is normally located to be generally unaffected by nearby single sources. If the ambient site were to serve as a measure of the "background" component, it should have a relatively consistent meteorology to stabilize transport processes. A review of the wind direction data for Sacramento and Los Angeles for each commute (see Figure 3-5) indicated that a predominant direction existed for the majority of the sampling periods in each city. In Los Angeles it was observed that the PM wind speeds were consistently higher than those in the AM, potentially affecting the rate of source plume dilutions.

Figure 3-1. ARB Main Study Raw MTBE and Benzene Data Comparing Trends for IN 1 and AMB



file: trend30

Figure 3-2. ARB Main Study Vehicle Study Ambient Concentration versus Inside Vehicle 1 Concentration for MTBE and Benzene for Sacramento and Los Angeles

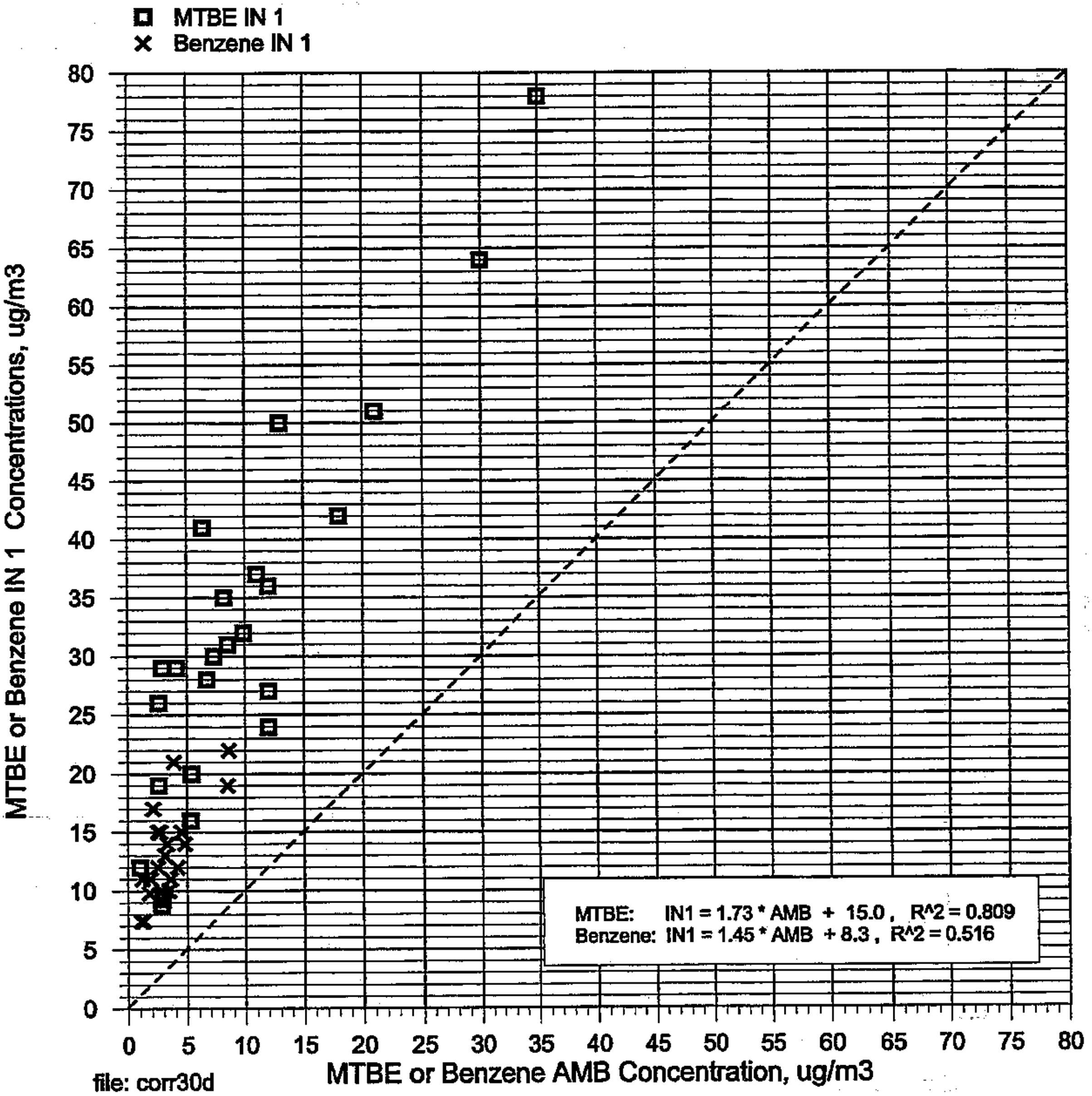
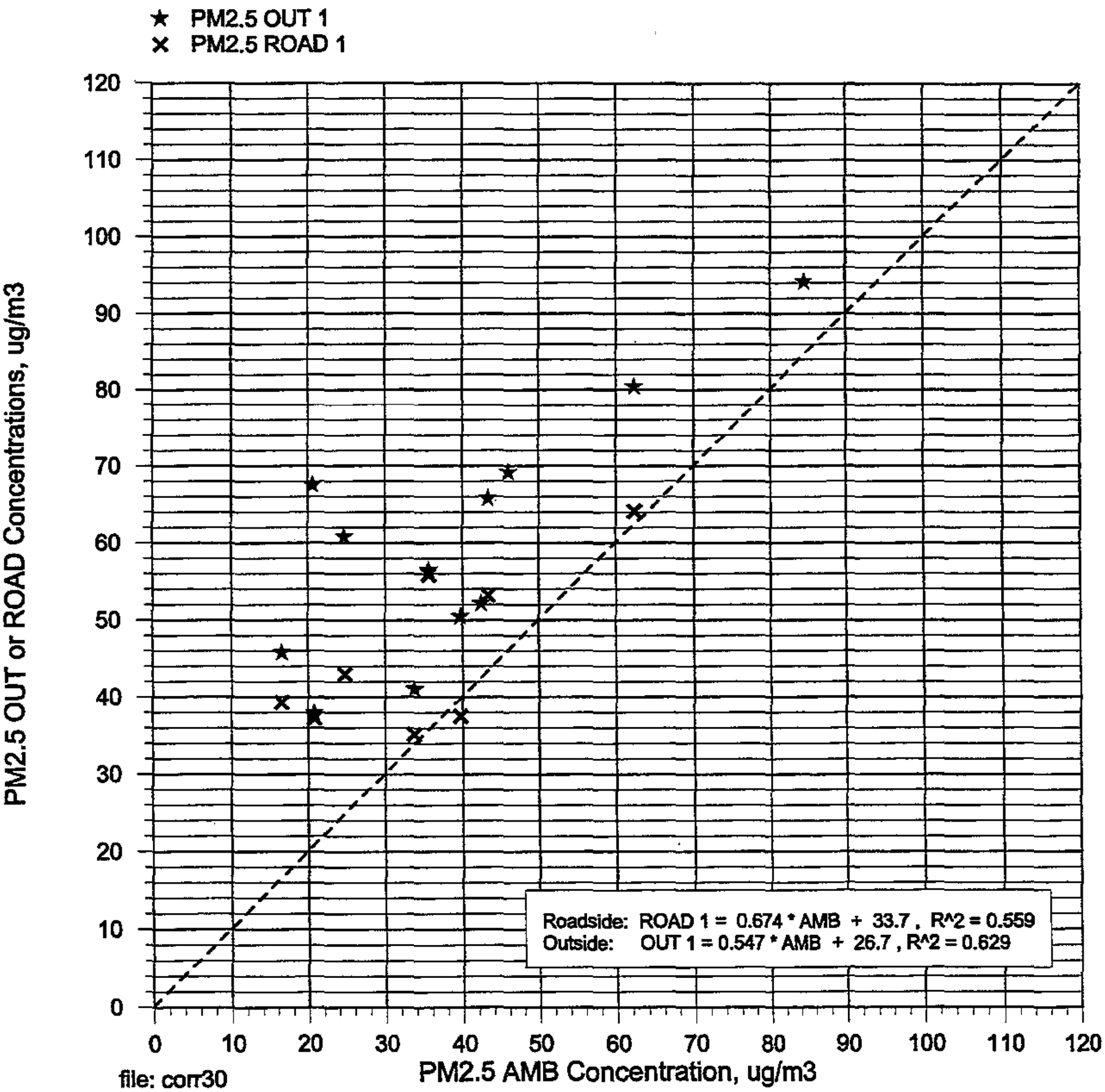
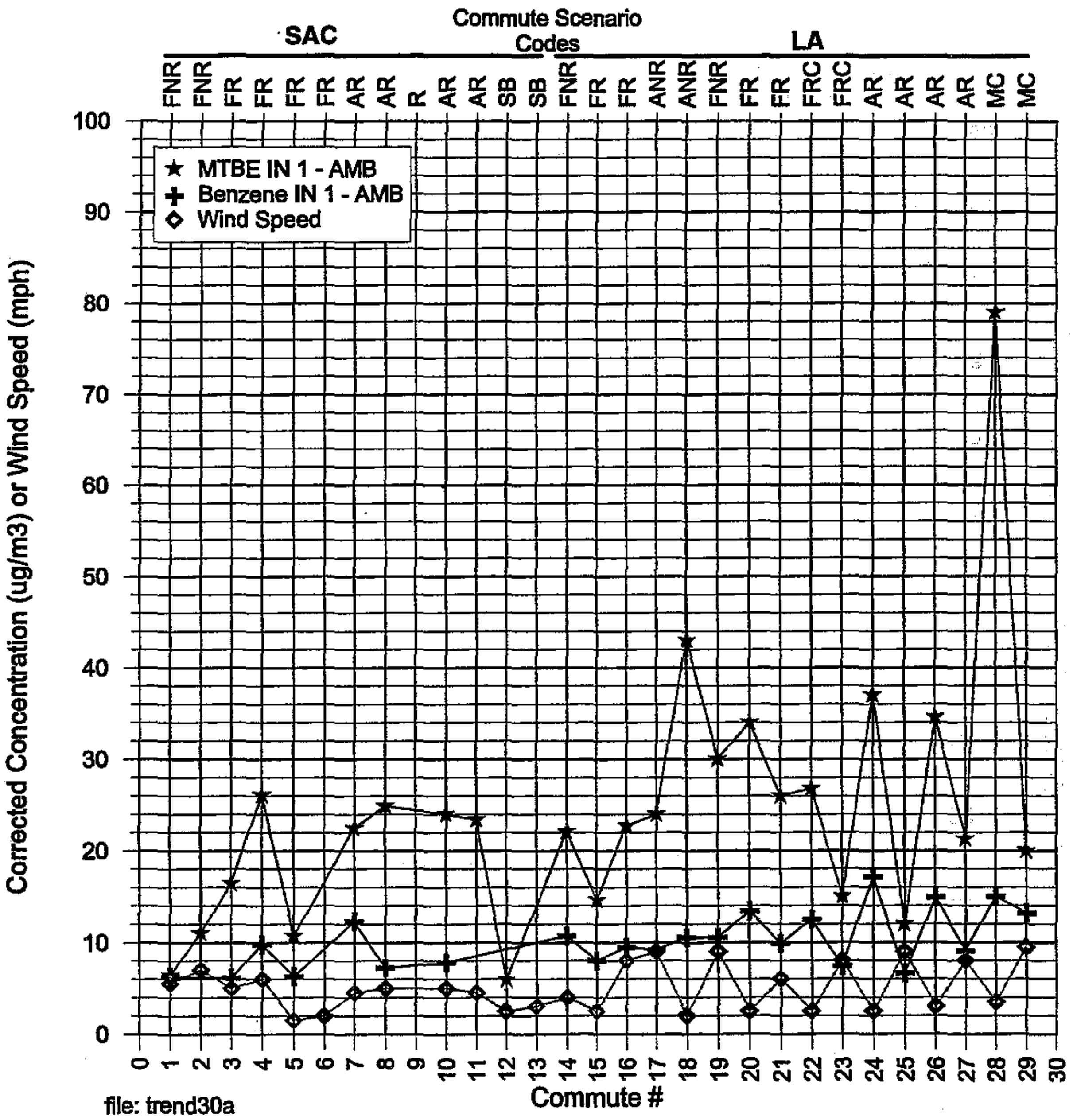


Figure 3-3. ARB Main Study Vehicle Study Ambient PM2.5 Mass Concentration versus Outside Vehicle 1 and Roadside 1 Mass Concentrations in Los Angeles



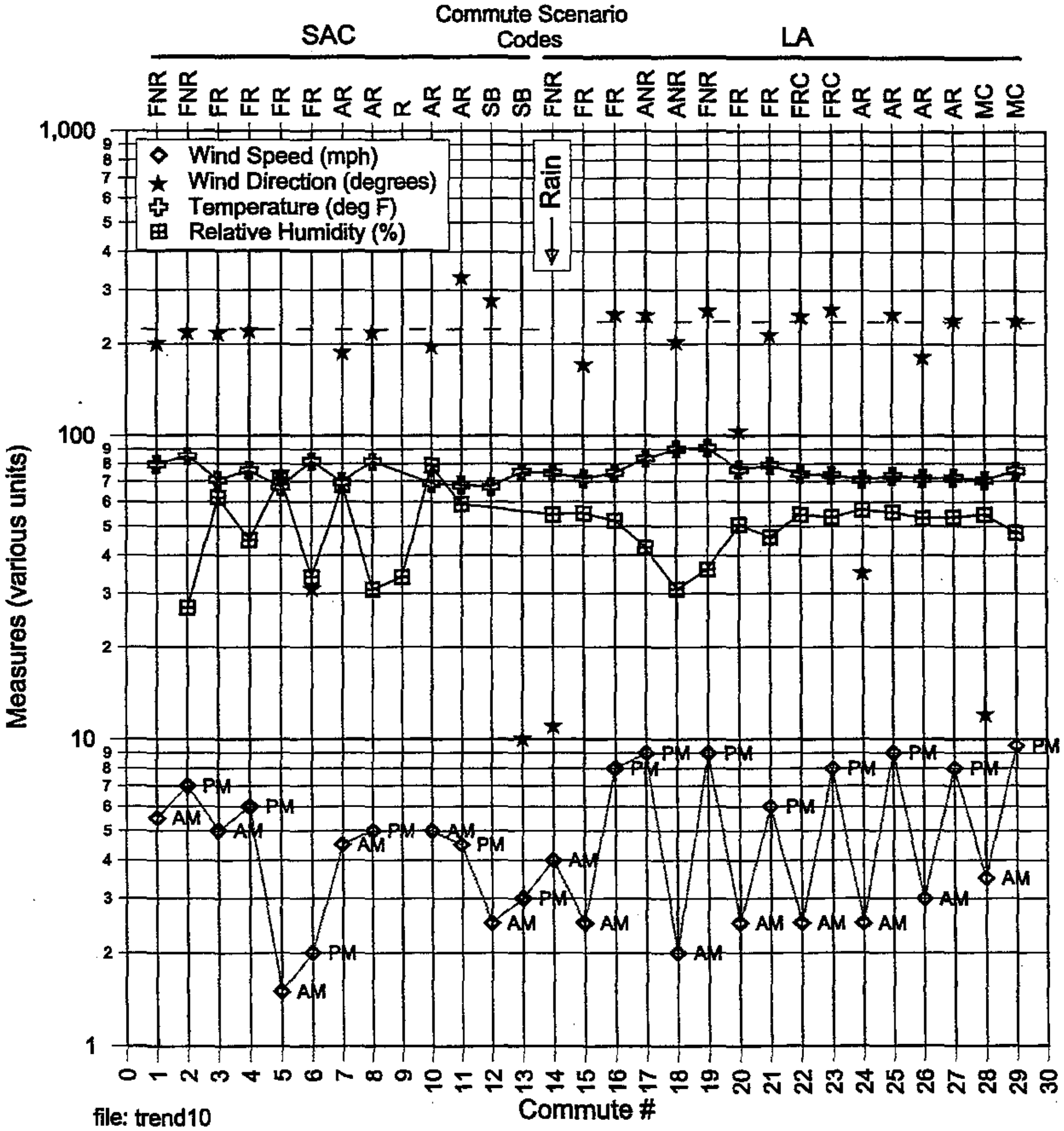
file: corr30

Figure 3-4. ARB Main Study Ambient-Corrected MTBE and Benzene Data



file: trend30a

Figure 3-5. ARB Main Study Raw Meteorology Wind Speed, Wind Direction, Temperature, and Relative Humidity



file: trend10

The subsequent data analyses in Section 4 typically focus on the ambient-corrected concentrations that could be associated with the increment contributed by the vehicular microenvironment. The ambient concentrations are provided in each instance, however, in order to assess the contribution above background.

3.3.4 Vehicular Measures

Vehicular summaries for mean speed, vehicle spacing (mean trailing distance of Vehicle 1 to the vehicles immediately ahead), miles traveled, fraction of time Vehicle 1 was directly behind an identified diesel vehicle, and Level of Congestion [a subjective scale from 1 (very light traffic density) to 6 (heavy density approaching a standstill)] are given in Table 3-4E for Sacramento and Table 3-5E for Los Angeles.

A general comparison can be made between Sacramento and Los Angeles for the AR and FR categories as shown in Table 3-6. While the mean speed for AR is approximately the same in Sacramento and Los Angeles, the FR commutes in LA were significantly faster by 10 mph. This resulted in a larger number of miles traveled in LA (16 miles/ FR commute). The trailing distances in LA are significantly closer than in Sacramento, at approximately 20 feet closer for both AR and FR commutes. The Level of Congestion was essentially the same in Sacramento and LA for AR and FR, but the percentages of the time Vehicle 1 was trailing a diesel "target" vehicle were highly variable. Since a "smoking" diesel vehicle can significantly influence selected pollutant concentrations, even during short trailing events, the percentages of time under (subjective) diesel influence by type should be considered. It should be noted that some degree of uncertainty exists in these categorizations, even though the observers were experienced in characterizing vehicular traffic. This uncertainty arises from occasional difficulty in determining the fuel source for some vehicles, especially the light duty trucks counted in the "Other Diesel Influence" category.

Table 3-6. Comparison of Vehicular Measures for Selected Sacramento and Los Angeles Commutes

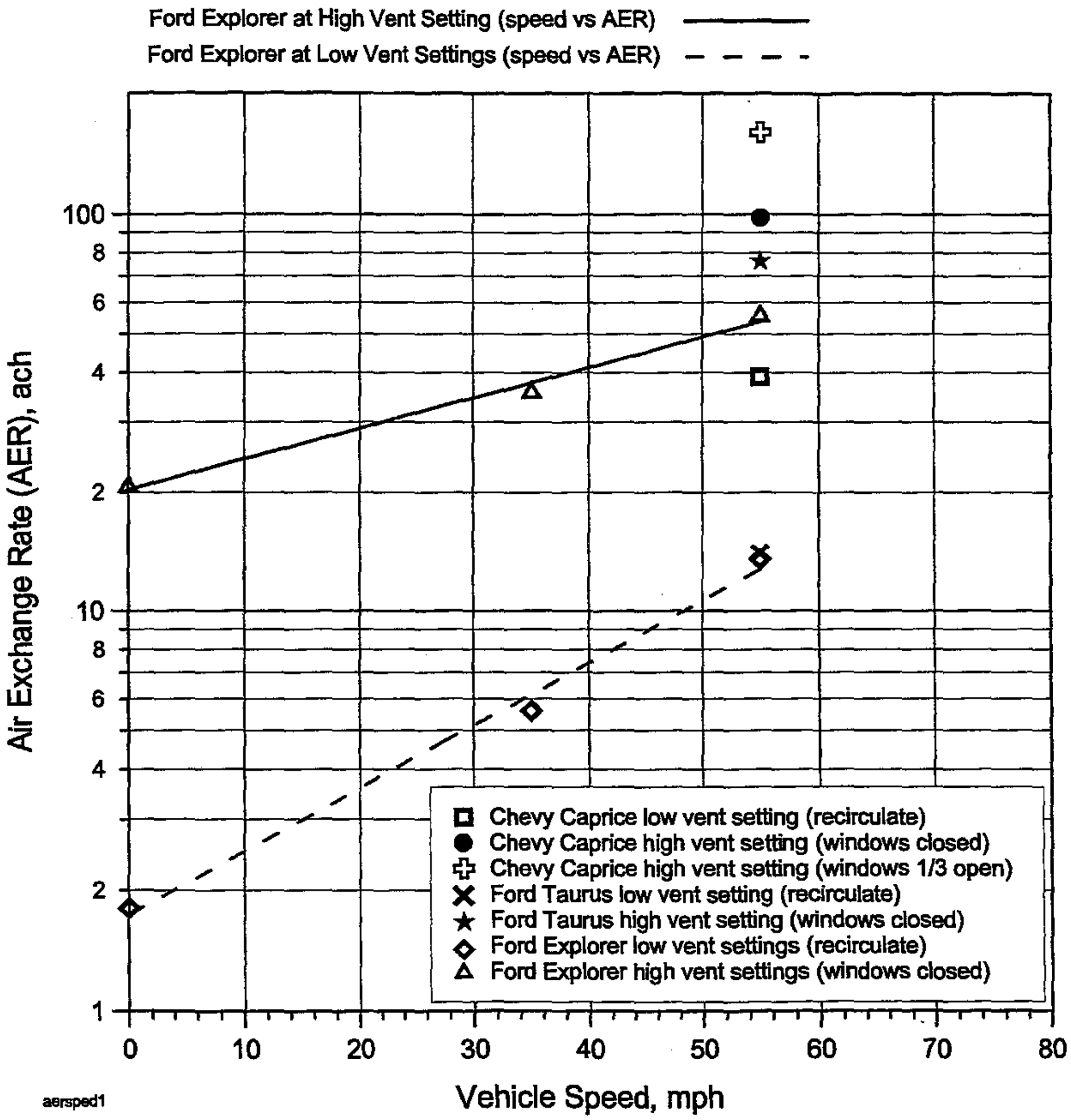
	Sacramento		Los Angeles	
Measure	AR	FR	AR	FR
Vehicle Speed, mph	23.8	32.5	21.5	42.1
Spacing, feet	74.4	68.9	55.2	50.4
Level of Congestion, unitless	2.5	3.9	2.7	3.3
Miles traveled	49.1	68.3	43.0	84.2
Diesel Bus Influence, %	4 %	22 %	0%	0%
Heavy Duty Diesel Truck Influence, %	0 %	47 %	0%	77%
Other Diesel Influence, %	0 %	7 %	1%	5%

3.3.5 Vehicle Air Exchange Rates

The air exchange rates were determined at constant vehicle speed (55 mph) for all vehicles, since it was expected that (a) the vent settings would significantly affect the AER, (b) low AER's could have an "insulating" effect on relatively short-term (e.g. following a bus) pollutant concentration excursions. The tabulated air exchange data are given in Table 3-7 for each vehicle and ventilation setting. The Chevrolet Caprice and Ford Taurus AER's were determined at a constant speed of 55 mph. The Ford Explorer AER's were determined for a range of speeds (0, 35 and 55 mph) to illustrate the influence of vehicle speed on AER. The data are also plotted in Figure 3-6 , and indicate that vehicle speed versus AER is reasonably semi-logarithmic (based on very limited data). The low vent setting in the Explorer provided AER's that changed by almost an order of magnitude from 0 to 55 mph.

Table 3-7. Air Exchange Rate Data Summary for All Vehicles by Vent Setting and (Constant) Speed									
	Low vent Setting			Medium vent Setting			High vent Setting		
Vehicle	0 mph	35 mph	55 mph	0 mph	35 mph	55 mph	0 mph	35 mph	55 mph
1991 Chevrolet Caprice	nd	nd	39	nd	nd	98	nd	nd	160
1997 Ford Taurus	nd	nd	14	nd	nd	76	nd	nd	nd
1997 Ford Explorer	1.8	5.6	13.5	20.7	35.7	55.5	nd	nd	nd
Note:	These air exchange rate were determined for constant speed commutes to indicate the relative influence of vent settings.								

Figure 3-6. ARB In-Vehicle Study
Constant Speed Air Exchange Rates
by Vehicle Type, Vent Setting, and Speed



aersped1

4.0 DISCUSSION

The analysis of the data for this project is necessarily limited to the evaluating research study objectives. The obvious wealth of information contained in the data base, however, suggests that further data analyses by ARB beyond those presented here could be very fruitful. Only a few of the pollutant measures summarized (especially VOC's other than MTBE) are discussed in any detail, relative to the research objectives. While data are summarized for Vehicle 2 in each instance, the data for this second vehicle were reviewed in detail only to address the differences between vehicles in section 4.2.2.

4.1 Focus Pollutants

In order to discuss trends and data analyses in a simplified but focused manner for the evaluation of study design objectives, only a few selected pollutant measures representing general classes are addressed. Specifically, MTBE (and occasionally benzene) data were analyzed as a target VOC, $PM_{2.5}$ for particle mass, formaldehyde, CO, and occasionally, total particle count and $PM_{2.5}$ sulfur. Individual tables summarizing all commutes for $PM_{2.5}$ and PM_{10} mass, MTBE, formaldehyde, and carbon monoxide are provided in Appendix J. The special study commutes (Section 4.3) and selected data analyses (Section 4.4) address additional measures. The single source of the fuel additive, MTBE, provided the most consistent gas-phase pollutant relationships compared to all other pollutants. Almost every other pollutant is known to have multiple sources.

4.2 Evaluation of Study Design Objectives

The workplan for this project defined specific design objectives to guide the study design and the collection of data. These objectives (Table 1-2) were developed, based on the premise that commuter exposure (to concentrations over a time interval) were potentially influenced by a number of key factors. The factors considered are the influences of:

(A) the type of California vehicle being driven,
(B) the influence of driver-selected ventilation choices (window-up situations),
(C) the type of roadway,
(D) the differences between two California metro areas,
(E) the level of congestion on the roadways, and
(F) the general time of day period when the commute occurred.

The overall study design attempted to apply a balanced factorial scheme to allow relatively simple comparisons between the concentration means of various scenarios. The evaluation of these influences on in-vehicle concentration levels are addressed by appropriate organization of the means and data ranges. In most cases, the corrections have been made for the ambient "background" levels (if appropriate), prior to computing means. The ambient levels are provided in these tables to provide an indication of the magnitude of the background contributions. The special nature of the Rural (R), School Bus (SB), Freeway Rush Carpool (FRC), and Maximum Concentration (MC) commutes, suggested that these concentrations not be included in the computations assessing the study design objectives in Section 4.2. The special study commutes are addressed separately in section 4.3.

The driving protocols defined in Section 2.3 have a substantial influence on the data analyses. Some of the key points in these protocols are: (1) trailing single polluting "target" vehicles, even for relatively short periods, may have significantly influenced the 2 hour commute averages for selected pollutants, (2) combining "significantly" influenced commutes into a single scenario composite with a relatively small sample size, may have provided a somewhat misleading picture for certain pollutants, (3) the tandem nature of the commutes, with Vehicle 2 almost always trailing Vehicle 1, sometimes exposed Vehicle 2 to higher concentrations for some pollutants, and (4) the limited number of vehicle types and ventilation settings evaluated. The factors of small sample sizes for each scenario (freeway rush, arterial rush, etc.) and the potential for single vehicle influences in a given commute, combine to suggest that these data analyses are not to be considered as necessarily definitive, but generally indicative of the ranges of concentrations that could be encountered in similar commutes.

4.2.1 Ventilation Setting Influence (High vs Low)

Tables 4-1 (A thru D) summarize the concentration data for non-special commutes for all measures focusing on the influence of "low" and "high" ventilation setting on the in-vehicle concentration levels. Mean values for IN 1, IN 2, OUT 1, and OUT 2 were computed for Sacramento (alone), Los Angeles (alone), and both cities, stratified by the "Low" or "High" ventilation setting for the commute (see Table 1-1 for vent settings). The ventilation settings for Vehicle 1 were identical in both cities. These means are uncorrected for ambient background. In order to estimate the penetration of each pollutant into the vehicles, the differences between the inside and outside values were computed for each vehicle and given in the last two columns to give (IN 1 - OUT 1) and (IN 2 - OUT 2). Note that these differences are the same whether or not the ambient background is subtracted. Vehicle 1 is the 1991 Chevrolet Caprice (sedan) in both cities. Vehicle 2 is a 1997 Ford Taurus (sedan) in Sacramento, and a 1997 Ford Explorer (SUV) in Los Angeles. Thus, the (IN 1 - OUT 1) column would be expected to be the same between cities for all measurement. The (IN 2 - OUT 2) column, however, could be different between cities. Since formaldehyde was not measured outside the vehicles, the influence of vent setting did not apply. The presumption is that the sources of the pollutants being addressed are external to the vehicles. Interior sources would confound such an analysis.

A review of the tabular data indicated relatively small differences for IN - OUT (relative to IN1) for both vehicles, for all of the VOC's except acetonitrile. The sources of this compound are not clear, and may have existed inside one or both vehicles. The particle-associated measures ($PM_{2.5}$ mass, particle count, black carbon-Aethalometer, and $PM_{2.5}$ S) tend to show that there is a distinct reduction in particle species penetrating the vehicles. What is apparent is a general lack of influence of the vehicle ventilation settings on the pollutant concentrations. A plot of (IN 1 - OUT 1) in Figure 4-1 for CO, MTBE, benzene, and $PM_{2.5}$ shows no consistent relationships of "Low" and "High" indicators for any of the pollutants (Low setting commutes highlighted with bold dashed lines). The general loss of $PM_{2.5}$ from outside to inside for $PM_{2.5}$ is apparent, but no significant influence of vent setting is shown. The measured loss is biased somewhat by the requirement for the outside vehicle samples to be drawn through a sample line. The accuracy of applying an individual commute correction factor for gravimetric particle data, based on optical particle counter data, is undefined. A range of approximate loss factors of $PM_{2.5}$ mass was computed[6] for the Main Study commutes to be 19 to 21 %. An approximate 20% correction to the OUT 1 data was made and plotted in a manner similar to Figure 4-2, but the same conclusion was reached, that no apparent influence of vent settings on inside $PM_{2.5}$ concentrations was found. A similar plot for Vehicle 2 in Figure 4-2 for $PM_{2.5}$ again provided no relationship between vent setting and inside concentration. No judgements could be made for formaldehyde, since outside samples were not collected. For the vehicles tested, the vent settings utilized, and the relatively high AER's for most commutes, no significant influences of vent settings were apparent on the in-vehicle concentrations (by modifying the outside concentration levels).

[6] Using selected LAS-X particle size distributions for the arterial and freeway commutes, and applying the California aerosol densities determined by Kreisberg et al., 1998.

Table 4-1A. Influence of Vehicle Ventilation Settings on Organic Commute-Average Concentrations

				Concentrations (not corrected for Ambient) in Measure Units					
Measure	City	Vent Setting	AMB Mean	IN 1 Mean	IN 2 Mean	OUT 1 Mean	OUT 2 Mean	IN 1 mean - OUT 1 mean	IN 2 mean - OUT 2 mean
Isobutylene	Sac	Hi	1.8	9.0	8.9	8.0	8.3	1.1	0.6
µg/m3		Low	2.5	11.5	11.1	11.5	8.8	0.0	2.3
	LA	Hi	4.4	17.0	15.9	17.2	15.9	-0.2	0.1
		Low	6.6	19.5	18.9	20.3	18.5	-0.8	0.4
1,3-Butadiene	Sac	Hi	0.3	2.2	1.8	1.8	2.0	0.4	-0.2
µg/m3		Low	0.3	3.1	2.6	3.2	2.0	-0.1	0.6
	LA	Hi	0.4	3.5	3.0	3.5	2.9	0.0	0.1
		Low	0.8	4.0	3.3	4.2	3.4	-0.2	-0.1
Acetonitrile	Sac	Hi	17.9	59.7	52.0	1.7	35.5	58.0	16.5
µg/m3		Low	66.4	223.6	334.9	2.1	166.6	221.4	168.3
	LA	Hi	11.8	43.8	50.4	3.0	37.2	40.8	13.2
		Low	35.4	312.6	399.5	5.1	227.4	307.5	172.1
DCM	Sac	Hi	2.2	1.5	1.1	1.3	2.0	0.2	-0.9
µg/m3		Low	3.1	1.4	1.9	1.4	2.0	0.0	-0.1
	LA	Hi	6.3	2.6	3.4	3.2	3.2	-0.6	0.1
		Low	4.2	3.6	2.9	2.9	3.0	0.7	-0.1
MTBE	Sac	Hi	3.7	21.4	19.3	20.0	18.5	1.4	0.8
µg/m3		Low	5.4	26.6	19.6	24.4	17.4	2.2	2.2
	LA	Hi	13.6	40.2	34.5	40.7	34.8	-0.5	0.1
		Low	16.7	44.0	36.7	46.6	37.7	-2.6	-0.9
ETBE	Sac	Hi	0.3	0.1	0.1	0.2	0.5	-0.1	-0.4
µg/m3		Low	0.4	0.2	0.2	0.2	0.2	0.0	0.0
	LA	Hi	0.1	0.0	0.0	0.0	0.0	0.0	0.1
		Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TCFM	Sac	Hi	2.9	2.5	2.3	2.3	3.6	0.3	-1.3
µg/m3		Low	3.0	8.3	3.3	2.8	2.8	5.5	0.5
	LA	Hi	1.6	1.6	1.7	1.7	1.7	-0.2	0.1
		Low	2.1	1.7	1.7	1.8	1.7	0.0	0.0
Benzene	Sac	Hi	1.6	9.4	11.2	8.4	10.5	1.1	0.7
µg/m3		Low	2.3	11.6	11.9	11.9	11.0	-0.3	0.9
	LA	Hi	3.7	13.9	13.4	13.9	13.1	0.0	0.4
		Low	4.8	16.5	14.4	16.9	14.7	-0.4	-0.3
Toluene	Sac	Hi	5.9	22.2	23.5	19.5	24.0	2.7	-0.5
µg/m3		Low	6.9	40.6	24.4	27.4	21.7	13.1	2.7
	LA	Hi	22.9	36.1	31.6	35.1	32.0	1.0	0.1
		Low	14.4	40.4	31.1	41.0	33.1	-0.5	-2.0
Ethylbenzene	Sac	Hi	1.8	4.6	4.5	4.0	4.5	0.6	0.0
µg/m3		Low	1.4	8.2	5.2	6.2	4.7	2.0	0.5
	LA	Hi	2.0	7.3	6.1	7.1	6.1	0.2	0.1
		Low	2.6	8.7	5.9	8.4	6.4	0.3	-0.5
M,P-Xylene	Sac	Hi	2.7	19.4	18.2	16.1	17.6	3.3	0.6
mg/m3		Low	4.5	33.0	19.1	23.3	17.1	9.6	2.0
	LA	Hi	5.8	27.6	23.0	26.7	22.6	1.0	0.3
		Low	8.6	33.0	22.5	33.3	24.6	-0.3	-2.2
O-Xylene	Sac	Hi	1.2	6.7	6.4	5.7	6.5	1.0	-0.1
µg/m3		Low	2.3	11.2	6.7	8.2	6.5	2.9	0.1
		Low	3.3	11.6	8.4	11.9	9.0	-0.2	-0.6
Formaldehyde	Sac	Hi	4.2	6.0	4.5	na	na	na	na
µg/m3		Low	3.9	8.5	10.7	na	na	na	na
	LA	Hi	12.6	5.3	3.7	na	na	na	na
		Low	11.8	5.2	7.5	na	na	na	na

Notes: a Expected n values for Sacramento are: Hi - (6), Lo - (4)
Expected n values for Los Angeles are: Hi - (8), Lo - (4)
with exceptions to the n values in parentheses next to the mean.
b Means and ranges computed from uncensored data
c Values are ug/m3, unless noted otherwise in Measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-1B. Influence of Vehicle Ventilation Settings on Continuous Commute-Average Concentrations

Measure	City	Vent Setting	AMB Mean	Concentrations (not corrected for Ambient) in Measure Units IN 1 Means	IN 2 Mean	OUT 1 Mean	OUT 2 Mean	IN 1 mean - OUT 1 mean	IN 2 mean - OUT 2 mean
CO Avg (ppm)	Sac	Hi	0.0	2.0	3.5	2.5	4.1	-0.5	-0.6
		Low	0.0	2.1	2.7	2.3	4.0	-0.2	-1.4
	LA	Hi	0.5	4.3	4.5	4.4	4.7	0.0	-0.2
		Low	0.5	4.9	5.3	5.4	6.1	-0.5	-0.8
CO Peak (ppm)	Sac	Hi	0.0	12.3	18.5	17.3	21.7	-4.9	-3.2
		Low	0.8	9.3	10.3	15.5	13.3	-6.3	-3.0
	LA	Hi	1.5	35.0	14.4	39.5	17.5	-4.5	-3.1
		Low	1.3	12.5	8.0	29.3	12.8	-16.8	-4.8
Black Carbon µg/m3	Sac	Hi	na	5.7	na	4.7	na	1.0	na
		Low	na	3.6	na	5.9	na	-2.4	na
	LA	Hi	na	11.6	na	15.2	na	-3.6	na
		Low	na	20.6	na	19.0	na	1.6	na
LASX mean total particle counts/cm3	Sac	Hi	na	841	na	1,680	na	-839	na
		Low	na	505	na	1,349	na	-845	na
	LA	Hi	na	3,305	na	6,261	na	-2,956	na
		Low	na	2,865	na	6,652	na	-3,786	na

Notes: a Expected n values for Sacramento are: Hi - (6), Lo - (4)
Expected n values for Los Angeles are: Hi - (8), Lo - (4)
with exceptions to the n values in parentheses next to the mean.
b Means and ranges computed from uncensored data
c Values are ug/m3, unless noted otherwise in Measure column
Ambient data not available to correct black carbon or LAS-X data
LAS-X OUT data corrected for sampling line losses
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-1C. Influence of Vehicle Ventilation Settings on PM10 Commute-Average Concentration Data

				Concentrations (not corrected for Ambient) in Measure Units					
Measure	City	Vent Setting	AMB Mean	IN 1 Means	IN 2 Mean	OUT 1 Mean	OUT 2 Mean	IN 1 mean - OUT 1 mean	IN 2 mean - OUT 2 mean
PM 10	Sac	Hi	22.7	25.8	8.1	na	na	na	na
µg/m3		Low	23.8	22.9	14.6	na	na	na	na
	LA	Hi	61.3	57.6	48.4	na	na	na	na
		Low	90.7	53.4	51.4	na	na	na	na
PM10 Cd	Sac	Hi	0.11	0.10	0.10	na	na	na	na
µg/m3		Low	0.10	0.10	0.10	na	na	na	na
	LA	Hi	0.10	0.11	0.10	na	na	na	na
		Low	0.10	0.10	0.11	na	na	na	na
PM10 Cr	Sac	Hi	0.40	0.40	0.40	na	na	na	na
µg/m3		Low	0.40	0.40	0.40	na	na	na	na
	LA	Hi	0.40	0.40	0.40	na	na	na	na
		Low	0.40	0.40	0.40	na	na	na	na
PM10 Mn	Sac	Hi	0.04	0.04	0.04	na	na	na	na
µg/m3		Low	0.04	0.04	0.04	na	na	na	na
	LA	Hi	0.04	0.04	0.04	na	na	na	na
		Low	0.04	0.04	0.04	na	na	na	na
PM10 Ni	Sac	Hi	0.03	0.03	0.03	na	na	na	na
µg/m3		Low	0.03	0.03	0.03	na	na	na	na
	LA	Hi	0.03	0.03	0.03	na	na	na	na
		Low	0.03	0.03	0.03	na	na	na	na
PM10 Pb	Sac	Hi	0.03	0.03	0.03	na	na	na	na
µg/m3		Low	0.03	0.04	0.03	na	na	na	na
	LA	Hi	0.03	0.03	0.03	na	na	na	na
		Low	0.03	0.03	0.03	na	na	na	na
PM10 S	Sac	Hi	0.46	0.43	0.32	na	na	na	na
µg/m3		Low	0.47	0.38	0.28	na	na	na	na
	LA	Hi	2.64	2.08	1.97	na	na	na	na
		Low	2.98	2.13	2.15	na	na	na	na

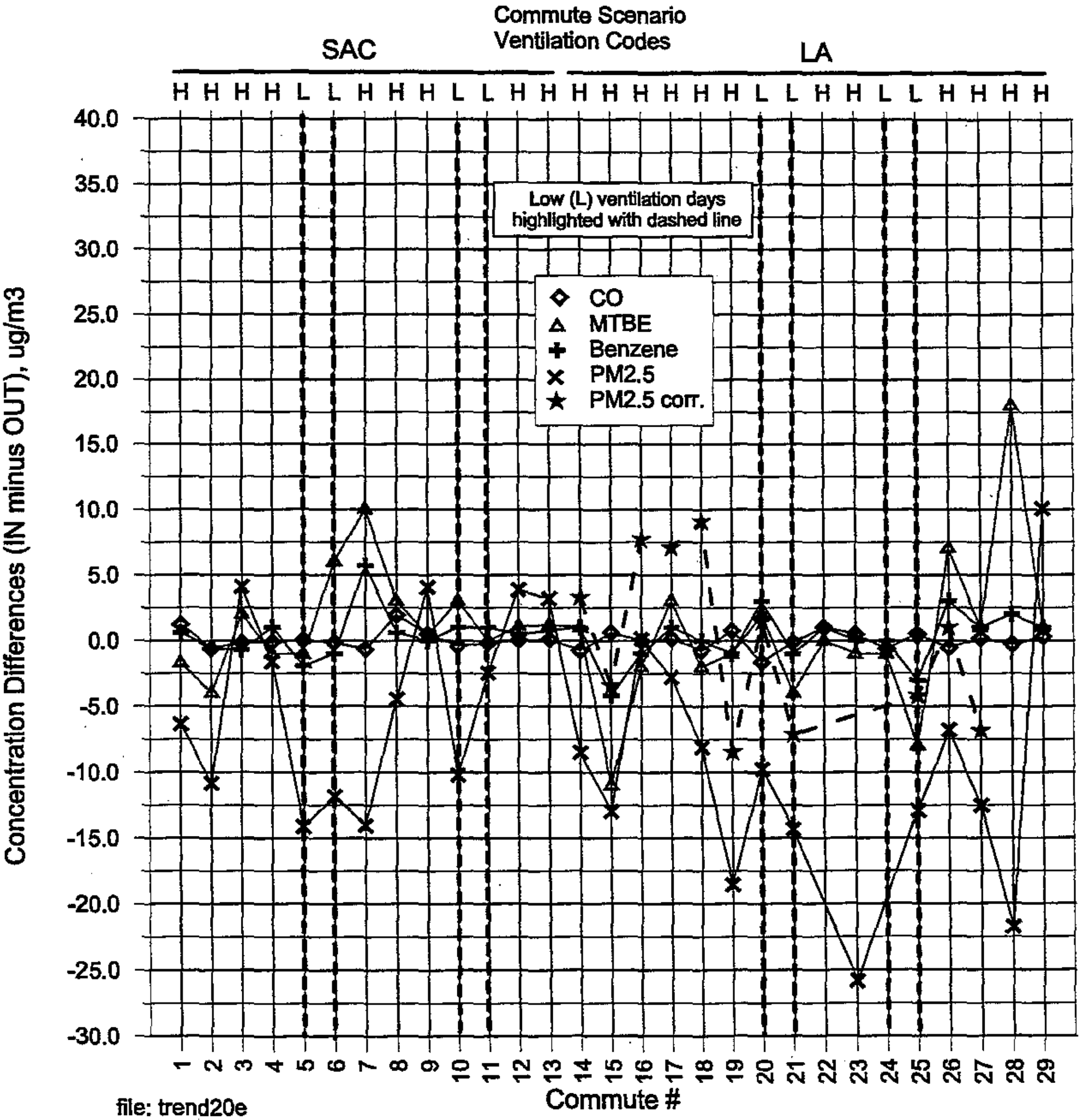
Notes: a Expected n values for Sacramento are: Hi - (6), Lo - (4)
Expected n values for Los Angeles are: Hi - (8), Lo - (4)
with exceptions to the n values in parentheses next to the mean.
b Means and ranges computed from uncensored data
c Values are ug/m3, unless noted otherwise in Measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-1D. Influence of Vehicle Ventilation Settings on PM2.5 Commute-Average Concentration Data

Measure	City	Vent Setting	AMB Mean	Concentrations (not corrected for Ambient) in Measure Units					
				IN 1 Means	IN 2 Mean	OUT 1 Mean	OUT 2 Mean	IN 1 mean - OUT 1 mean	IN 2 mean - OUT 2 mean
PM 2.5 µg/m3	Sac	Hi	5.9	13.3	7.6	18.9	11.2	-5.5	-3.6
		Low	12.4	11.3	11.0	21.1	16.9	-9.8	-5.9
	LA	Hi	36.2	49.8	40.6	58.5	39.9	-8.8	0.7
		Low	56.2	47.2	34.4	71.4	49.0	-24.2	-14.7
PM2.5 Cd µg/m3	Sac	Hi	0.10	0.10	0.10	0.10	0.10	0.00	0.00
		Low	0.10	0.10	0.12	0.10	0.10	0.00	0.02
	LA	Hi	0.11	0.10	0.10	0.10	0.10	0.00	0.00
		Low	0.10	0.10	0.10	0.10	0.10	0.00	0.00
PM2.5 Cr µg/m3	Sac	Hi	0.40	0.40	0.40	0.40	0.40	0.00	0.00
		Low	0.40	0.40	0.40	0.40	0.40	0.00	0.00
	LA	Hi	0.40	0.40	0.40	0.40	0.40	0.00	0.00
		Low	0.40	0.40	0.40	0.40	0.40	0.00	0.00
PM2.5 Mn µg/m3	Sac	Hi	0.04	0.04	0.04	0.04	0.04	0.00	0.00
		Low	0.04	0.04	0.04	0.04	0.04	0.00	0.00
	LA	Hi	0.04	0.04	0.04	0.04	0.04	0.00	0.00
		Low	0.04	0.04	0.04	0.04	0.04	0.00	0.00
PM2.5 Ni µg/m3	Sac	Hi	0.03	0.03	0.03	0.03	0.03	0.00	0.00
		Low	0.03	0.03	0.03	0.03	0.03	0.00	0.00
	LA	Hi	0.03	0.03	0.03	0.03	0.03	0.00	0.00
		Low	0.03	0.03	0.03	0.03	0.03	0.00	0.00
PM2.5 Pb µg/m3	Sac	Hi	0.03	0.03	0.03	0.03	0.03	0.00	0.00
		Low	0.03	0.03	0.03	0.05	0.03	-0.02	0.00
	LA	Hi	0.03	0.03	0.03	0.04	0.03	0.00	0.00
		Low	0.03	0.03	0.03	0.03	0.03	0.00	0.00
PM2.5 S µg/m3	Sac	Hi	0.46	0.49	0.33	0.54	0.45	-0.05	-0.12
		Low	0.39	0.35	0.27	0.38	0.33	-0.02	-0.06
	LA	Hi	1.87	1.72	1.62	1.84	1.67	-0.11	-0.05
		Low	2.54	1.99	1.70	2.53	1.94	-0.54	-0.24

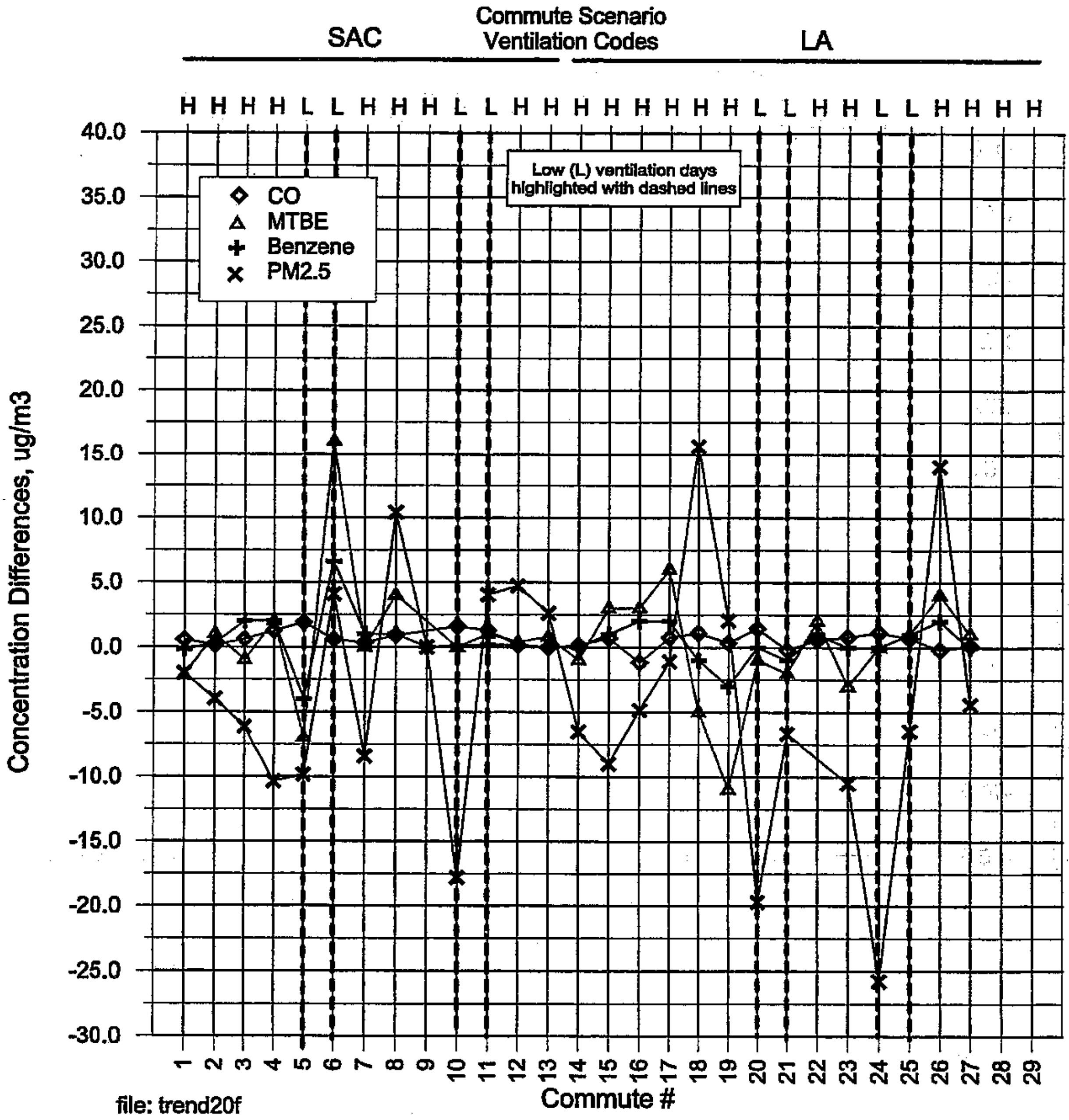
Notes: a Expected n values for Sacramento are: Hi - (6), Lo - (4)
Expected n values for Los Angeles are: Hi - (8), Lo - (4)
with exceptions to the n values in parentheses next to the mean.
b Means and ranges computed from uncensored data
c Values are ug/m3, unless noted otherwise in Measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Figure 4-1. Differences Between Inside and Outside Concentrations by Vehicle Ventilation Setting for Vehicle 1



file: trend20e

Figure 4-2. Differences Between Inside and Outside Concentration by Vehicle Ventilation Setting for Vehicle 2



4.2.2 Vehicle Type Influence (Sedans and SUV)

Tables 4-2 (A, B and C) summarize the concentration data for non-special commutes for all measures focusing on the influence of vehicle type on the in-vehicle concentration levels. Mean values for IN 1, IN 2, OUT 1, and OUT 2 were computed for Sacramento and Los Angeles, not corrected for ambient background, for each commute. Vehicle 1 was the same in both cities. Similar to the previous section for ventilation influences, the differences between the inside and outside values were computed for each vehicle and given in columns (A) and (B) to give (IN 1 - IN 2) and (OUT 1 - OUT 2). As previously noted, Vehicle 1 is the 1991 Chevrolet Caprice (sedan) in both cities. Vehicle 2 is a 1997 Ford Taurus (sedan) in Sacramento, and a 1997 Ford Explorer (SUV) in Los Angeles. Again, the (IN 1 - OUT 1) column would be expected to be the same between cities for all measurement, especially since there appeared to be no influence of vent setting on penetration. Although the data might suggest that some differences do exist between the two cities [the outside being larger than the inside more in Los Angeles than Sacramento for most of the VOC's], the differences are smaller an probably within the experimental error.

In order to evaluate the differences between Vehicle 1 and both Vehicle 2's, the IN 1 - IN 2 column was computed. The presumption is that the sources of the pollutants being addressed are external to the vehicles. Interior sources (or sinks) would confound such an analysis. This column suggests differenceminimal differences between the vehicles in Sacramento or Los Angeles for all pollutants except $PM_{2.5}$ mass. This difference is possibly attributed to a smaller particle loss rate between the outside and inside for Vehicle 1. The last column is the difference between outside concentrations for the two vehicles (OUT 1 - OUT 2). This term was computed to determine if Vehicle 2's position trailing Vehicle 1 showed the potential for lower concentrations. Only acetonitrile and carbon monoxide are negative (OUT 2 > OUT 1) for both cities. Although this may suggest that Vehicle 1 may have been a (weak) source for these pollutants, it is more likely that the CO differences are within the experimental error, and the acetonitrile values may have been cross-contaminated from the DNPH cartridges. Positive differences for both cities for $PM_{2.5}$ suggest that the emissions from the target vehicles immediately in front of Vehicle 1 were higher due to proximity. The air exchange rate data (Figure 3-6) suggest that the Explorer could provide some "insulating" effect at very low speeds, as compared to either the Caprice or the Ford Taurus (used in Sacramento). This could not be definitively established, however, given the limited number of low speed commutes. Both the newer Explorer and Taurus were intuitively expected to be more "airtight" than the older Caprice. During this study, the ranges of average commute speeds between cities were not substantial. In general, there appeared to be only a weak dependence (if any) of in-vehicle pollutant concentrations on vehicle type, except perhaps for $PM_{2.5}$. The differences between Vehicle 1 and Vehicle 2 were somewhat masked, however, by the higher pollutant "exposure" of Vehicle 1 from being closer to the exhausts of the "target" vehicles [see OUT 1 - OUT 2 column].

Table 4-2A. Influence of Vehicle Type on Organic Commute-Average Concentration Data

			Concentrations (not corrected for Ambient) in Measure Units						
Measure	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	IN 1 mean - OUT 1 mean	IN 1 mean - IN 2 mean	OUT 1 mean - OUT 2 mean
Isobutylene	Sac	2.1	10.0	9.8	9.4	8.5	0.6	0.2	0.9
μg/m3	LA	5.1	17.9	16.9	18.2	16.8	-0.4	1.0	1.4
1,3-Butadiene	Sac	0.3	2.6	2.1	2.4	2.0	0.2	0.5	0.4
μg/m3	LA	0.5	3.7	3.1	3.7	3.1	-0.1	0.6	0.6
Acetonitrile	Sac	37.3	125.2	165.1	1.9	89.6	123.3	-39.9	-87.7
μg/m3	LA	19.7	133.4	166.8	3.7	100.6	129.7	-33.4	-96.9
DCM	Sac	2.6	1.4	1.4	1.3	2.0	0.1	0.0	-0.7
μg/m3	LA	5.6	2.9	3.2	3.1	3.2	-0.2	-0.3	0.0
MTBE	Sac	4.4	23.5	19.4	21.7	18.1	1.7	4.0	3.7
μg/m3	LA	14.7	41.5	35.2	42.7	35.8	-1.2	6.2	6.9
ETBE	Sac	0.4	0.1	0.2	0.2	0.4	0.0	0.0	-0.2
μg/m3	LA	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TCFM	Sac	2.9	4.8	2.7	2.5	3.3	2.4	2.1	-0.8
μg/m3	LA	1.7	1.6	1.7	1.7	1.7	-0.1	-0.1	0.0
Benzene	Sac	1.9	10.3	11.5	9.8	10.7	0.5	-1.2	-0.9
μg/m3	LA	4.0	14.8	13.7	14.9	13.6	-0.1	1.1	1.3
Toluene	Sac	6.3	29.6	23.9	22.7	23.1	6.9	5.7	-0.4
μg/m3	LA	20.1	37.5	31.4	37.1	32.3	0.5	6.1	4.7
Ethylbenzene	Sac	1.6	6.0	4.8	4.9	4.6	1.1	1.3	0.3
μg/m3	LA	2.2	7.8	6.1	7.6	6.2	0.2	1.7	1.4
M,P-Xylene	Sac	3.4	24.8	18.6	19.0	17.4	5.8	6.2	1.6
μg/m3	LA	6.7	29.4	22.8	28.9	23.3	0.6	6.6	5.6
O-Xylene	Sac	1.7	8.5	6.5	6.7	6.3	1.8	2.0	0.4
μg/m3	LA	2.7	10.5	8.3	10.4	8.4	0.1	2.1	2.0
Formaldehyde	Sac	4.0	11.1	11.3	na	na	na	-0.2	na
μg/m3	LA	12.4	16.5	16.4	na	na	na	0.1	na

Notes: a Expected n value for Sacramento is: (10)
Expected n value for Los Angeles is (12)
b Values are ug/m3, unless noted otherwise in measure column
c Vehicle 1 (IN 1 and OUT 1) is 1991 Chevrolet Caprice for SAC and LA
d Vehicle 2 (IN 2 and OUT 2) is 1997 Ford Taurus in SAC and 1997 Ford Explorer in LA
e Special study commutes (Rural, School Bus, Carpool, and Max. Concentration) data not included
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-2B. Influence of Vehicle Type on Continuous Commute-Average Concentration Data

		Measures in specified units							
Measure	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	IN 1 mean - OUT 1 mean	IN 1 mean - IN 2 mean	OUT 1 mean - OUT 2 mean
CO Avg	Sac	0.0	2.0	3.2	2.4	4.1	-0.4	-1.2	-1.7
(ppm)	LA	0.5	4.5	4.8	4.7	5.2	-0.2	-0.2	-0.5
CO Peak	Sac	0.3	11.1	15.2	16.4	18.3	-5.3	-4.1	-1.9
(ppm)	LA	1.4	27.5	12.3	36.1	15.9	-8.6	15.3	20.2
Black Carbon	Sac	NA	4.8	na	5.2	na	-0.4	na	na
μg/m3	LA	NA	10.5	na	15.2	na	-4.7	na	na
LASX	Sac	NA	707	na	1,548	na	-841.0	na	na
particles/cm3	LA	NA	3,159	na	6,391	na	-3232.8	na	na

Notes: a Expected n value for Sacramento is: (10)
Expected n value for Los Angeles is (12)
b Values are ug/m3, unless noted otherwise in measure column
c Vehicle 1 (IN 1 and OUT 1) is 1991 Chevrolet Caprice for SAC and LA
d Vehicle 2 (IN 2 and OUT 2) is 1997 Ford Taurus in SAC and 1997 Ford Explorer in LA
e Special study commutes (Rural, School Bus, Carpool, and Max. Concentration) data not included
Ambient data not available to correct black carbon or LAS-X data
LAS-X OUT data corrected for sampling line losses
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-2C. Influence of Vehicle Type on PM2.5 & PM10 Commute-Average Concentration Data

			Concentrations (not corrected for Ambient) in Measure Units						
Measure	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	IN 1 mean - OUT 1 mean	IN 1 mean - IN 2 mean	OUT 1 mean - OUT 2 mean
PM 10 mass	Sac	23.1	24.6	10.9	na	na	na	na	na
μg/m3	LA	71.1	56.2	49.4	na	na	na	na	na
PM 2.5 mass	Sac	8.7	12.6	9.0	19.8	13.0	-7.2	3.6	6.8
μg/m3	LA	42.8	48.9	38.5	62.8	42.9	-13.9	10.4	19.9
PM10 Cd	Sac	0.07	0.04	0.05	na	na	na	na	na
μg/m3	LA	0.04	0.05	0.03	na	na	na	na	na
PM10 Cr	Sac	0.03	0.02	0.02	na	na	na	na	na
μg/m3	LA	0.02	0.01	0.01	na	na	na	na	na
PM10 Mn	Sac	0.03	0.03	0.01	na	na	na	na	na
μg/m3	LA	0.01	0.01	0.01	na	na	na	na	na
PM10 Ni	Sac	0.01	0.01	0.01	na	na	na	na	na
μg/m3	LA	0.01	0.01	0.01	na	na	na	na	na
PM10 Pb	Sac	0.01	0.03	0.01	na	na	na	na	na
μg/m3	LA	0.01	0.01	0.01	na	na	na	na	na
PM10 S	Sac	0.50	0.46	0.33	na	na	na	na	na
μg/m3	LA	2.38	1.88	1.85	na	na	na	na	na
PM2.5 Cd	Sac	0.03	0.05	0.06	0.04	0.02	0.0	0.0	0.0
μg/m3	LA	0.03	0.02	0.05	0.05	0.04	0.0	0.0	0.0
PM2.5 Cr	Sac	0.01	0.02	0.02	0.01	0.01	0.0	0.0	0.0
μg/m3	LA	0.02	0.02	0.01	0.01	0.01	0.0	0.0	0.0
PM2.5 Mn	Sac	0.01	0.01	0.02	0.02	0.01	0.0	0.0	0.0
μg/m3	LA	0.01	0.01	0.01	0.01	0.00	0.0	0.0	0.0
PM2.5 Ni	Sac	0.00	0.01	0.00	0.01	0.01	0.0	0.0	0.0
μg/m3	LA	0.01	0.01	0.01	0.01	0.01	0.0	0.0	0.0
PM2.5 Pb	Sac	0.01	0.02	0.02	0.03	0.02	0.0	0.0	0.0
μg/m3	LA	0.01	0.01	0.01	0.02	0.01	0.0	0.0	0.0
PM2.5 S	Sac	0.44	0.44	0.31	0.48	0.40	0.0	0.1	0.1
μg/m3	LA	2.09	1.81	1.64	2.07	1.76	-0.3	0.2	0.3

Notes: a Expected n value for Sacramento is: (10)
Expected n value for Los Angeles is (12)
b Values are ug/m3, unless noted otherwise in measure column
c Vehicle 1 (IN 1 and OUT 1) is 1991 Chevrolet Caprice for SAC and LA
d Vehicle 2 (IN 2 and OUT 2) is 1997 Ford Taurus in SAC and 1997 Ford Explorer in LA
e Special study commutes (Rural, School Bus, Carpool, and Max. Concentration) data not included
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-2D. Influence of Vehicle Type on Commute-Average Associated Measures

Measure	City	AMB mean	Measures in specified units: IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	IN 1 mean - OUT 1 mean	IN 1 mean - IN 2 mean	OUT 1 mean - OUT 2 mean
Speed (mph)	Sac	na	32.3	na	na	na	na	na	na
	LA	na	33.2	na	na	na	na	na	na
Spacing Range (feet)	Sac	na	75.4	na	na	na	na	na	na
	LA	na	52.1	na	na	na	na	na	na
Level of Congestion (unitless)	Sac	na	3.0	na	na	na	na	na	na
	LA	na	2.9	na	na	na	na	na	na
Miles Traveled	Sac	na	66.8	na	na	na	na	na	na
	LA	na	67.9	na	na	na	na	na	na
Heavy Duty Diesel Influence, %	Sac	na	41%	na	na	na	na	na	na
	LA	na	36%	na	na	na	na	na	na

Notes:

a Expected n value for Sacramento is: (10)
Expected n value for Los Angeles is (12)
b Values are ug/m3, unless noted otherwise in measure column
c Vehicle 1 (IN 1 and OUT 1) is 1991 Chevrolet Caprice for SAC and LA
d Vehicle 2 (IN 2 and OUT 2) is 1997 Ford Taurus in SAC and 1997 Ford Explorer in LA
e Special study commutes (Rural, School Bus, Carpool, and Max. Concentration) data not included
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

4.2.3 Roadway Type Influence (Freeway and Arterial)

Tables 4-3 (A thru E) summarize the concentration data for non-special commutes for all measures focusing on the influence of roadway type on the in-vehicle concentration levels. Mean values for IN 1, IN 2, OUT 1, and OUT 2 were stratified by freeway and arterial commutes and computed for Sacramento and Los Angeles. The concentrations were corrected for ambient background, for each commute. To focus on the in-vehicle concentration influences for the Caprice, differences were computed between the scenario means as given in the last two columns for Car 1 and Car 2.

The larger metropolitan area and associated higher traffic densities in Los Angeles would suggest that the LA means should be significantly higher than those from Sacramento in almost all cases. For MTBE, this was true for both freeway and arterial commutes. A similar trend was noted for benzene. The data for MTBE and benzene also suggest that both Sacramento and LA commutes produced higher IN 1 concentrations for arterial roadways, as compared to freeways. This was reversed, however, for IN 2, suggesting that additional (unmeasured) factors including the spacing between Car 1 and Car 2 may have been different for the two roadway types. A partial explanation for the difference for Car 1, may be the substantial diesel "influence" from target vehicle trailing in Los Angeles (see Table 4-3E). Following diesel vehicles (which generate no MTBE and undoubtedly induce greater mixing from turbulence) 50 % and 82 % of the time on freeways (as compared to 4 % and 2 % on arterial roadways), could significantly reduce the MTBE concentrations in the trailing vehicle [while increasing the concentrations of diesel-associated pollutants]. This could also help to explain the similar trends for many of the other VOC's. CO shows a similar trend to target VOC's. This is reasonable, since gasoline powered vehicles could be expected to generate greater quantities of CO than diesels, while diesels generate greater quantities of black carbon and particles. The particle issue is complex, however, in that the substantial turbulence behind larger vehicle, may periodically re-entrain some larger particles that fall within the <10 μm size range. Additionally, the ambient $PM_{2.5}$ and PM_{10} concentrations were substantial compared to the differences observed. The black carbon and particle count data suggest that LA is substantially higher for both measures, however, there were no ambient data available to use to correct the concentration data. The $PM_{2.5}$ and PM_{10} sulfur (background-corrected) data suggest that the LA and freeway particle concentration data are higher, but the differences were very small compared to the ambient levels. While LA formaldehyde levels were generally higher in LA, compared to Sacramento, the Sacramento in-vehicle levels for the arterial commutes were significantly higher than for LA.

A review of the vehicular data in Table 4-3E (Scenario Comparison for Car 1) shows that the miles traveled per commute were significantly higher in LA for the arterial commute at significantly higher speeds. The spacing between vehicles in LA was significantly closer than those in Sacramento. Arterial vehicle spacing was somewhat higher than freeway. The levels of traffic congestion were similar in LA and Sacramento for freeway and arterial roadways, with the freeway congestion somewhat higher than the arterial. The influence of roadway type on concentrations, comparing Sacramento and Los Angeles, appears to be significant for selected driving scenarios, but is affected by a number of complicating factors. The location (LA or Sacramento) appears to be the most important factor. The driving protocol focus on diesel vehicles also contributed to the difficulty in detecting consistent trends associated with roadway type.

Table 4-3A. Influence of Roadway Type on Organic Commute-Average Concentrations

	Type	City	AMB mean	Concentrations (corrected for Ambient) in Measure Units: IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Comparisons:	Car 1	Car 2
Isobutylene µg/m3	FR	Sac	1.9	8.5	10.5	8.3	7.7	Freeway: Sac - LA	-2.8	-2.0
		LA	5.2	11.3	12.5	12.5	12.0	Arterial: Sac - LA	2.4	-5.5
	AR	Sac	2.7	8.9	6.8	7.7	6.5	Sac: Freeway - Arterial	-4.4	3.7
		LA	4.3	13.3	12.3	12.9	11.5	LA: Freeway - Arterial	10.7	0.2
1,3-Butadiene µg/m3	FR	Sac	0.1	2.6	2.7	2.7	2.2	Freeway: Sac - LA	-0.5	-0.3
		LA	0.7	3.1	3.0	3.4	3.0	Arterial: Sac - LA	-0.7	-1.1
	AR	Sac	0.5	2.3	1.2	1.9	1.5	Sac: Freeway - Arterial	0.3	1.5
		LA	0.4	3.0	2.3	3.0	2.3	LA: Freeway - Arterial	0.1	0.7
Acetonitrile µg/m3	FR	Sac	45.3	71.4	177.2	-43.5	62.5	Freeway: Sac - LA	-59.4	15.8
		LA	19.9	130.8	161.4	-14.1	76.9	Arterial: Sac - LA	-37.6	-113.8
	AR	Sac	36.7	137.4	133.5	-34.7	57.6	Sac: Freeway - Arterial	-66.0	43.7
		LA	30.1	175.0	247.3	-27.9	138.1	LA: Freeway - Arterial	-44.2	-85.9
DCM µg/m3	FR	Sac	1.9	-0.9	-0.2	-0.8	0.0	Freeway: Sac - LA	-0.6	-0.3
		LA	3.0	-0.3	0.0	0.3	0.1	Arterial: Sac - LA	-1.4	-2.4
	AR	Sac	4.1	-1.9	-2.5	-2.4	-1.5	Sac: Freeway - Arterial	1.0	2.2
		LA	3.6	-0.5	-0.1	-0.5	-0.4	LA: Freeway - Arterial	0.2	0.1
MTBE µg/m3	FR	Sac	3.2	19.8	17.7	18.0	15.4	Freeway: Sac - LA	-4.4	-5.3
		LA	13.5	24.3	23.0	28.0	22.9	Arterial: Sac - LA	-2.7	-5.6
	AR	Sac	6.7	23.6	15.3	19.8	14.0	Sac: Freeway - Arterial	-3.8	2.4
		LA	9.7	26.3	20.9	26.4	19.6	LA: Freeway - Arterial	-2.0	2.1
ETBE µg/m3	FR	Sac	0.1	0.0	-0.1	-0.1	-0.1	Freeway: Sac - LA	0.0	0.0
		LA	0.1	-0.1	-0.1	-0.1	-0.1	Arterial: Sac - LA	-0.6	-0.5
	AR	Sac	0.8	-0.6	-0.5	-0.4	0.1	Sac: Freeway - Arterial	0.5	0.4
		LA	0.0	0.0	0.0	0.0	0.0	LA: Freeway - Arterial	-0.1	-0.1
TCFM µg/m3	FR	Sac	2.2	0.2	0.8	0.1	0.6	Freeway: Sac - LA	0.4	0.9
		LA	1.8	-0.2	-0.1	0.1	-0.1	Arterial: Sac - LA	4.9	-1.1
	AR	Sac	4.2	4.7	-1.2	-1.2	0.5	Sac: Freeway - Arterial	-4.5	2.0
		LA	1.7	-0.2	-0.1	-0.2	-0.2	LA: Freeway - Arterial	0.0	0.0
Benzene µg/m3	FR	Sac	1.4	8.9	12.5	9.8	10.9	Freeway: Sac - LA	-1.5	1.0
		LA	4.0	10.4	11.5	11.0	11.1	Arterial: Sac - LA	-2.4	-1.3
	AR	Sac	2.9	9.2	8.4	7.1	8.0	Sac: Freeway - Arterial	-0.4	4.1
		LA	2.8	11.7	9.7	11.7	9.2	LA: Freeway - Arterial	-1.3	1.8
Toluene µg/m3	FR	Sac	4.6	27.3	22.9	19.5	20.6	Freeway: Sac - LA	12.3	10.7
		LA	19.0	15.0	12.2	15.4	12.9	Arterial: Sac - LA	-0.2	-4.2
	AR	Sac	8.2	27.1	16.2	17.2	15.1	Sac: Freeway - Arterial	0.2	6.7
		LA	9.6	27.4	20.5	26.4	20.1	LA: Freeway - Arterial	-12.4	-8.2
Ethylbenzene µg/m3	FR	Sac	0.7	4.8	4.3	3.9	3.8	Freeway: Sac - LA	-0.4	0.3
		LA	2.2	5.2	4.0	5.0	4.0	Arterial: Sac - LA	0.4	-0.2
	AR	Sac	1.8	6.3	3.9	4.6	3.9	Sac: Freeway - Arterial	-1.6	0.4
		LA	1.6	5.9	4.1	5.6	4.1	LA: Freeway - Arterial	-0.7	-0.1
M,P-Xylene µg/m3	FR	Sac	2.7	22.0	18.4	16.7	16.1	Freeway: Sac - LA	1.3	2.3
		LA	7.4	20.8	16.0	20.3	16.5	Arterial: Sac - LA	2.5	-2.2
	AR	Sac	5.0	26.0	14.9	17.7	14.3	Sac: Freeway - Arterial	-4.0	3.5
		LA	5.3	23.6	17.1	23.3	17.1	LA: Freeway - Arterial	-2.8	-1.1
O-Xylene µg/m3	FR	Sac	1.5	6.9	5.7	5.2	5.1	Freeway: Sac - LA	-0.3	0.0
		LA	2.8	7.2	5.7	7.1	5.8	Arterial: Sac - LA	0.3	-1.3
	AR	Sac	2.3	8.4	4.8	6.0	5.1	Sac: Freeway - Arterial	-1.5	0.8
		LA	2.0	8.1	6.2	8.1	6.1	LA: Freeway - Arterial	-0.9	-0.5
Formaldehyde µg/m3	FR	Sac	4.0	7.2	10.0	na	na	Freeway: Sac - LA	6.0	1.2
		LA	6.7	7.7	8.8	na	na	Arterial: Sac - LA	2.1	2.4
	AR	Sac	4.1	8.1	8.5	na	na	Sac: Freeway - Arterial	-0.5	1.5
		LA	9.7	5.7	6.1	na	na	LA: Freeway - Arterial	-0.4	2.7

Note: a Expected n values for Sacramento are: FR (4), AR (4)
Expected n values for Los Angeles are: FR (4), AR (4)
b Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-3B. Influence of Roadway Type on Continuous Commute-Average Concentration Data

				Concentrations (corrected for Ambient) in Measure Units						
	Type	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Comparisons:	Car 1	Car 2
CO Avg (ppm)	FR	Sac	0.0	2.1	3.1	2.2	4.2	Freeway: Sac - LA	-2.5	-1.8
		LA	0.5	4.6	4.9	4.9	5.1	Arterial: Sac - LA	-2.0	-1.4
	AR	Sac	0.0	2.3	3.0	2.7	4.1	Sac: Freeway - Arterial	-0.2	0.1
		LA	0.0	4.2	4.4	4.3	4.8	LA: Freeway - Arterial	0.3	0.5
CO Peak (ppm)	FR	Sac	0.0	10.5	22.3	11.5	25.8	Freeway: Sac - LA	-22.3	10.8
		LA	1.3	32.8	11.5	30.3	13.5	Arterial: Sac - LA	-12.8	0.3
	AR	Sac	0.8	10.0	8.8	22.7	12.8	Sac: Freeway - Arterial	0.5	13.5
		LA	0.5	22.8	8.5	39.8	14.0	LA: Freeway - Arterial	10.0	3.0
Black Carbon µg/m3	FR	Sac	na	6.7	na	7.9	na	Freeway: Sac - LA	-3.7	na
		LA	na	10.4	na	17.7	na	Arterial: Sac - LA	-18.4	na
	AR	Sac	na	1.3	na	3.1	na	Sac: Freeway - Arterial	5.5	na
		LA	na	19.7	na	17.4	na	LA: Freeway - Arterial	-9.3	na
LASX particle counts/cm3	FR	Sac	na	759	na	1,942	na	Freeway: Sac - LA	-2202	na
		LA	na	2,960	na	6,724	na	Arterial: Sac - LA	-2656	na
	AR	Sac	na	33	na	139	na	Sac: Freeway - Arterial	725	na
		LA	na	2,690	na	5,170	na	LA: Freeway - Arterial	271	na

Note: a Expected n values for Sacramento are: FR (4), AR (4)
Expected n values for Los Angeles are: FR (4), AR (4)
b Values are ug/m3, unless noted otherwise in measure column
Ambient data not available to correct black carbon or LAS-X data
LAS-X OUT data corrected for sampling line losses
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-3C. Influence of Roadway Type on PM10 Commute-Average Concentration Data

	Type	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Comparisons:	Car 1	Car 2
				Concentrations (corrected for Ambient) in Measure Units						
PM 10 mass	FR	Sac	22.7	7.5	-12.7	na	na	Freeway: Sac - LA	12.2	10.7
μg/m3		LA	59.5	-4.7	-23.3	na	na	Arterial: Sac - LA	27.8	15.5
	AR	Sac	20.3	-3.9	-10.3	na	na	Sac: Freeway - Arterial	11.4	-2.3
		LA	77.3	-31.7	-25.9	na	na	LA: Freeway - Arterial	27.0	2.5
PM10 Cd	FR	Sac	0.10	0.00	0.00	na	na	Freeway: Sac - LA	-0.02	-0.01
μg/m3		LA	0.10	0.02	0.01	na	na	Arterial: Sac - LA	0.00	0.00
	AR	Sac	0.10	0.00	0.00	na	na	Sac: Freeway - Arterial	0.00	0.00
		LA	0.10	0.00	0.00	na	na	LA: Freeway - Arterial	0.02	0.01
PM10 Cr	FR	Sac	0.40	0.00	0.00	na	na	Freeway: Sac - LA	0.00	0.00
μg/m3		LA	0.40	0.00	0.00	na	na	Arterial: Sac - LA	0.00	0.00
	AR	Sac	0.40	0.00	0.00	na	na	Sac: Freeway - Arterial	0.00	0.00
		LA	0.40	0.00	0.00	na	na	LA: Freeway - Arterial	0.00	0.00
PM10 Mn	FR	Sac	0.04	0.00	0.00	na	na	Freeway: Sac - LA	0.00	0.00
μg/m3		LA	0.04	0.00	0.00	na	na	Arterial: Sac - LA	0.01	0.00
	AR	Sac	0.04	0.01	0.00	na	na	Sac: Freeway - Arterial	-0.01	0.00
		LA	0.04	0.00	0.00	na	na	LA: Freeway - Arterial	0.00	0.00
PM10 Ni	FR	Sac	0.03	0.00	0.00	na	na	Freeway: Sac - LA	0.00	0.00
μg/m3		LA	0.03	0.00	0.00	na	na	Arterial: Sac - LA	0.00	0.00
	AR	Sac	0.03	0.00	0.00	na	na	Sac: Freeway - Arterial	0.00	0.00
		LA	0.03	0.00	0.00	na	na	LA: Freeway - Arterial	0.00	0.00
PM10 Pb	FR	Sac	0.03	0.00	0.00	na	na	Freeway: Sac - LA	0.00	0.00
μg/m3		LA	0.03	0.00	0.00	na	na	Arterial: Sac - LA	0.01	0.00
	AR	Sac	0.03	0.01	0.00	na	na	Sac: Freeway - Arterial	-0.01	0.00
		LA	0.03	0.00	0.00	na	na	LA: Freeway - Arterial	0.00	0.00
PM10 S	FR	Sac	0.48	-0.01	-0.19	na	na	Freeway: Sac - LA	0.21	0.27
μg/m3		LA	1.56	-0.23	-0.46	na	na	Arterial: Sac - LA	0.93	0.70
	AR	Sac	0.44	-0.07	-0.16	na	na	Sac: Freeway - Arterial	0.05	-0.03
		LA	3.62	-0.99	-0.85	na	na	LA: Freeway - Arterial	0.77	0.39

Note: a Expected n values for Sacramento are: FR (4), AR (4)
Expected n values for Los Angeles are: FR (4), AR (4)
b Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-3D. Influence of Roadway Type on PM2.5 Commute-Average Concentration Data

				Concentrations (corrected for Ambient) in Measure Units						
	Type	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Comparisons:	Car 1	Car 2
PM 2.5 mass µg/m3	FR	Sac	6.3	8.2	0.2	14.2	6.7	Freeway: Sac - LA	-4.1	0.3
		LA	32.1	12.3	-0.1	21.6	10.0	Arterial: Sac - LA	6.0	14.5
	AR	Sac	10.6	-1.0	-0.6	6.8	2.4	Sac: Freeway - Arterial	9.2	0.8
		LA	48.0	-7.0	-15.1	16.0	-9.4	LA: Freeway - Arterial	19.3	15.0
PM2.5 Cd µg/m3	FR	Sac	0.10	0.00	0.00	0.00	0.00	Freeway: Sac - LA	0.00	0.00
		LA	0.10	0.00	0.00	0.00	0.00	Arterial: Sac - LA	0.00	0.00
	AR	Sac	0.10	0.00	0.00	0.00	0.00	Sac: Freeway - Arterial	0.00	0.00
		LA	0.10	0.00	0.00	0.00	0.00	LA: Freeway - Arterial	0.00	0.00
PM2.5 Cr µg/m3	FR	Sac	0.10	0.00	0.00	0.00	0.00	Freeway: Sac - LA	0.00	0.00
		LA	0.10	0.00	0.00	0.00	0.00	Arterial: Sac - LA	0.00	0.00
	AR	Sac	0.10	0.00	0.00	0.00	0.00	Sac: Freeway - Arterial	0.00	0.00
		LA	0.10	0.00	0.00	0.00	0.00	LA: Freeway - Arterial	0.00	0.00
PM2.5 Mn µg/m3	FR	Sac	0.35	-0.08	0.02	0.08	0.01	Freeway: Sac - LA	-0.08	0.02
		LA	0.35	0.00	0.00	0.01	0.00	Arterial: Sac - LA	-0.08	0.00
	AR	Sac	0.35	-0.08	0.00	-0.07	0.00	Sac: Freeway - Arterial	0.00	0.02
		LA	0.35	0.00	0.00	0.00	0.00	LA: Freeway - Arterial	0.00	0.00
PM2.5 Ni µg/m3	FR	Sac	0.03	0.01	0.00	0.00	0.00	Freeway: Sac - LA	0.01	0.00
		LA	0.03	0.00	0.00	0.00	0.00	Arterial: Sac - LA	0.00	0.00
	AR	Sac	0.03	0.00	0.00	0.00	0.00	Sac: Freeway - Arterial	0.01	0.00
		LA	0.03	0.00	0.00	0.00	0.01	LA: Freeway - Arterial	0.00	0.00
PM2.5 Pb µg/m3	FR	Sac	0.03	0.01	0.01	0.02	0.00	Freeway: Sac - LA	0.01	0.01
		LA	0.03	0.01	0.00	0.00	0.00	Arterial: Sac - LA	0.00	0.01
	AR	Sac	0.03	0.01	0.01	0.03	0.01	Sac: Freeway - Arterial	0.00	0.00
		LA	0.03	0.01	0.00	0.00	0.00	LA: Freeway - Arterial	0.00	0.00
PM2.5 S µg/m3	FR	Sac	0.40	0.02	-0.11	0.06	-0.02	Freeway: Sac - LA	0.03	0.05
		LA	1.34	-0.01	-0.16	0.08	-0.09	Arterial: Sac - LA	0.60	0.64
	AR	Sac	0.39	-0.06	-0.18	0.00	-0.13	Sac: Freeway - Arterial	0.08	0.08
		LA	3.09	-0.66	-0.82	-0.07	-0.49	LA: Freeway - Arterial	0.65	0.66

Note: a Expected n values for Sacramento are: FR (4), AR (4)
Expected n values for Los Angeles are: FR (4), AR (4)
b Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-3E. Influence of Roadway Type on Commute-Average Associated Measures

				Concentrations (corrected for Ambient) in Measure Units						
	Type	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Scenario Comparisons:	Car 1	Car 2
Speed (mph)	FR	Sac	na	32.5	na	na	na	Freeway: Sac - LA	-9.6	na
		LA	na	42.1	na	na	na	Arterial: Sac - LA	2.1	na
	AR	Sac	na	23.8	na	na	na	Sac: Freeway - Arterial	8.7	na
		LA	na	21.7	na	na	na	LA: Freeway - Arterial	20.4	na
Spacing Range (fee)	FR	Sac	na	68.9	na	na	na	Freeway: Sac - LA	18.5	na
		LA	na	50.4	na	na	na	Arterial: Sac - LA	19.2	na
	AR	Sac	na	74.4	na	na	na	Sac: Freeway - Arterial	-5.5	na
		LA	na	55.2	na	na	na	LA: Freeway - Arterial	-4.7	na
Level of Congestion (unitless)	FR	Sac	na	3.9	na	na	na	Freeway: Sac - LA	0.5	na
		LA	na	3.3	na	na	na	Arterial: Sac - LA	-0.2	na
	AR	Sac	na	2.5	na	na	na	Sac: Freeway - Arterial	1.4	na
		LA	na	2.7	na	na	na	LA: Freeway - Arterial	0.6	na
Miles Traveled	FR	Sac	na	68.3	na	na	na	Freeway: Sac - LA	-15.9	na
		LA	na	84.2	na	na	na	Arterial: Sac - LA	6.1	na
	AR	Sac	na	49.1	na	na	na	Sac: Freeway - Arterial	19.2	na
		LA	na	43.0	na	na	na	LA: Freeway - Arterial	41.2	na
Heavy Duty Diesel Influence (% of commute)	FR	Sac	na	50%	na	na	na	Freeway: Sac - LA	-26%	na
		LA	na	82%	na	na	na	Arterial: Sac - LA	2%	na
	AR	Sac	na	4%	na	na	na	Sac: Freeway - Arterial	52%	na
		LA	na	2%	na	na	na	LA: Freeway - Arterial	80%	na

Note: a Expected n values for Sacramento are: FR (4), AR (4)
Expected n values for Los Angeles are: FR (4), AR (4)
b Values are ug/m3, unless noted otherwise in measure column
a Not Avaliable (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

4.2.4 Freeway Congestion Influence (Rush and Non-Rush)

Tables 4-4 (A thru E) summarize the concentration data for non-special commutes for all measures focusing on the influence of freeway congestion level on the in-vehicle concentration levels. Mean values for ambient-corrected IN 1, IN 2, OUT 1, and OUT 2 were stratified by freeway rush (FR) and freeway non-rush (FNR) commutes and computed for Sacramento and Los Angeles. To focus on the in-vehicle concentration influences for the Caprice, differences were computed between city and scenario means as given in the last column.

Intuitively, Los Angeles rush periods might be expected to be higher than those for Sacramento for freeway rush and freeway non-rush periods, given the larger freeways and greater traffic volumes. Similarly, freeway rush would be expected to be higher than freeway non-rush periods. The traffic measures in Table 4-4E show that these expectations are generally consistent for most of the freeway-generated pollutants measured. The LA freeway rush commutes produced significantly higher in-vehicle concentrations for MTBE, benzene, $PM_{2.5}$, and CO, than did the Sacramento commutes. This trend was even more pronounced for the freeway non-rush commutes (except for CO), comparing LA to Sacramento. An assessment of the general influence of freeway congestion level on in-vehicle concentrations could not be defined that applied in all cases.

While in-vehicle levels for rush commutes were higher in Sacramento compared to non-rush, the reverse appeared to be true in Los Angeles for MTBE, benzene, and $PM_{2.5}$. Closer inspection of the individual commute data, however, showed that single, unusual commutes had strong influences on the commute averages. Both the MTBE and benzene IN1 Rush levels in LA for 9/26 AM were relatively low, while the $PM_{2.5}$ IN1 Non-Rush level for 9/25 AM was relatively high. The undue influence of these single values suggests that the limited data set is too small and variable to be definitive. The FR commutes in LA had an unexpectedly higher speed and greater miles traveled than in Sacramento, consistent with a slightly lower Level of Congestion in LA. Even with the higher LA rush period speeds, the vehicle spacing in LA for both FR and FNR were substantially smaller. As expected, the vehicle speeds were somewhat greater during non-rush periods in both cities.

The scenario differences for MTBE, benzene, and $PM_{2.5}$ levels inside Vehicle 1 were consistently related inversely with the vehicle spacing comparisons in Table 4-4E. This consistency supports the observation that spacing to the lead vehicle is potentially an important factor in the in-vehicle concentration levels for pollutants generated on the roadway, and even more important if the lead vehicle is a significant source. This observation was less consistent for those pollutants with significant non-vehicular sources. Similar analyses were impossible for the pollutant measures that did not have an ambient background correction (e.g. particle count and black carbon). Although the freeway congestion level generally dictates a spacing between vehicles (spacing usually decreases as congestion increases), the driver may have some latitude in how closely leading vehicles are followed (or whether to change to a different lane position). In general, the Freeway Rush commutes did appear to show higher background-corrected in-vehicle concentrations than did the Non-Rush commutes.

Table 4-4A. Influence of Freeway Congestion Level on Organic Commute-Average Concentration Data

				Concentrations (corrected for Ambient) in Measure Units						
Measure	**Type**	**City**	**AMB mean**	**IN 1 mean**	**IN 2 mean**	**OUT 1 mean**	**OUT 2 mean**	**Inside Comparisons:**	**Car 1**	**Car 2**
Isobutylene	FR	Sac	1.9	8.5	10.5	8.3	7.7	Rush: Sac - LA	-2.8	-2.0
μg/m3		LA	5.2	11.3	12.5	12.5	12.0	Non-Rush: Sac - LA	-6.7	-5.1
	FNR	Sac	1.2	4.8	3.8	4.5	3.5	Sac: Rush - Non-Rush	3.7	6.7
		LA	5.8	11.5	8.9	12.0	11.3	LA: Rush - Non-Rush	-0.2	3.6
1,3-Butadiene	FR	Sac	0.1	2.6	2.7	2.7	2.2	Rush: Sac - LA	-0.5	-0.3
μg/m3		LA	0.7	3.1	3.0	3.4	3.0	Non-Rush: Sac - LA	-1.9	-1.5
	FNR	Sac	0.1	1.8	1.3	1.2	1.1	Sac: Rush - Non-Rush	0.8	1.4
		LA	0.4	3.7	2.8	3.6	3.2	LA: Rush - Non-Rush	-0.6	0.2
Acetonitrile	FR	Sac	45.3	71.4	177.2	-43.5	62.5	Rush: Sac - LA	-59.4	15.8
μg/m3		LA	19.9	130.8	161.4	-14.1	76.9	Non-Rush: Sac - LA	6.7	-18.5
	FNR	Sac	22.5	22.2	17.8	-20.6	21.5	Sac: Rush - Non-Rush	49.2	159.4
		LA	9.7	15.5	36.3	-6.2	30.1	LA: Rush - Non-Rush	115.4	125.1
DCM	FR	Sac	1.9	-0.9	-0.2	-0.8	0.0	Rush: Sac - LA	-0.6	-0.3
μg/m3		LA	3.0	-0.3	0.0	0.3	0.1	Non-Rush: Sac - LA	13.2	12.9
	FNR	Sac	1.1	-0.2	-0.3	0.0	0.2	Sac: Rush - Non-Rush	-0.7	0.1
		LA	16.9	-13.4	-13.2	-13.5	-13.3	LA: Rush - Non-Rush	13.0	13.3
MTBE	FR	Sac	3.2	19.8	17.7	18.0	15.4	Rush: Sac - LA	-4.4	-5.3
μg/m3		LA	13.5	24.3	23.0	28.0	22.9	Non-Rush: Sac - LA	-17.5	-9.7
	FNR	Sac	2.0	8.6	9.4	11.3	9.8	Sac: Rush - Non-Rush	11.2	8.3
		LA	15.3	26.1	19.1	26.4	25.1	LA: Rush - Non-Rush	-1.9	3.9
ETBE	FR	Sac	0.1	0.0	-0.1	-0.1	-0.1	Rush: Sac - LA	0.0	0.0
μg/m3		LA	0.1	-0.1	-0.1	-0.1	-0.1	Non-Rush: Sac - LA	0.1	0.1
	FNR	Sac	0.0	0.0	0.0	0.0	0.0	Sac: Rush - Non-Rush	-0.1	-0.1
		LA	0.1	-0.1	-0.1	-0.1	-0.1	LA: Rush - Non-Rush	0.0	0.0
TCFM	FR	Sac	2.2	0.2	0.8	0.1	0.6	Rush: Sac - LA	0.4	0.9
μg/m3		LA	1.8	-0.2	-0.1	0.1	-0.1	Non-Rush: Sac - LA	-0.5	-0.6
	FNR	Sac	1.8	-0.2	-0.3	-0.1	-0.2	Sac: Rush - Non-Rush	0.3	1.1
		LA	1.4	0.3	0.4	0.4	0.5	LA: Rush - Non-Rush	-0.5	-0.4
Benzene	FR	Sac	1.4	8.9	12.5	9.8	10.9	Rush: Sac - LA	-1.5	1.0
μg/m3		LA	4.0	10.4	11.5	11.0	11.1	Non-Rush: Sac - LA	-4.9	-2.3
	FNR	Sac	0.9	5.7	6.4	5.7	6.3	Sac: Rush - Non-Rush	3.2	6.1
		LA	3.9	10.6	8.6	10.6	10.1	LA: Rush - Non-Rush	-0.2	2.8
Toluene	FR	Sac	4.6	27.3	22.9	19.5	20.6	Rush: Sac - LA	12.3	10.7
μg/m3		LA	19.0	15.0	12.2	15.4	12.9	Non-Rush: Sac - LA	8.5	16.4
	FNR	Sac	5.8	7.4	9.5	8.4	12.5	Sac: Rush - Non-Rush	20.0	13.4
		LA	39.9	-1.1	-7.0	-0.7	-1.2	LA: Rush - Non-Rush	16.1	19.2
Ethylbenzene	FR	Sac	0.7	4.8	4.3	3.9	3.8	Rush: Sac - LA	-0.4	0.3
μg/m3		LA	2.2	5.2	4.0	5.0	4.0	Non-Rush: Sac - LA	-5.4	-4.6
	FNR	Sac	3.2	-0.3	-0.7	-0.6	-0.7	Sac: Rush - Non-Rush	5.0	5.0
		LA	2.1	5.2	3.9	5.2	4.7	LA: Rush - Non-Rush	0.0	0.1
M,P-Xylene	FR	Sac	2.7	22.0	18.4	16.7	16.1	Rush: Sac - LA	1.3	2.3
μg/m3		LA	7.4	20.8	16.0	20.3	16.5	Non-Rush: Sac - LA	-10.5	-6.6
	FNR	Sac	1.8	10.7	9.2	8.9	8.9	Sac: Rush - Non-Rush	11.3	9.2
		LA	5.7	21.2	15.8	20.9	18.8	LA: Rush - Non-Rush	-0.5	0.2
O-Xylene	FR	Sac	1.5	6.9	5.7	5.2	5.1	Rush: Sac - LA	-0.3	0.0
μg/m3		LA	2.8	7.2	5.7	7.1	5.8	Non-Rush: Sac - LA	-3.5	-2.1
	FNR	Sac	0.7	3.7	3.2	3.1	3.0	Sac: Rush - Non-Rush	3.2	2.5
		LA	2.5	7.2	5.3	7.1	6.4	LA: Rush - Non-Rush	0.0	0.4
Formaldehyde	FR	Sac	4.0	7.7	8.7	na	na	Rush: Sac - LA	-2.0	-2.7
μg/m3		LA	6.7	9.6	11.4	na	na	Non-Rush: Sac - LA	5.9	11.4
	FNR	Sac	4.0	3.7	3.5	na	na	Sac: Rush - Non-Rush	7.9	5.2
		LA	21.1	-4.1	-7.9	na	na	LA: Rush - Non-Rush	-6.2	19.2

Note: a Expected n values for Sacramento are: FR (4), FNR (2)
Expected n values for Los Angeles are: FR (4), FNR (2)
Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-4B. Influence of Freeway Congestion Level on Continuous Commute-Average Concentration Data

				Concentrations (corrected for Ambient) in Measure Units						
Measure	**Type**	**City**	**AMB mean**	**IN 1 mean**	**IN 2 mean**	**OUT 1 mean**	**OUT 2 mean**	**Inside Comparisons:**	**Car 1**	**Car 2**
CO Avg (ppm)	FR	Sac	0.0	2.1	3.1	2.2	4.2	Rush: Sac - LA	-3.0	-2.2
		LA	0.5	5.1	5.4	5.3	5.6	Non-Rush: Sac - LA	-2.9	-0.9
	FNR	Sac	0.0	1.5	3.5	2.2	3.9	Sac: Rush - Non-Rush	0.6	-0.4
		LA	1.3	4.4	4.5	4.4	4.7	LA: Rush - Non-Rush	0.7	0.9
CO Peak (ppm)	FR	Sac	0.0	10.5	22.3	11.5	25.8	Rush: Sac - LA	-23.5	9.5
		LA	1.3	34.0	12.8	31.5	14.8	Non-Rush: Sac - LA	-13.5	-5.0
	FNR	Sac	0.0	13.0	12.5	14.0	13.0	Sac: Rush - Non-Rush	-2.5	9.8
		LA	3.0	26.5	17.5	44.5	20.0	LA: Rush - Non-Rush	7.5	-4.8
Black Carbon µg/m3	FR	Sac	na	6.7	na	7.9	na	Rush: Sac - LA	-3.7	na
		LA	na	10.4	na	17.7	na	Non-Rush: Sac - LA	-3.7	na
	FNR	Sac	na	8.3	na	4.0	na	Sac: Rush - Non-Rush	-1.6	na
		LA	na	12.1	na	16.4	na	LA: Rush - Non-Rush	-1.6	na
LAS-X particle counts/cm3	FR	Sac	na	759	na	1,942	na	Rush: Sac - LA	-2,202	na
		LA	na	2,960	na	6,724	na	Non-Rush: Sac - LA	-3,046	na
	FNR	Sac	na	991	na	1,857	na	Sac: Rush - Non-Rush	-232	na
		LA	na	4,037	na	8,528	na	LA: Rush - Non-Rush	-1,077	na

Note: a Expected n values for Sacramento are: FR (4), FNR (2)
Expected n values for Los Angeles are: FR (4), FNR (2)
Values are ug/m3, unless noted otherwise in measure column
Ambient data not available to correct black carbon or LAS-X data
LAS-X OUT data corrected for sampling line losses
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-4C. Influence of Freeway Congestion Level on PM10 Commute-Average Concentration Data

				Concentrations (corrected for Ambient) in Measure Units						
Measure	Type	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Comparisons:	Car 1	Car 2
PM 10 mass	FR	Sac	22.7	7.5	-17.2	na	na	Rush: Sac - LA	12.2	6.2
μg/m3		LA	59.5	-4.7	-23.3	na	na	Non-Rush: Sac - LA	-12.6	-25.2
	FNR	Sac	29.4	0.2	-16.0	na	na	Sac: Rush - Non-Rush	7.3	-1.1
		LA	53.8	12.8	9.2	na	na	LA: Rush - Non-Rush	-17.4	-32.5
PM10 Cd	FR	Sac	0.10	0.00	0.00	na	na	Rush: Sac - LA	-0.02	0.00
μg/m3		LA	0.10	0.02	0.00	na	na	Non-Rush: Sac - LA	-0.03	-0.03
	FNR	Sac	0.13	-0.03	-0.03	na	na	Sac: Rush - Non-Rush	0.03	0.03
		LA	0.10	0.00	0.00	na	na	LA: Rush - Non-Rush	0.02	0.00
PM10 Cr	FR	Sac	0.40	0.00	0.00	na	na	Rush: Sac - LA	0.00	0.00
μg/m3		LA	0.40	0.00	0.00	na	na	Non-Rush: Sac - LA	0.00	0.00
	FNR	Sac	0.40	0.00	0.00	na	na	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.40	0.00	0.00	na	na	LA: Rush - Non-Rush	0.00	0.00
PM10 Mn	FR	Sac	0.04	0.00	0.00	na	na	Rush: Sac - LA	0.00	0.00
μg/m3		LA	0.04	0.00	0.00	na	na	Non-Rush: Sac - LA	0.00	0.00
	FNR	Sac	0.04	0.00	0.00	na	na	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.04	0.00	0.00	na	na	LA: Rush - Non-Rush	0.00	0.00
PM10 Ni	FR	Sac	0.03	0.00	0.00	na	na	Rush: Sac - LA	0.00	0.00
μg/m3		LA	0.03	0.00	0.00	na	na	Non-Rush: Sac - LA	0.00	0.00
	FNR	Sac	0.03	0.00	0.00	na	na	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.03	0.00	0.00	na	na	LA: Rush - Non-Rush	0.00	0.00
PM10 Pb	FR	Sac	0.03	0.00	0.00	na	na	Rush: Sac - LA	0.00	0.00
μg/m3		LA	0.03	0.00	0.00	na	na	Non-Rush: Sac - LA	0.00	0.00
	FNR	Sac	0.03	0.00	0.00	na	na	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.03	0.00	0.00	na	na	LA: Rush - Non-Rush	0.00	0.00
PM10 S	FR	Sac	0.48	-0.01	-0.19	na	na	Rush: Sac - LA	0.21	0.27
μg/m3		LA	1.56	-0.23	-0.46	na	na	Non-Rush: Sac - LA	-0.03	-0.25
	FNR	Sac	0.68	-0.07	-0.20	na	na	Sac: Rush - Non-Rush	0.06	0.01
		LA	1.69	-0.04	0.06	na	na	LA: Rush - Non-Rush	-0.19	-0.52

Note: a Expected n values for Sacramento are: FR (4), FNR (2)
Expected n values for Los Angeles are: FR (4), FNR (2)
Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-4D. Influence of Freeway Congestion Level on PM2.5 Commute-Average Concentration Data

Measure	Type	City	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Comparisons:	Car 1	Car 2
				Concentrations (corrected for Ambient) in Measure Units						
PM 2.5 mass µg/m3	FR	Sac	5.7	8.8	1.0	14.8	7.3	Rush: Sac - LA	-3.5	1.1
		LA	32.1	12.3	-0.1	21.6	10.0	Non-Rush: Sac - LA	-17.3	-9.5
	FNR	Sac	10.3	4.1	2.1	12.7	5.1	Sac: Rush - Non-Rush	4.7	-1.1
		LA	33.3	21.4	11.6	35.0	13.9	LA: Rush - Non-Rush	-9.1	-11.7
PM2.5 Cd µg/m3	FR	Sac	0.10	0.00	0.00	0.00	0.00	Rush: Sac - LA	0.00	0.00
		LA	0.10	0.00	0.00	0.00	0.00	Non-Rush: Sac - LA	0.09	0.05
	FNR	Sac	0.10	0.00	0.00	0.00	0.00	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.14	-0.09	-0.04	-0.09	-0.04	LA: Rush - Non-Rush	0.09	0.04
PM2.5 Cr µg/m3	FR	Sac	0.40	0.00	0.00	0.00	0.00	Rush: Sac - LA	0.00	0.00
		LA	0.40	0.00	0.00	0.00	0.00	Non-Rush: Sac - LA	0.00	0.00
	FNR	Sac	0.40	0.00	0.00	0.00	0.00	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.40	0.00	0.00	0.00	0.00	LA: Rush - Non-Rush	0.00	0.00
PM2.5 Mn µg/m3	FR	Sac	0.04	0.00	0.00	0.00	0.00	Rush: Sac - LA	0.00	0.00
		LA	0.00	0.00	0.00	0.00	0.00	Non-Rush: Sac - LA	0.00	0.00
	FNR	Sac	0.04	0.00	0.00	0.00	0.00	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.04	0.00	0.00	0.00	0.00	LA: Rush - Non-Rush	0.00	0.00
PM2.5 Ni µg/m3	FR	Sac	0.03	0.00	0.00	0.00	0.00	Rush: Sac - LA	0.00	0.00
		LA	0.03	0.00	0.00	0.00	0.00	Non-Rush: Sac - LA	0.00	0.00
	FNR	Sac	0.03	0.00	0.00	0.00	0.00	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.03	0.00	0.00	0.00	0.00	LA: Rush - Non-Rush	0.00	0.00
PM2.5 Pb µg/m3	FR	Sac	0.03	0.00	0.00	0.00	0.00	Rush: Sac - LA	0.00	0.00
		LA	0.03	0.00	0.00	0.00	0.00	Non-Rush: Sac - LA	0.00	0.00
	FNR	Sac	0.03	0.00	0.00	0.00	0.00	Sac: Rush - Non-Rush	0.00	0.00
		LA	0.03	0.00	0.00	0.00	0.00	LA: Rush - Non-Rush	0.00	0.00
PM2.5 S µg/m3	FR	Sac	0.40	0.02	-0.11	0.06	0.01	Rush: Sac - LA	0.03	0.05
		LA	1.34	-0.01	-0.16	0.08	-0.13	Non-Rush: Sac - LA	0.19	0.30
	FNR	Sac	0.59	0.08	-0.07	0.08	0.06	Sac: Rush - Non-Rush	-0.06	-0.04
		LA	1.71	-0.11	-0.37	0.07	0.10	LA: Rush - Non-Rush	0.10	0.21

Note: a Expected n values for Sacramento are: FR (4), FNR (2)
Expected n values for Los Angeles are: FR (4), FNR (2)
Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-4E. Influence of Freeway Congestion Level on Commute-Average Associated Measures

				Measure Units						
Measure	**Type**	**City**	**AMB mean**	**IN 1 mean**	**IN 2 mean**	**OUT 1 mean**	**OUT 2 mean**	**Scenario Comparisons:**	**Car 1**	**Car 2**
Speed (mph)	FR	Sac	na	32.5	na	na	na	Rush: Sac - LA	-9.6	na
		LA	na	42.1	na	na	na	Non-Rush: Sac - LA	1.4	na
	FNR	Sac	na	48.6	na	na	na	Sac: Rush - Non-Rush	-16.1	na
		LA	na	47.3	na	na	na	LA: Rush - Non-Rush	-5.1	na
Spacing Range (feet)	FR	Sac	na	68.9	na	na	na	Rush: Sac - LA	18.5	na
		LA	na	50.4	na	na	na	Non-Rush: Sac - LA	44.6	na
	FNR	Sac	na	90.4	na	na	na	Sac: Rush - Non-Rush	-21.4	na
		LA	na	45.7	na	na	na	LA: Rush - Non-Rush	4.7	na
Level of Congestion (unitless)	FR	Sac	na	3.9	na	na	na	Rush: Sac - LA	0.5	na
		LA	na	3.3	na	na	na	Non-Rush: Sac - LA	-1.1	na
	FNR	Sac	na	2.5	na	na	na	Sac: Rush - Non-Rush	1.3	na
		LA	na	3.6	na	na	na	LA: Rush - Non-Rush	-0.3	na
Miles Traveled	FR	Sac	na	68.3	na	na	na	Rush: Sac - LA	-15.9	na
		LA	na	84.2	na	na	na	Non-Rush: Sac - LA	3.8	na
	FNR	Sac	na	99.1	na	na	na	Sac: Rush - Non-Rush	-30.9	na
		LA	na	95.3	na	na	na	LA: Rush - Non-Rush	-11.1	na
Heavy Duty Diesel Influence % of commute	FR	Sac	na	50%	na	na	na	Rush: Sac - LA	-32%	na
		LA	na	82%	na	na	na	Non-Rush: Sac - LA	39%	na
	FNR	Sac	na	84%	na	na	na	Sac: Rush - Non-Rush	-34%	na
		LA	na	45%	na	na	na	LA: Rush - Non-Rush	37%	na

Note: a Expected n values for Sacramento are: FR (4), FNR (2)
Expected n values for Los Angeles are: FR (4), FNR (2)
Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

4.2.5 Freeway Commute Period Influence (AM vs PM)

Tables 4-5 (A thru E) summarize the concentration data for non-special commutes for all measures focusing on the influence of the rush hour period (AM or PM) on the in-vehicle concentration levels. Mean values for ambient-corrected IN 1, IN 2, OUT 1, and OUT 2 were stratified by freeway rush (FR) and freeway non-rush (FNR) commutes and computed for Sacramento and Los Angeles. To focus on the in-vehicle concentration influences for the Caprice, differences were computed between city and scenario means as given in the last column.

An initial review of the vehicle measures and the meteorology in Table 4-5E showed that while PM wind speeds were essential the same as AM in Sacramento, they were substantially higher by 5 mph in Los Angeles. Plotting the ambient-corrected in-vehicle MTBE and benzene concentrations versus wind speed for Los Angeles (see Figure 4-3) suggested that the concentration levels of both VOC's tended to increase at the lower AM wind speeds. This might have resulted from an increased dilution of the roadway microenvironmental pollutant concentrations as the wind turbulence levels increase. Another possibility is that the traffic density is different between AM and PM. Examination of the Level of Congestion for LA, however, showed no significant difference in perceived congestion, with only a slight decrease in traffic speed and spacing.

A review of the data in Tables 4-5A and 4-5B show that MTBE, benzene, $PM_{2.5}$, and CO in-vehicle concentrations are all significantly higher in LA than Sacramento during the AM, but only slightly higher in the PM. This is attributed to the lower wind speed in LA during the AM period, combined with the generally higher concentration levels in LA, compared to Sacramento. While the AM in-vehicle concentrations were typically higher for LA, Sacramento data for MTBE, benzene, $PM_{2.5}$,and CO all showed the opposite trend, being significantly higher in the PM. This appears to be associated with the significant increase in PM Level of Congestion in Sacramento (Table 4-5E), as compared to the AM periods. While Sacramento had a significantly higher PM Level of Congestion (than AM), LA data showed little difference between AM and PM congestion. The $PM_{2.5}$ and PM_{10} sulfur Ambient levels in Tables 4-show substantially higher levels in LA, compared to Sacramento, but not on a background-corrected in-vehicle basis. This was also applicable to the formaldehyde levels.

In general, the PM commutes show substantially higher background-corrected pollutant concentrations in Sacramento, while the reverse was true in Los Angeles. The primary influencing factors appear to be the substantial increase in ambient PM wind speed in LA over AM, and the higher PM Level of Congestion in Sacramento, compared to the AM.

Table 4-5A. Influence of Time of Day on Organic Commute-Average Concentration Data

Measure	Type	Time Period	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Car 1 Comparisons	
			Concentrations (corrected for Ambient) in Measure Units						
Isobutylene	Sac	AM	2.5	7.2	5.7	5.7	5.4	AM: Sac - LA	-7.0
μg/m3		PM	1.7	8.6	9.6	8.9	7.4	PM: Sac - LA	-2.6
	LA	AM	5.6	14.2	12.6	14.1	12.5	Sac: AM - PM	-1.4
		PM	5.0	11.2	11.0	12.1	10.8	LA: AM - PM	3.0
1,3-Butadiene	Sac	AM	0.3	2.4	1.7	1.8	1.6	AM: Sac - LA	-1.1
μg/m3		PM	0.2	2.3	1.9	2.3	1.8	PM: Sac - LA	-0.5
	LA	AM	0.7	3.5	2.8	3.5	2.8	Sac: AM - PM	0.1
		PM	0.3	2.8	2.3	3.0	2.4	LA: AM - PM	0.7
Acetonitrile	Sac	AM	59.4	110.4	18.1	-57.9	-2.4	AM: Sac - LA	49.9
μg/m3		PM	15.1	65.5	237.6	-12.9	107.1	PM: Sac - LA	-101.5
	LA	AM	29.9	60.5	143.7	-25.8	75.6	Sac: AM - PM	44.9
		PM	9.4	167.0	150.6	-6.1	86.4	LA: AM - PM	-106.5
DCM	Sac	AM	2.1	-0.4	-0.9	-0.8	-0.3	AM: Sac - LA	4.2
μg/m3		PM	3.1	-1.9	-1.4	-1.7	-0.9	PM: Sac - LA	-1.2
	LA	AM	7.9	-4.6	-4.0	-3.9	-4.1	Sac: AM - PM	1.6
		PM	3.3	-0.8	-0.7	-1.0	-0.8	LA: AM - PM	-3.8
MTBE	Sac	AM	6.2	16.0	10.2	13.5	12.4	AM: Sac - LA	-14.9
μg/m3		PM	2.5	22.2	19.9	21.2	15.0	PM: Sac - LA	-0.6
	LA	AM	16.7	30.9	22.6	31.4	22.8	Sac: AM - PM	-6.2
		PM	12.6	22.8	18.6	24.6	19.5	LA: AM - PM	8.1
ETBE	Sac	AM	0.2	-0.1	0.0	0.0	0.0	AM: Sac - LA	0.0
μg/m3		PM	0.5	-0.4	-0.4	-0.4	0.0	PM: Sac - LA	-0.3
	LA	AM	0.1	-0.1	-0.1	-0.1	0.0	Sac: AM - PM	0.3
		PM	0.1	-0.1	-0.1	-0.1	-0.1	LA: AM - PM	0.0
TCFM	Sac	AM	2.5	4.7	-0.1	-0.1	0.1	AM: Sac - LA	4.6
μg/m3		PM	3.3	-0.8	-0.4	-0.8	0.6	PM: Sac - LA	-0.5
	LA	AM	1.6	0.1	0.2	0.2	0.1	Sac: AM - PM	5.5
		PM	1.8	-0.3	-0.2	-0.2	-0.2	LA: AM - PM	0.3
Benzene	Sac	AM	2.4	7.8	8.2	6.8	8.6	AM: Sac - LA	-4.4
μg/m3		PM	1.3	9.0	11.0	8.9	9.0	PM: Sac - LA	-0.3
	LA	AM	4.7	12.2	10.3	12.1	10.0	Sac: AM - PM	-1.2
		PM	3.4	9.3	9.0	9.6	9.1	LA: AM - PM	2.9
Toluene	Sac	AM	7.8	19.6	13.8	13.3	15.4	AM: Sac - LA	2.9
μg/m3		PM	4.8	26.9	21.3	19.4	18.2	PM: Sac - LA	8.7
	LA	AM	27.0	16.7	8.1	15.7	9.2	Sac: AM - PM	-7.3
		PM	13.2	18.2	14.5	18.3	15.3	LA: AM - PM	-1.5
Ethylbenzene	Sac	AM	2.4	3.3	2.0	2.3	2.0	AM: Sac - LA	-3.1
μg/m3		PM	0.8	5.5	4.2	4.3	3.9	PM: Sac - LA	0.7
	LA	AM	2.6	6.4	4.1	6.1	4.2	Sac: AM - PM	-2.2
		PM	1.9	4.8	3.6	4.6	3.8	LA: AM - PM	1.6
M,P-Xylene	Sac	AM	4.5	19.6	12.7	13.4	12.4	AM: Sac - LA	-6.7
μg/m3		PM	2.4	23.1	17.6	17.6	15.4	PM: Sac - LA	4.1
	LA	AM	8.3	26.4	17.0	25.2	17.5	Sac: AM - PM	-3.5
		PM	5.2	19.0	15.1	19.1	15.7	LA: AM - PM	7.4
O-Xylene	Sac	AM	1.9	6.4	4.2	4.5	4.2	AM: Sac - LA	-2.6
μg/m3		PM	1.4	7.3	5.5	5.6	5.2	PM: Sac - LA	0.8
	LA	AM	3.2	9.0	6.0	8.8	6.0	Sac: AM - PM	-0.9
		PM	2.2	6.6	5.4	6.6	5.5	LA: AM - PM	2.4
Formaldehyde	Sac	AM	3.4	7.8	6.3	na	na	AM: Sac - LA	2.5
μg/m3		PM	5.2	6.4	9.8	na	na	PM: Sac - LA	1.2
	LA	AM	11.1	5.3	6.0	na	na	Sac: AM - PM	1.4
		PM	13.5	5.2	1.7	na	na	LA: AM - PM	0.1

Note: a Expected n values for Sacramento are: AM (5), PM (5)
Expected n values for Los Angeles are: AM (6), PM (6)
b Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-5B. Influence of Time of Day on Continuous Commute-Average Concentration Data

Measure	Type	Time Period	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Car 1 Comparisons	
			Concentrations (corrected for Ambient) in Measure Units						
CO Avg (ppm)	Sac	AM	0.0	2.0	2.7	2.4	3.7	AM: Sac - LA	-2.6
		PM	0.0	2.1	3.6	2.3	4.4	PM: Sac - LA	-1.4
	LA	AM	0.6	4.6	4.5	5.2	5.2	Sac: AM - PM	-0.1
		PM	0.4	3.4	4.0	3.2	4.1	LA: AM - PM	1.1
CO Peak (ppm)	Sac	AM	0.6	8.6	9.4	16.5	12.0	AM: Sac - LA	-26.2
		PM	0.0	13.0	20.4	15.5	24.0	PM: Sac - LA	-4.3
	LA	AM	2.0	34.8	10.2	48.8	14.7	Sac: AM - PM	-4.4
		PM	0.8	17.3	11.5	20.5	14.3	LA: AM - PM	17.5
Black Carbon µg/m3	Sac	AM	na	5.4	na	5.8	na	AM: Sac - LA	-9.2
		PM	na	4.4	na	4.7	na	PM: Sac - LA	-10.3
	LA	AM	na	14.5	na	21.5	na	Sac: AM - PM	1.0
		PM	na	14.7	na	11.4	na	LA: AM - PM	-0.2
LASX total counts/cm3	Sac	AM	na	679	na	1,531	na	AM: Sac - LA	-2,958
		PM	na	818	na	1,614	na	PM: Sac - LA	-1,863
	LA	AM	na	3,637	na	7,370	na	Sac: AM - PM	-139
		PM	na	2,681	na	5,413	na	LA: AM - PM	956

Note: a Expected n values for Sacramento are: AM (5), PM (5)
Expected n values for Los Angeles are: AM (6), PM (6)
b Values are ug/m3, unless noted otherwise in measure column
Ambient data not available to correct black carbon or LAS-X data
LAS-X OUT data corrected for sampling line losses
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-5C. Influence of Time of Day on PM10 Commute-Average Concentration Data

Measure	Type	Time Period	AMB mean	Concentrations (corrected for Ambient) in Measure Units: IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Car 1 Comparisons	
PM 10 mass	Sac	AM	25.5	2.6	-14.1	na	na	AM: Sac - LA	23.0
μg/m3		PM	20.7	0.4	-10.8	na	na	PM: Sac - LA	9.9
	LA	AM	80.9	-20.3	-22.0	na	na	Sac: AM - PM	2.3
		PM	61.3	-9.5	-21.3	na	na	LA: AM - PM	-10.8
PM10 Cd	Sac	AM	0.11	-0.01	-0.01	na	na	AM: Sac - LA	-0.02
μg/m3		PM	0.10	0.00	0.00	na	na	PM: Sac - LA	0.00
	LA	AM	0.10	0.01	0.00	na	na	Sac: AM - PM	-0.01
		PM	0.10	0.00	0.01	na	na	LA: AM - PM	0.01
PM10 Cr	Sac	AM	0.40	0.00	0.00	na	na	AM: Sac - LA	0.00
μg/m3		PM	0.40	0.00	0.00	na	na	PM: Sac - LA	0.00
	LA	AM	0.40	0.00	0.00	na	na	Sac: AM - PM	0.00
		PM	0.40	0.00	0.00	na	na	LA: AM - PM	0.00
PM10 Mn	Sac	AM	0.04	0.00	0.00	na	na	AM: Sac - LA	0.00
μg/m3		PM	0.04	0.01	0.00	na	na	PM: Sac - LA	0.01
	LA	AM	0.04	0.00	0.00	na	na	Sac: AM - PM	-0.01
		PM	0.04	0.00	0.00	na	na	LA: AM - PM	0.00
PM10 Ni	Sac	AM	0.03	0.00	0.00	na	na	AM: Sac - LA	0.00
μg/m3		PM	0.03	0.00	0.00	na	na	PM: Sac - LA	0.00
	LA	AM	0.03	0.00	0.00	na	na	Sac: AM - PM	0.00
		PM	0.03	0.00	0.00	na	na	LA: AM - PM	0.00
PM10 Pb	Sac	AM	0.03	0.01	0.00	na	na	AM: Sac - LA	0.01
μg/m3		PM	0.03	0.00	0.00	na	na	PM: Sac - LA	0.00
	LA	AM	0.03	0.00	0.00	na	na	Sac: AM - PM	0.01
		PM	0.03	0.00	0.00	na	na	LA: AM - PM	0.00
PM10 S	Sac	AM	0.64	-0.06	-0.21	na	na	AM: Sac - LA	0.49
μg/m3		PM	0.37	-0.03	-0.15	na	na	PM: Sac - LA	0.42
	LA	AM	2.18	-0.56	-0.51	na	na	Sac: AM - PM	-0.03
		PM	2.58	-0.45	-0.56	na	na	LA: AM - PM	-0.10

Note: a Expected n values for Sacramento are: AM (5), PM (5)
Expected n values for Los Angeles are: AM (6), PM (6)
b Values are ug/m3, unless noted otherwise in measure column
na Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-5D. Influence of Time of Day on PM2.5 Commute-Average Concentration Data

Measure	Type	Time Period	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Car 1 Comparisons	
				Concentrations (corrected for Ambient) in Measure Units					
PM 2.5 mass µg/m3	Sac	AM	9.6	3.6	-0.7	11.8	8.1	AM: Sac - LA	-3.9
		PM	7.4	4.4	1.8	10.8	1.8	PM: Sac - LA	-0.2
	LA	AM	49.3	7.5	-4.3	25.2	0.9	Sac: AM - PM	-0.7
		PM	36.4	4.6	-4.3	14.8	-0.7	LA: AM - PM	2.9
PM2.5 Cd µg/m3	Sac	AM	0.10	0.00	0.01	0.00	0.00	AM: Sac - LA	0.01
		PM	0.10	0.00	0.00	0.00	0.00	PM: Sac - LA	0.00
	LA	AM	0.11	-0.01	-0.01	-0.01	-0.01	Sac: AM - PM	0.00
		PM	0.10	0.00	0.01	0.00	0.00	LA: AM - PM	-0.01
PM2.5 Cr µg/m3	Sac	AM	0.40	0.00	0.00	0.00	0.00	AM: Sac - LA	0.00
		PM	0.40	0.00	0.00	0.00	0.00	PM: Sac - LA	0.00
	LA	AM	0.40	0.00	0.00	0.00	0.00	Sac: AM - PM	0.00
		PM	0.40	0.00	0.00	0.00	0.00	LA: AM - PM	0.00
PM2.5 Mn µg/m3	Sac	AM	0.04	0.00	0.00	0.00	0.00	AM: Sac - LA	0.00
		PM	0.04	0.00	0.00	0.00	0.00	PM: Sac - LA	0.00
	LA	AM	0.04	0.00	0.00	0.00	0.00	Sac: AM - PM	0.00
		PM	0.04	0.00	0.00	0.00	0.00	LA: AM - PM	0.00
PM2.5 Ni µg/m3	Sac	AM	0.03	0.00	0.00	0.00	0.00	AM: Sac - LA	0.00
		PM	0.03	0.00	0.00	0.00	0.00	PM: Sac - LA	0.00
	LA	AM	0.03	0.00	0.00	0.00	0.00	Sac: AM - PM	0.00
		PM	0.03	0.00	0.00	0.00	0.00	LA: AM - PM	0.00
PM2.5 Pb µg/m3	Sac	AM	0.03	0.00	0.00	0.00	0.00	AM: Sac - LA	-0.01
		PM	0.03	0.00	0.00	0.00	0.00	PM: Sac - LA	0.00
	LA	AM	0.03	0.01	0.00	0.01	0.00	Sac: AM - PM	0.00
		PM	0.03	0.00	0.00	0.00	0.00	LA: AM - PM	0.01
PM2.5 S µg/m3	Sac	AM	0.53	0.03	-0.15	0.07	-0.05	AM: Sac - LA	0.32
		PM	0.34	-0.02	-0.11	0.01	-0.02	PM: Sac - LA	0.43
	LA	AM	2.04	-0.30	-0.53	-0.01	-0.40	Sac: AM - PM	0.05
		PM	2.59	-0.45	-0.62	-0.07	-0.48	LA: AM - PM	0.15

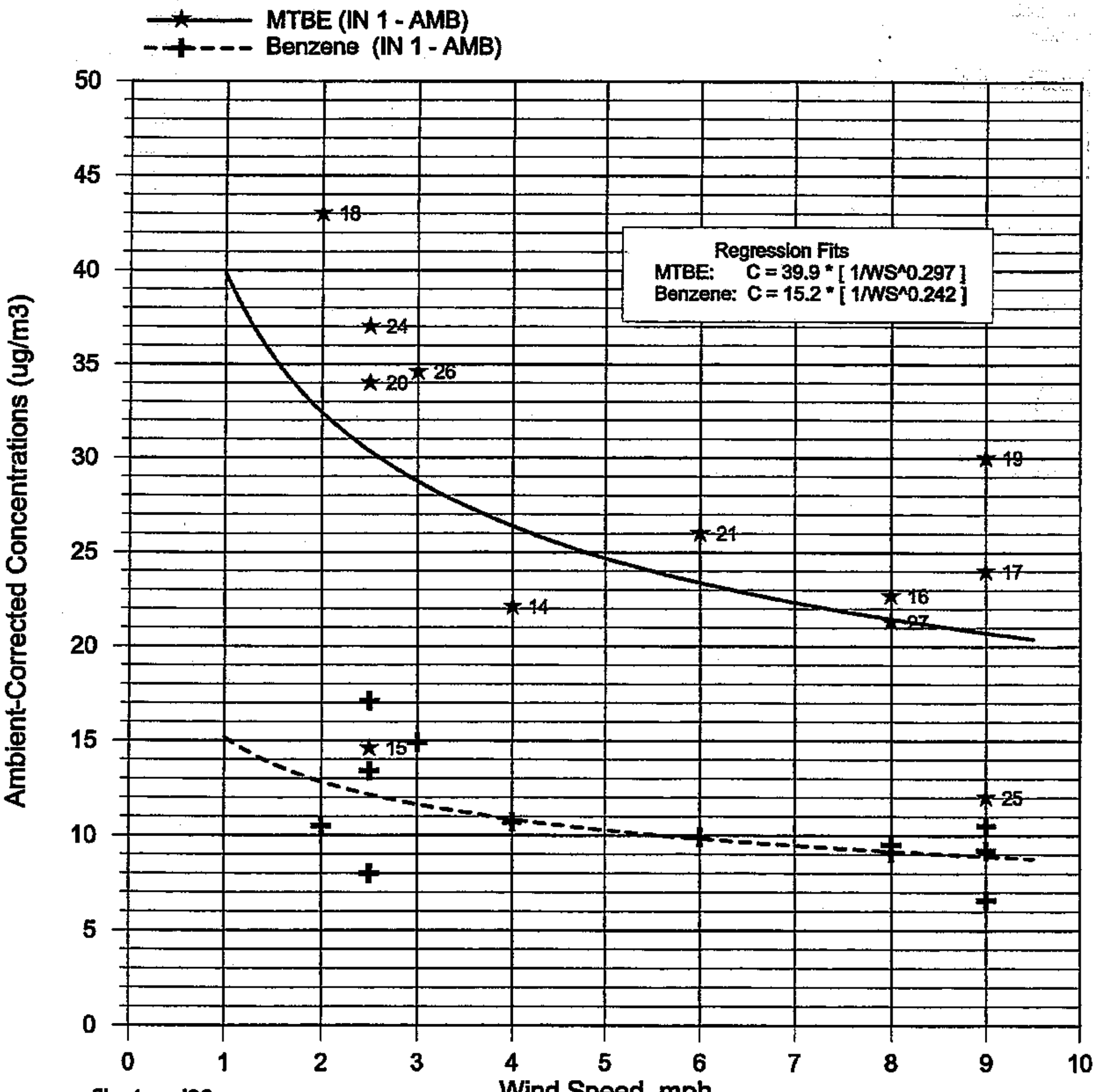
Note: a Expected n values for Sacramento are: AM (5), PM (5)
Expected n values for Los Angeles are: AM (6), PM (6)
b Values are ug/m3, unless noted otherwise in measure column
NA Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Table 4-5E. Influence of Time of Day on Commute-Average Associated Measures & Meteorology

Measure	Type	Time Period	AMB mean	IN 1 mean	IN 2 mean	OUT 1 mean	OUT 2 mean	Inside Car 1 Comparisons	
			Measures in specified units						
Measure									
Speed (mph)	Sac	AM	na	35.9	na	na	na	AM: Sac - LA	1.1
		PM	na	28.7	na	na	na	PM: Sac - LA	-6.6
	LA	AM	na	34.7	na	na	na	Sac: AM - PM	7.2
		PM	na	35.3	na	na	na	LA: AM - PM	-0.5
Spacing Range (feet)	Sac	AM	na	69.6	na	na	na	AM: Sac - LA	28.1
		PM	na	81.2	na	na	na	PM: Sac - LA	20.0
	LA	AM	na	41.5	na	na	na	Sac: AM - PM	-11.7
		PM	na	61.3	na	na	na	LA: AM - PM	-19.7
Level of Congestion (unitless)	Sac	AM	na	2.2	na	na	na	AM: Sac - LA	-1.1
		PM	na	3.9	na	na	na	PM: Sac - LA	0.9
	LA	AM	na	3.3	na	na	na	Sac: AM - PM	-1.7
		PM	na	3.0	na	na	na	LA: AM - PM	0.3
Miles Traveled	Sac	AM	na	73.7	na	na	na	AM: Sac - LA	12.2
		PM	na	59.8	na	na	na	PM: Sac - LA	-14.5
	LA	AM	na	61.6	na	na	na	Sac: AM - PM	14.0
		PM	na	74.3	na	na	na	LA: AM - PM	-12.8
Heavy Duty Diesel Influence % of commute	Sac	AM	na	38%	na	na	na	AM: Sac - LA	-5%
		PM	na	39%	na	na	na	PM: Sac - LA	11%
	LA	AM	na	43%	na	na	na	Sac: AM - PM	-1%
		PM	na	28%	na	na	na	LA: AM - PM	15%
WindSpeed mph	Sac	AM	4.3	na	na	na	na	AM: Sac - LA	1.5
		PM	4.9	na	na	na	na	PM: Sac - LA	-3.3
	LA	AM	2.8	na	na	na	na	Sac: AM - PM	-0.6
		PM	8.2	na	na	na	na	LA: AM - PM	-5.4
Temp deg. F	Sac	AM	71.2	na	na	na	na	AM: Sac - LA	-4.6
		PM	78.4	na	na	na	na	PM: Sac - LA	-0.4
	LA	AM	75.8	na	na	na	na	Sac: AM - PM	-7.2
		PM	78.8	na	na	na	na	LA: AM - PM	-3.0
Relative Humidity %	Sac	AM	73.6	na	na	na	na	AM: Sac - LA	23.5
		PM	32.2	na	na	na	na	PM: Sac - LA	-15.4
	LA	AM	50.1	na	na	na	na	Sac: AM - PM	41.4
		PM	47.6	na	na	na	na	LA: AM - PM	2.5

Note: a Expected n values for Sacramento are: AM (5), PM (5)
Expected n values for Los Angeles are: AM (6), PM (6)
b Values are ug/m3, unless noted otherwise in measure column
NA Not Available (no samples scheduled)
AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2
ROAD - both roadside sites, ROAD 1 - roadside site 1, ROAD 2 - roadside site 2

Figure 4-3. ARB Main Study Ambient-Corrected MTBE and Benzene Data versus Wind Speed for Los Angeles Commutes (only)



file: trend30e

4. 3 Special Study Commutes

A number of commutes focused on specific scenarios defined by ARB that could broaden the information base from the program. These included a single rural commute in Sacramento to indicate the in-vehicle levels that might be encountered in a very low traffic density, background setting. Two school bus commutes were included in Sacramento which utilized a school bus as Vehicle 2, simulating a selected actual school system route with student stops. To estimate the potential concentration reductions from traveling in the typically less-traveled carpool lane, two freeway rush hour commutes were made in Los Angeles where Vehicle 1 traveled in a designated freeway carpool lane on I-10, while Vehicle 2 remained in the "slow" lanes on the same freeway. Two maximum concentration commutes in Los Angeles were included at the conclusion of the study, to estimate the in-vehicle concentration levels if the commuter carried out specific actions, including a re-fueling stop, driving in downtown street canyon, and closely trailing smoking city diesel buses.

4.3.1 Rural Commute

The concentrations in the Sacramento rural (R) commute approached the MQL's for almost every pollutant, as shown in Tables 3-4A thru 3-4D, and Appendix H-9. The minimal traffic volume permitted the vehicles to proceed at or above the posted speed limits for the entire 2 hour period. While no ambient station data were available for this commute, two roadside samplers were established which indicated concentrations that were even lower than the in-vehicle concentrations by 1/2 to 1/3. Rural commutes would obviously exhibit extremely low exposures for all measured pollutants.

4.3.2 School Bus Commutes

In order to estimate the levels of study pollutants inside a typical 30 foot California diesel school bus, measurements were made in the center of the bus (student seating) with three of the windows on each side 1/2 down. A typical Sacramento neighborhood school bus route (see section 2.2.2 and the detailed route description in Appendix G) was driven repeatedly from a neighborhood to the school and back, during both an AM and a PM period. In the AM commute, Vehicle 1 lead the diesel school bus, while in the PM commute, Vehicle 1 trailed the bus to estimate the levels that may be encountered behind a bus. Outside sampling incorporated a sample line to the front of the bus, while inside sampling was accomplished in the fourth row of seats on the driver's side.

The summary data for composites of the two school bus (SB) commutes by pollutant/measure are given in Tables 3-4A thru F. The individual pollutant/measure data are also provided in Appendix tables H-12 and H-13. A separate summary of the school bus data, providing the differences between Vehicle 1 and the school bus for both AM and PM commutes are given in Tables 4-6A and 4-6B. Figure 4-4 and 4-5 are graphical summaries of the AM and PM commutes, respectively, for selected pollutants for the inside measures.

Figure 4-4. Comparison of Inside School Bus Concentrations with Inside Vehicle 1 Concentrations (car leading bus) for AM Commute

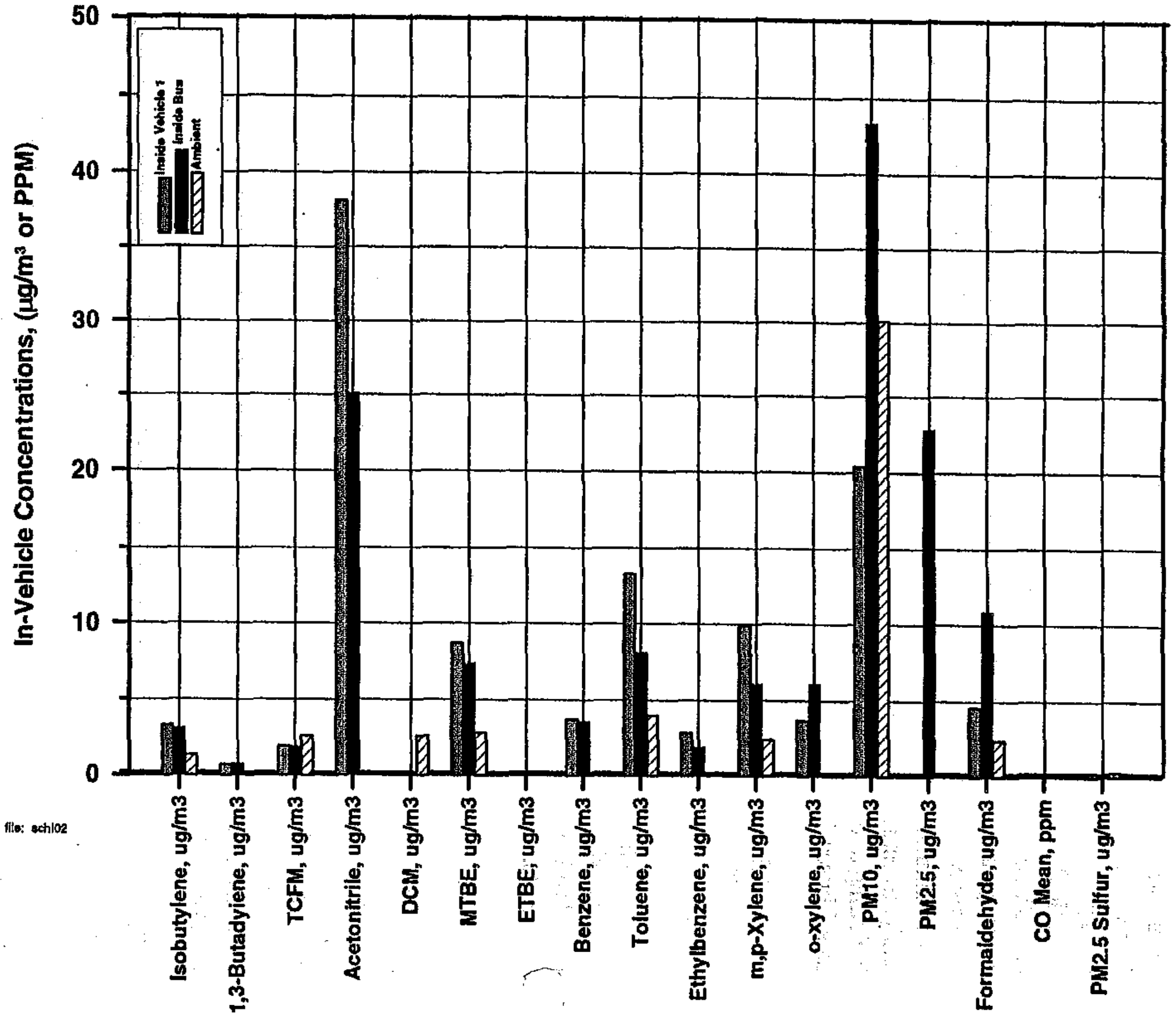
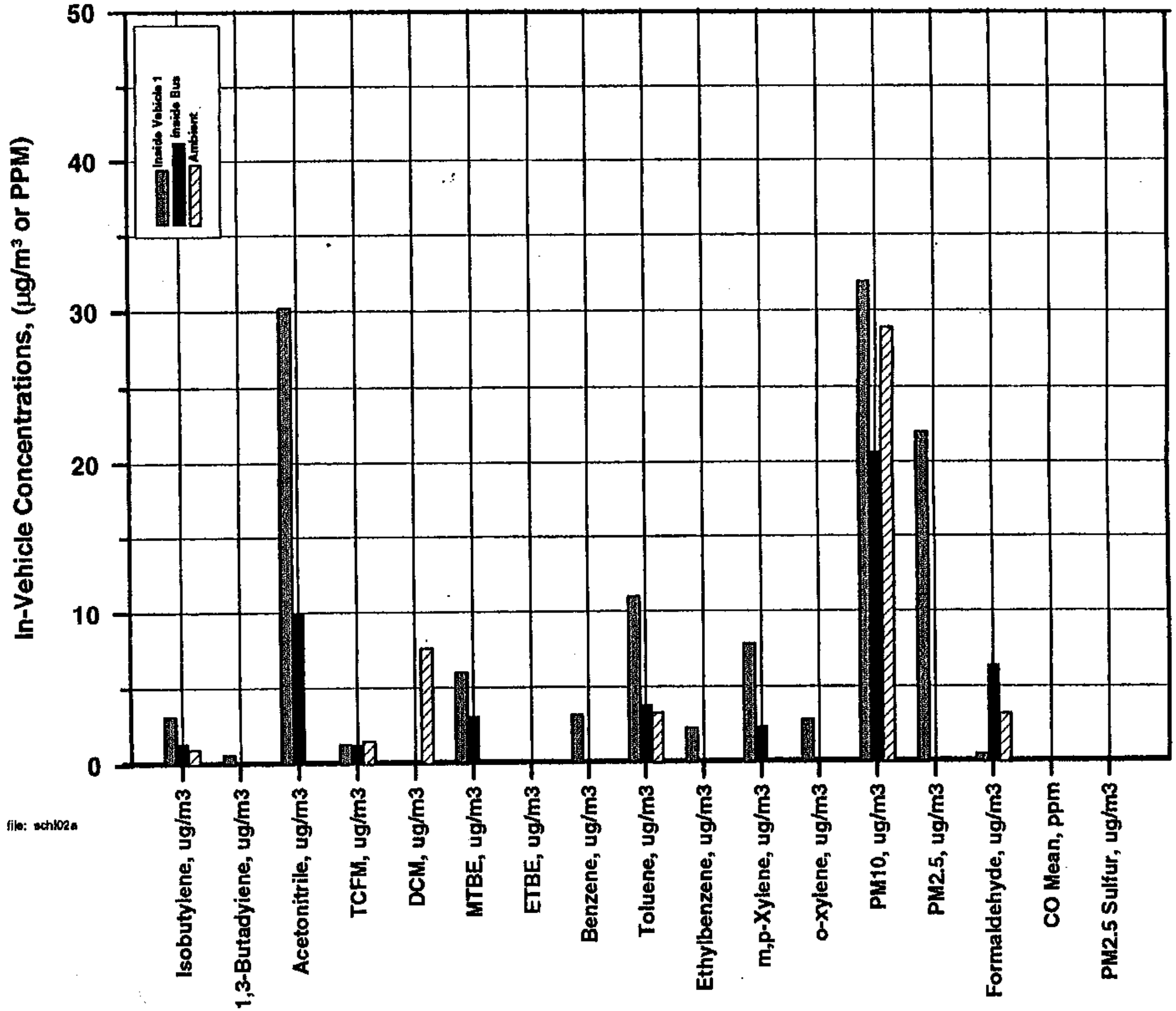


Figure 4-5. Comparison of Inside School Bus Concentrations with Inside Vehicle 1 Concentrations (car trailing bus) for PM Commute



The most obvious feature of the school bus data (e.g. see Table 3-4A) are that the pollutant measures are substantially lower in general for both ambient level and Vehicle 1 concentrations for most pollutants, compared to most of the commute types. The predominantly residential nature of the bus commutes and the associated very light traffic on the commute route resulted in MTBE levels that were significantly lower than either freeway or arterial commutes. Tables 4-6A and B show that most of the VOC's were slightly lower inside the school bus, while PM_{10} mass was somewhat higher when Vehicle 1 was leading. The $PM_{2.5}$ concentrations were too near or <MDL to compute differences. The open bus windows during both commutes apparently resulted in very similar inside and outside VOC data for the bus. The open windows appear to have resulted in higher PM_{10} concentrations inside the bus, as compared to Vehicle 1. The total LAS-X particle counts doubled (but were still quite low) when trailing the bus in the PM (as compared to AM), as did the black carbon. The black carbon data showed an increase of ~4 $\mu g/m^3$ while trailing, suggesting that soot carbon accounted for a significant portion of the increased particle mass.

Table 4-6A. Summary of Pollutants for AM School Bus Commute (Vehicle 1 Leading)							
	Ambient	IN 1 Caprice	IN 2 School Bus	IN Bus - Caprice difference	OUT 1 Caprice	OUT 2 School Bus	OUT Bus - Caprice difference
Isobutylene, µg/m3	1.3	3.3	3.1	-0.2	2.7	1.9	-0.8
1,3-Butadyiene, µg/m3	BDL	0.7	0.8	0.1	BDL	0.9	-0.9
Acetonitrile, µg/m3	68.7	38.1	25.1	-13.0	3.0	BDL	nc
TCFM, µg/m3	2.6	1.9	1.9	0.0	2.0	-40.0	-42.0
DCM, µg/m3	2.6	BDL	BDL	nc	BDL	0.3	-0.3
MTBE, µg/m3	2.8	8.7	7.4	-1.3	7.6	4.2	-3.4
ETBE, µg/m3	BDL	BDL	BDL	nc	BDL	BDL	nc
Benzene, µg/m3	BDL	3.7	3.6	-0.1	3.2	3.4	0.2
Toluene, µg/m3	4.0	13.3	8.1	-5.2	9.6	4.4	-5.2
Ethylbenzene, µg/m3	BDL	2.8	1.9	-0.9	2.1	1.8	-0.3
m,p-Xylene, µg/m3	2.4	9.9	6.1	-3.8	7.0	3.5	-3.5
o-xylene, µg/m3	BDL	3.7	6.1	2.4	2.6	2.3	-0.3
PM10, µg/m3	30.1	20.4	43.4	23.0	na	na	nc
PM2.5, µg/m3	BDL	BDL	22.8	nc	BDL	BDL	nc
Formaldehyde, µg/m3	2.4	4.6	10.9	6.3	0.0	9.9	9.9
CO Mean, ppm	BDL	BDL	BDL	nc	BDL	0.4	nc
PM2.5 Sulfur, µg/m3	0.28	0.24	0.21	-0.03	0.09	-0.02	-0.11
Black Carbon, µg/m3	na	0.9	na	nc	4.8	na	nc
LAS-X particles/cm3	na	18.0	na	nc	63.0	na	nc
NOTES:	Values are ug/m3, unless noted otherwise in measure column						
	na Not Available (no samples scheduled)						
	AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside						
	BDL - below detection limit		nc - not computed				

Table 4-6B. Summary of Pollutants for PM School Bus Commute (Vehicle 1 Trailing)							
				IN			OUT
		IN 1	IN 2	Bus - Caprice	OUT 1	OUT 2	Bus - Caprice
	Ambient	Caprice	School Bus	difference	Caprice	School Bus	difference
Isobutylene, µg/m3	1.0	3.1	1.4	-1.7	2.9	1.1	-1.8
1,3-Butadyiene, µg/m3	BDL	0.6	BDL	nc	0.6	BDL	nc
Acetonitrile, µg/m3	64.7	30.2	10.0	-20.2	2.2	28.8	26.6
TCFM, µg/m3	1.5	1.3	1.3	0.0	1.5	1.0	-0.5
DCM, µg/m3	7.6	BDL	BDL	nc	BDL	BDL	nc
MTBE, µg/m3	BDL	6.0	3.1	-2.9	4.8	2.3	-2.5
ETBE, µg/m3	BDL	BDL	BDL	nc	BDL	BDL	nc
Benzene, µg/m3	BDL	3.2	BDL	nc	2.4	BDL	nc
Toluene, µg/m3	3.3	11.0	3.8	-7.2	6.5	3.7	-2.8
Ethylbenzene, µg/m3	BDL	2.3	BDL	nc	BDL	BDL	nc
m,p-Xylene, µg/m3	BDL	7.8	2.4	-5.4	4.5	BDL	nc
o-xylene, µg/m3	BDL	2.8	BDL	nc	BDL	BDL	nc
PM10, µg/m3	28.9	31.9	20.7	-11.2	na	na	nc
PM2.5, µg/m3	BDL	22.0	BDL	nc	BDL	BDL	nc
Formaldehyde, µg/m3	3.2	0.5	6.4	5.9	na	na	nc
CO Mean, ppm	BDL	BDL	NS	nc	BDL	BDL	nc
PM2.5 Sulfur, µg/m3	0.19	0.24	0.22	-0.02	0.21	0.22	0.01
Black Carbon, µg/m3	na	8.9	na	nc	9.2	na	nc
LAS-X particles/cm3	na	29	na	nc	129	na	nc
NOTES:	Values are ug/m3, unless noted otherwise in measure column						
	na Not Available (no samples scheduled)						
	AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside						
	BDL - below detection limit			nc - not computed			

4.3.3 Carpool Lane Commutes

Two freeway commutes (one AM rush and one PM rush) were conducted in which Vehicle 1 commuted in the carpool lane of I-10 and Vehicle 2 (Ford Explorer) remained the slower non-carpool lanes. The commute route is shown on the map in Appendix C. The differences in congestion between the carpool lane and the non-carpool lanes resulted in a substantial increase in the miles driven in the carpool lane (97.1 miles (@ 48.5 mph) in the carpool lane vs 67.7 miles (@ 33.9 mph) in the non-carpool lanes during 2 hour commutes).

The freeway rush carpool (FRC) commute data are summarized in Tables 3-5A thru F, and in Table 4-7, indicating the differences between vehicles. The individual carpool commute data are found in Appendix tables H-22 and H-23. Figure 4-6 is a graphical summary of selected pollutants for the outside carpool measurements, while Figure 4-7 plots the inside carpool measures. The inside vehicle data show that the concentrations are significantly lower in the carpool lane for all pollutants. The number at the top of each set of bars indicates the percent reduction in concentration from driving in the carpool lane, with a negative sign indicating that the carpool lane value is higher than the non-carpool. In general, the VOC's are 30 to 50 % higher inside the non-carpool lane vehicle (Figure 4-7). Formaldehyde and CO are 21 % and 36 % higher, respectively. While PM_{10} is 16 % higher in Vehicle 2, $PM_{2.5}$ is 8 % lower. This seemed inconsistent at first, but review of the outside vehicle data in Figure 4-6 shows that the $PM_{2.5}$ levels are actually 92 % higher in the non-carpool lane. The differences in inside particle concentrations are apparently influenced by particle losses in the vehicle ventilation systems, and partially by the generally lower vehicle AER rate values (see Figure 3-6), accentuated by the lower vehicle speeds in the non-carpool lanes.

In order to estimate the differences in commuting exposures, a hypothetical 30 mile commute was utilized, and the total commute times required for carpool and non-carpool commutes computed (37.1 minutes for carpool, and 53.1 minutes for non-carpool). The pollutant concentration differences were then weighted by their respective commute times to provide the estimated exposure levels in $\mu g/m^3$ - minutes (or ppm - minutes). In order to remove the differences between vehicle AER's, the outside vehicle concentrations were used. The resulting exposures are shown in Figure 4-8, with the percent differences computed. In general, the pollutant exposures are 90 to 180 % higher in the non-carpool lane.

Table 4-7. Summary Composites of Pollutants for Two Carpool Lane Commutes

		IN 1	IN 2	IN Explorer - Caprice	OUT 1	OUT 2	OUT Explorer - Caprice
	Ambient	Caprice	Explorer	difference	Caprice	Explorer	difference
Isobutylene, µg/m3	3.8	14.2	19.4	5.2	14.2	20.1	5.9
1,3-Butadyiene, µg/m3	0.4	3.0	4.0	1.0	2.9	3.9	1.0
TCFM, µg/m3	1.5	1.5	1.5	0.0	1.5	1.6	0.1
Acetonitrile, µg/m3	76.9	46.2	69.1	22.9	2.1	48.4	46.3
DCM, µg/m3	2.4	2.6	3.3	0.7	2.5	4.0	1.5
MTBE, µg/m3	10.2	31.2	47.0	15.8	31.2	47.8	16.6
ETBE, µg/m3	0.2	0.0	0.0	0.0	0.0	0.0	nc
Benzene, µg/m3	3.0	12.7	17.4	4.7	12.3	17.4	5.1
Toluene, µg/m3	10.3	31.5	50.8	19.3	29.8	46.3	16.5
Ethylbenzene, µg/m3	1.7	6.1	8.0	1.9	5.6	7.6	2.0
m,p-Xylene, µg/m3	5.2	23.6	31.0	7.4	21.9	29.3	7.4
o-xylene, µg/m3	2.0	8.5	11.1	2.6	7.9	10.5	2.6
PM10, µg/m3	102.6	61.1	71.0	9.9	na	na	nc
PM2.5, µg/m3	58.1	46.9	43.3	-3.6	41.2	78.9	37.7
Formaldehyde, µg/m3	8.9	14.0	17.0	3.0	na	na	nc
CO Mean, ppm	BMD	3.6	4.9	1.3	2.8	5.6	2.8
PM2.5 Sulfur, µg/m3	4.1	3.1	2.8	-0.3	2.3	3.2	0.9
Black Carbon, µg/m3	na	4.4	na	nc	13.3	na	nc
LAS-X particles/cm3	na	2817	na	nc	5289	na	nc

Notes: IN 1 and OUT 1 are Vehicle 1 (Caprice) in carpool lane

IN 2 and OUT 2 are Vehicle 2 (Ford Explorer) in non-carpool lanes

Values are <u>not</u> background-corrected and are in ug/m3, unless noted otherwise in measure column

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

BDL - below detection limit

nc - not computed

Figure 4-6. Comparison of Outside-Vehicle 1 (OUT 1) Carpool Lane Concentrations With Adjacent Outside (OUT 2) Non-Carpool Lane Concentrations

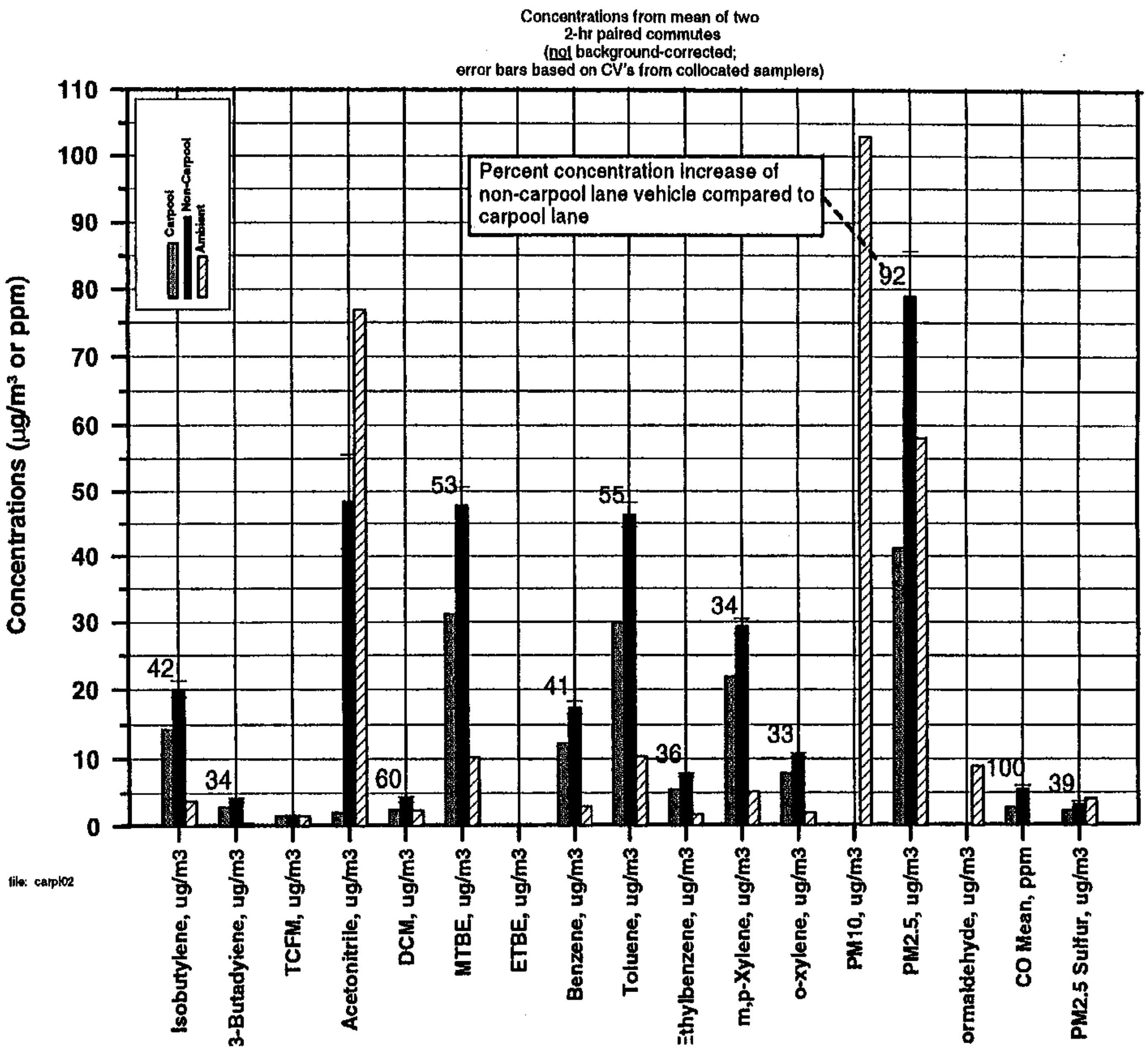
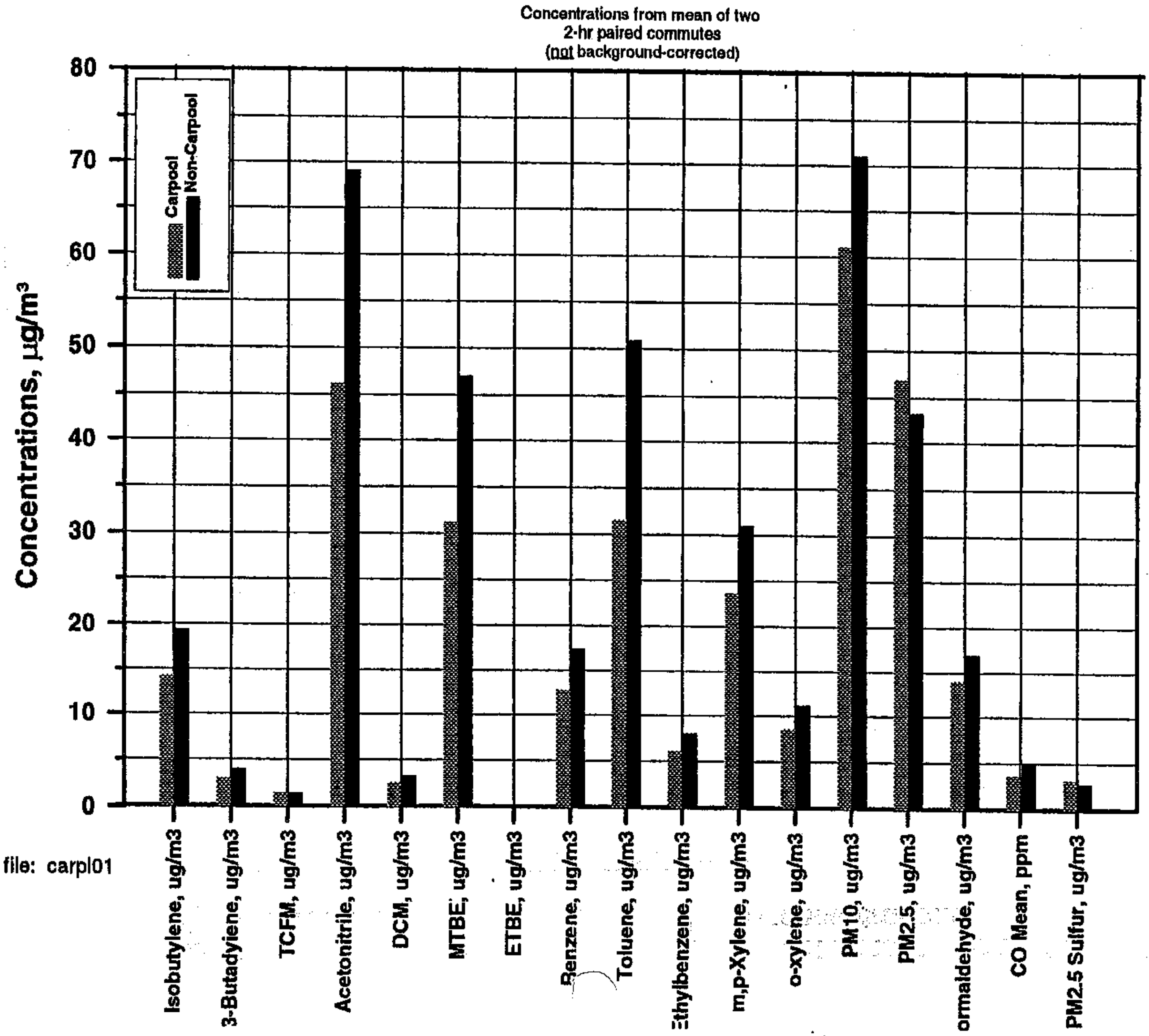
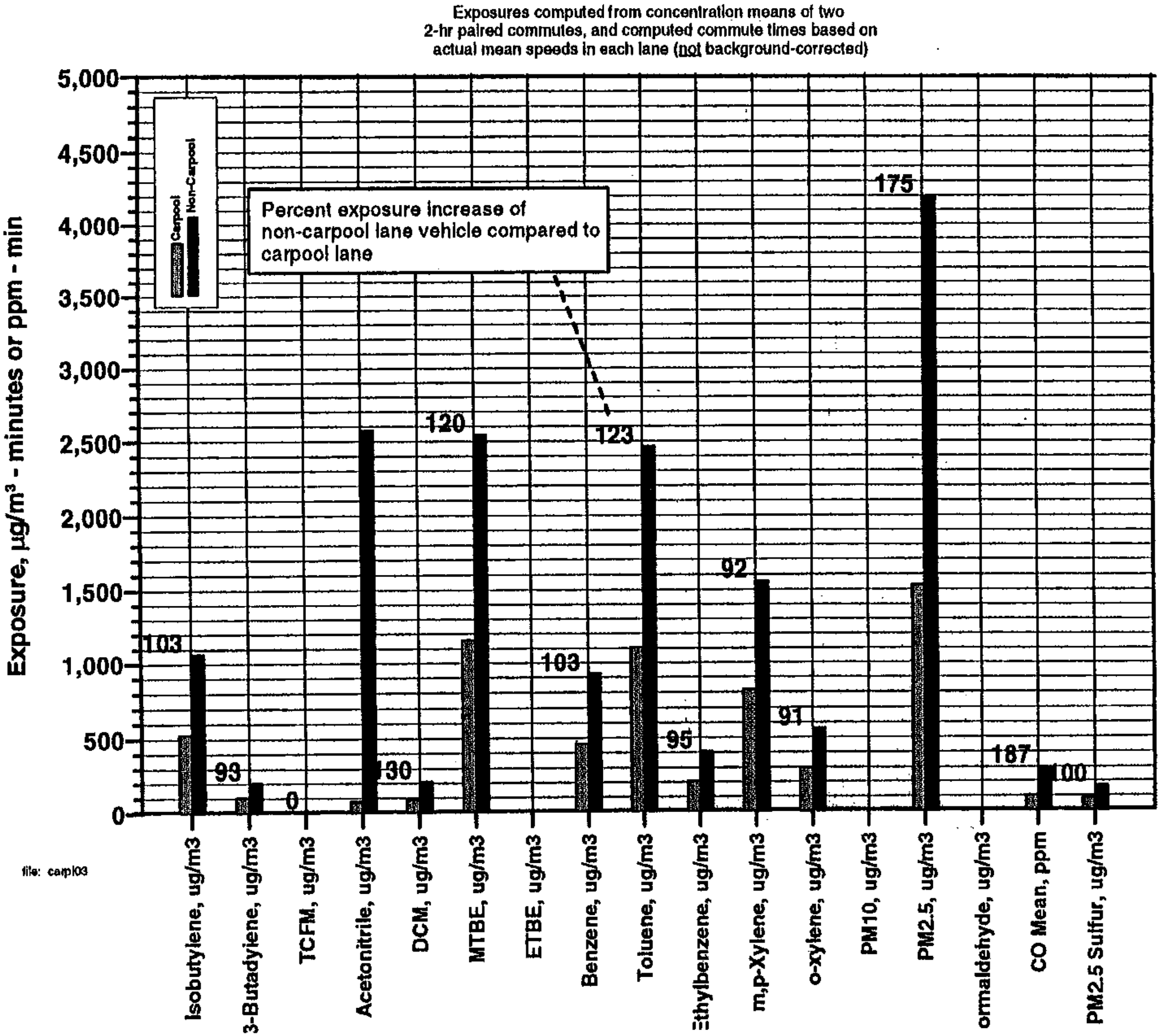


Figure 4-7. Comparison of Inside-Vehicle (IN 1) Carpool Lane Concentrations With Adjacent Lane Non-Carpool (IN 2) Concentrations



file: carpl01

Figure 4-8. Comparison of Outside-Vehicle (OUT 1) Carpool Lane Exposures With Adjacent Outside (OUT 2) Non-Carpool Lane Exposures for an Assumed 30 Mile Commute



file: carpl03

4.3.4 Maximum Concentration Commutes

Two commutes (one AM and one PM) were conducted in which the primary objective was placing Vehicle 1 in situations that (intuitively) could produce the maximum concentrations inside the vehicle for all pollutants, especially MTBE and particles. The detailed descriptions of the two commute routes and the drive scenarios are provided in Appendix G. The driving protocol included a gasoline refueling stop to maximize the potential of adding VOC vapor to the measured concentrations. Since smoking gasoline vehicles and diesel buses had been observed to provide the highest particle count data, these vehicles types were favored as "target" vehicles during the maximum commutes. Street canyon and depressed (or walled) roadway section situations had also been noted to provide elevated concentrations and situations with these features were also highlighted.

The maximum commute (MC) data are summarized in Tables 3-5A thru F, and in Table 4-8. The individual maximum commute data are found in Appendix tables H-28 and H-29. While the mean MTBE level was highest for MC commutes, as compared to the other scenarios in Table 3-5A1, a number of the individual commutes were higher than the lowest maximum concentration commute level. This was also true for benzene and toluene. The mean $PM_{2.5}$ and PM_{10} concentrations, particle counts, and black carbon in Table 3-5B were significantly higher for the MC commutes than any of the other scenarios, due at least partially to the higher percentage of diesel bus targets. CO was not significantly higher during the MC commutes. The total particle count data, which should reflect the higher percentage of diesel bus targets during the MC commutes, were elevated substantially for commute #29, but not quite as much for #28. The black carbon in-vehicle levels were consistently high at ~21 $\mu g/m^3$, although arterial non-rush commute #18 actually had the highest concentration at 22.9 $\mu g/m^3$. In general the maximum concentration commutes did produce significantly higher concentration levels, but not necessarily for all pollutants. The video analysis of selected commutes (see section 4.4.1) included maximum commute #29, illustrating the substantial contributions of single vehicles to elevated black carbon and particle count levels.

Table 4-8. Summary Composites of Pollutants for Two "Maximum" Commutes

	Ambient	IN 1 Caprice	IN 2 Explorer	IN 2 - IN 1 difference	OUT 1 Caprice	OUT 2 Explorer	OUT 2 - OUT 1 difference
Isobutylene, µg/m3	4.3	21.5	na	nc	19.6	na	nc
1,3-Butadyiene, µg/m3	0.4	4.7	na	nc	4.4	na	nc
TCFM, µg/m3	1.8	2.2	na	nc	2.0	na	nc
Acetonitrile, µg/m3	52.8	28.0	na	nc	2.4	na	nc
DCM, µg/m3	5.5	4.5	na	nc	4.0	na	nc
MTBE, µg/m3	10.7	60.2	na	nc	50.9	na	nc
ETBE, µg/m3	0.0	0.0	na	nc	0.0	na	nc
Benzene, µg/m3	2.9	17.2	na	nc	15.6	na	nc
Toluene, µg/m3	10.2	37.6	na	nc	36.8	na	nc
Ethylbenzene, µg/m3	1.6	8.0	na	nc	7.5	na	nc
m,p-Xylene, µg/m3	5.2	32.5	na	nc	29.7	na	nc
o-xylene, µg/m3	2.1	11.5	na	nc	10.6	na	nc
PM10, µg/m3	56.9	89.1	na	nc	na	na	nc
PM2.5, µg/m3	21.3	83.0	na	nc	88.9	na	nc
Formaldehyde, µg/m3	10.1	61.7	na	nc	67.6	na	nc
CO Mean, ppm	BDL	4.4	na	nc	4.3	na	nc
PM2.5 Sulfur, µg/m3	2.1	2.1	na	nc	2.3	na	nc
Black Carbon, µg/m3	na	20.9	na	nc	19.9	na	nc
LAS-X particles/cm3	na	4325	na	nc	7333	na	nc

Notes: IN 1 and OUT 1 are for Vehicle 1 (Caprice); no trailing Vehicle 2 was used for these commutes

Values are ug/m3, unless noted otherwise in measure column

na Not Available (no samples scheduled)

AMB - ambient site, IN 1 - inside car 1, IN 2 - inside car 2, OUT 1 - outside car 1, OUT 2 - outside car 2

BDL - below detection limit nc - not computed

4.4 Selected Data Analyses

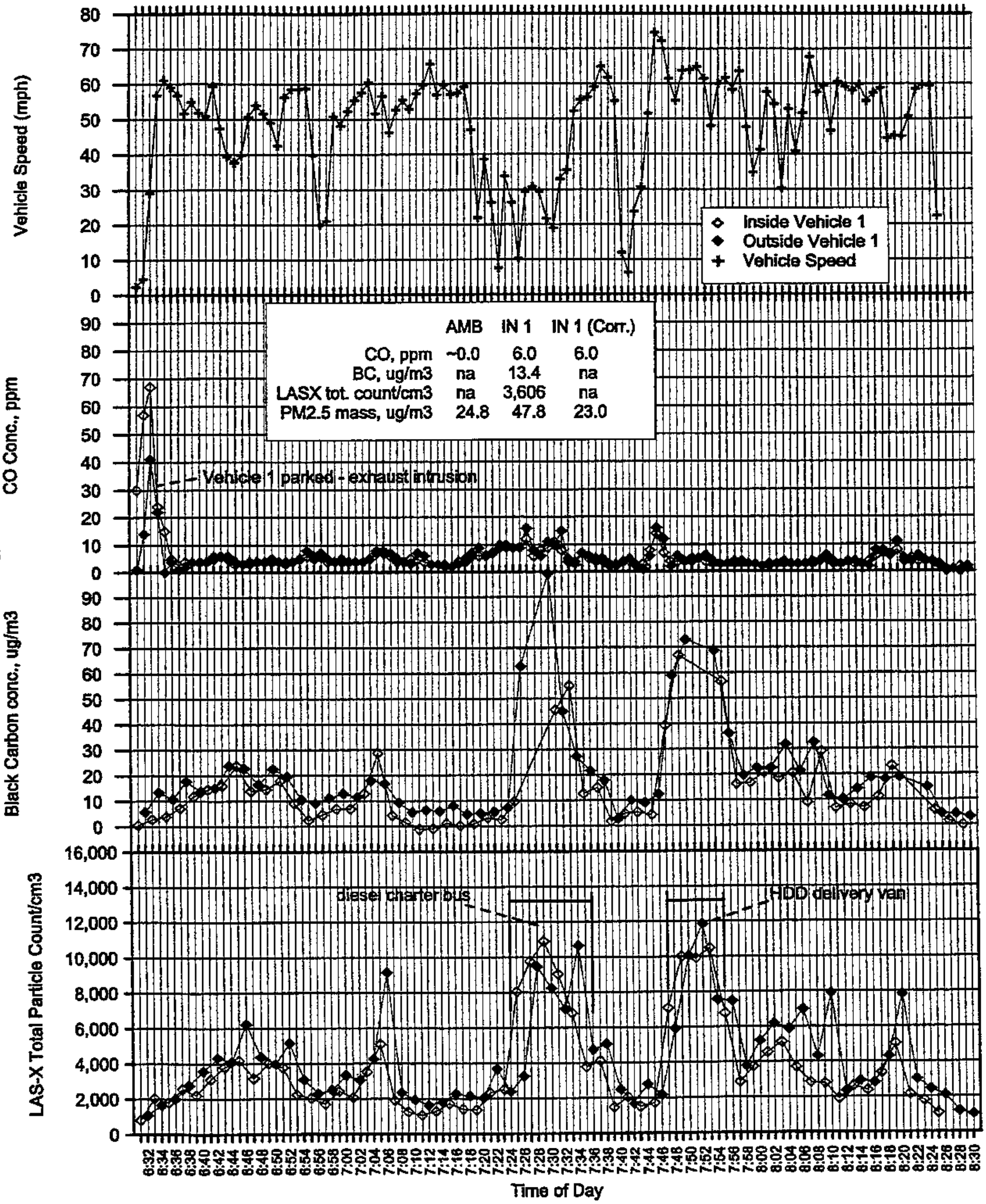
4.4.1 Video Analysis of Elevated Particle Commutes in Los Angeles

Near-real time pollutant measurements were made for CO, black carbon, and particle count in Vehicle 1. The data for these three pollutants were summarized as one minute averages for Vehicle 1. Thus 60 outside measurements were collected alternately, with 60 inside measurements during a 2 hour commute. In order to provide an indication of the situations ahead of the car that are influencing these concentrations, a video camera was operated to capture the view through the front windshield for the entire 120 minutes. By manually comparing the individual features in a graphical concentration profile with the activities occurring in front of the car, a semi-quantitative ink can be made between the presence or absence of potential commute features. These features might include "target" vehicle type, influence of the "target" exhaust location relative to the outside sampling inlet, and the influence of pollutant "trapping" features (e.g. sound walls, street canyons, etc.). A limited analysis of the video information paired with the pollutant data could provide information on the relative contributions of "target" vehicles, as well as possible mitigation steps a driver could take to reduce exposure.

In order to limit the scope of this type of analysis, a limited scheme was proposed in which the five highest concentration commutes (based primarily on integrated $PM_{2.5}$) in Los Angeles were selected. The commute selection was assisted by ranking the outside $PM_{2.5}$ particle concentrations in Appendix K. From this ranking the commutes chosen were to include the highest concentrations in each scenario category - FR, FNR, AR, ANR, and MC. The respective commute numbers for these scenarios were: 15, 14, 26, 17, and 29.

The continuous inside vehicle data for CO, black carbon, and particle count for the identified commutes were then consolidated along with the vehicle speed to provide the graphs shown in Figures 4-9 thru 4-13. Note that the concentration scales by pollutant are not necessarily the same on all graphs. The video records for each commute were then reviewed to identify the "target" vehicle and/or situation that appeared to lead to the significant peak concentrations from the graphs. The logs from these video observations are provided in Tables 4-9 thru 4-13. Note also that even though the relational observations are only "inferences" (since an exact cause-and-effect link between the peak levels and the "target" vehicles can only be inferred), the consistent relationship between certain targets (especially diesel buses) and roadway situations (primarily "cut sections" or street canyons) provides credibility. While it is not possible to completely describe the images on a 2 hour video in this report, an attempt has been made to identify the salient observations. The identification of key features (especially vehicle types) observed were assisted by the audio descriptions provided by the experienced Sierra navigator and driver.

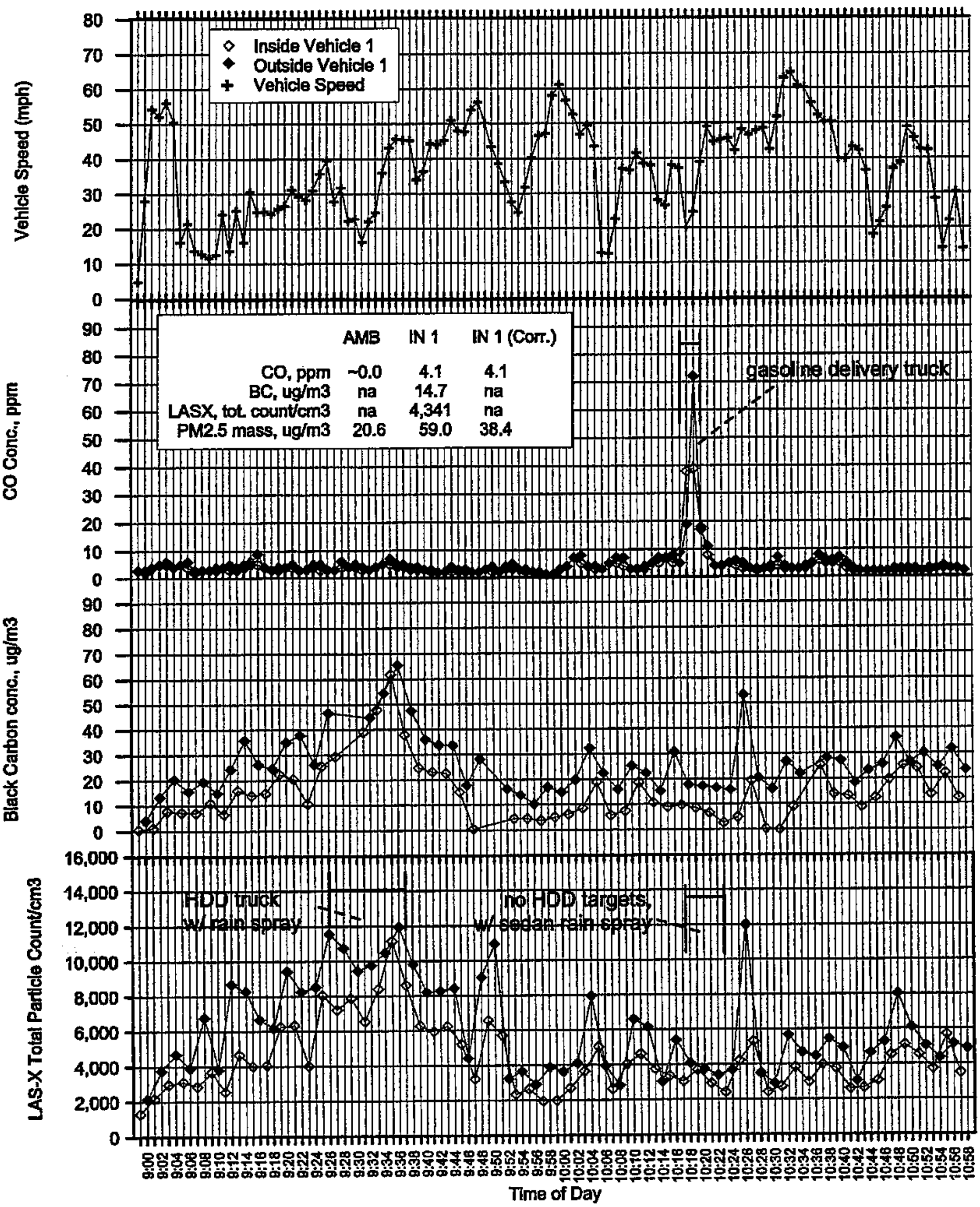
Figure 4-9. ARB Main Study Los Angeles Continuous Data
Vehicle Speed, CO, BC, and Count
Commute #15, 9/26/97 AM, FR



	AMB	IN 1	IN 1 (Corr.)
CO, ppm	~0.0	6.0	6.0
BC, ug/m3	na	13.4	na
LASX tot. count/cm3	na	3,606	na
PM2.5 mass, ug/m3	24.8	47.8	23.0

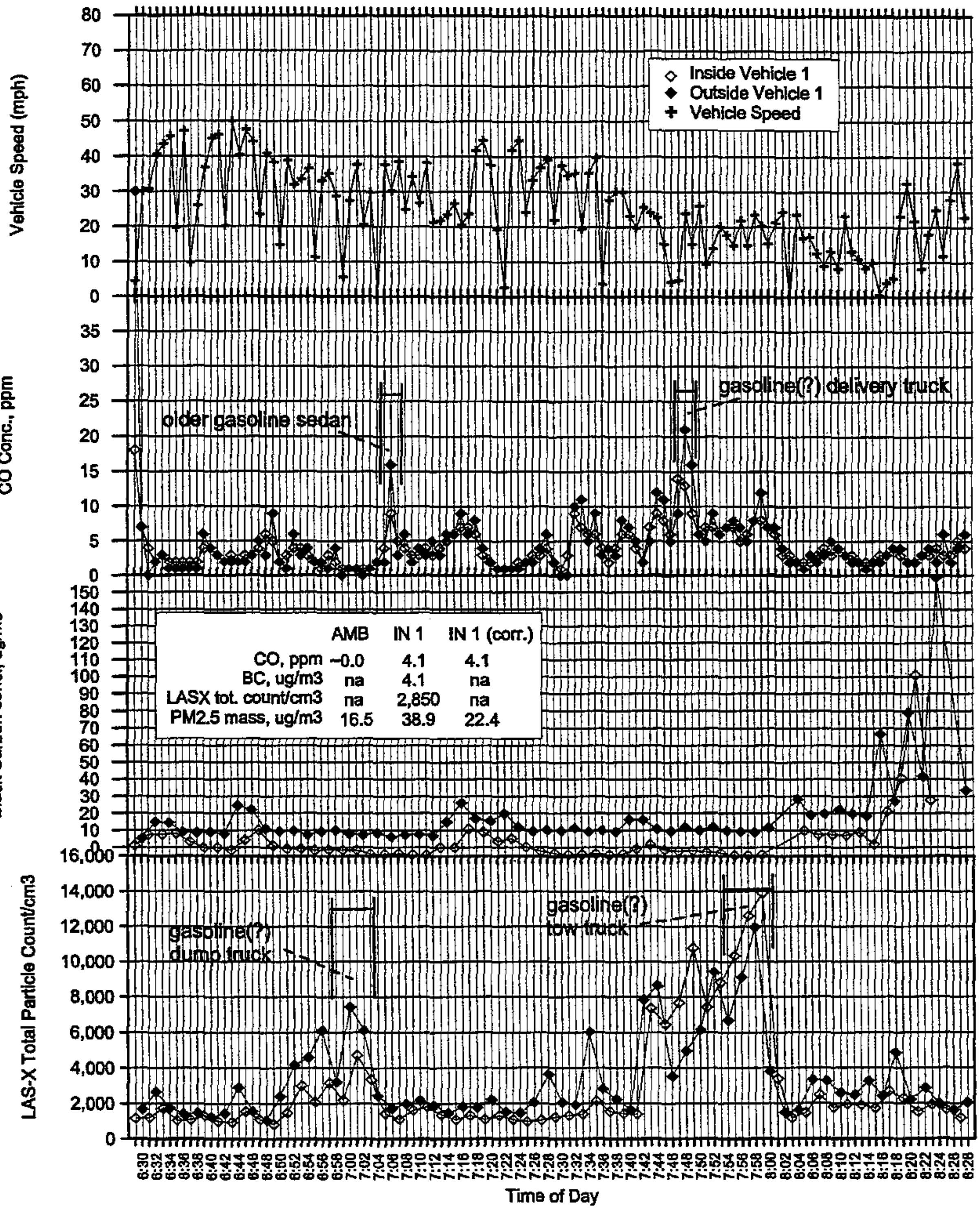
file: com15a

Figure 4-10. ARB Main Study Los Angeles Continuous Data
Vehicle Speedg, CO, BC, and Count
Commute #14, 9/25/97 AM, FNR [Raining]



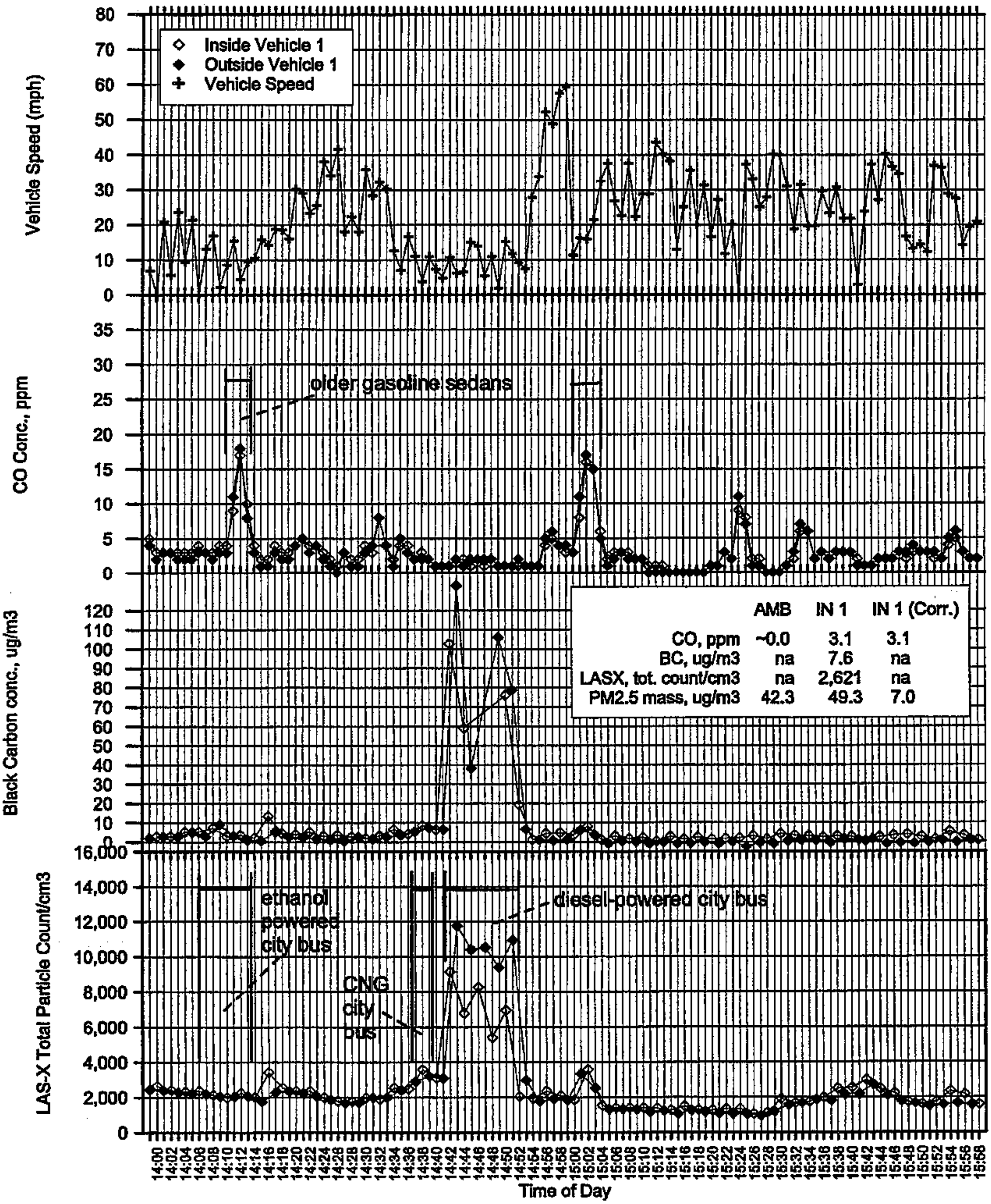
file: com14a

Figure 4-11. ARB Main Study Los Angeles Continuous Data
Vehicle Speed, CO, BC, and Count
Commute #26, 10/2/97 AM, AR



file: com26a

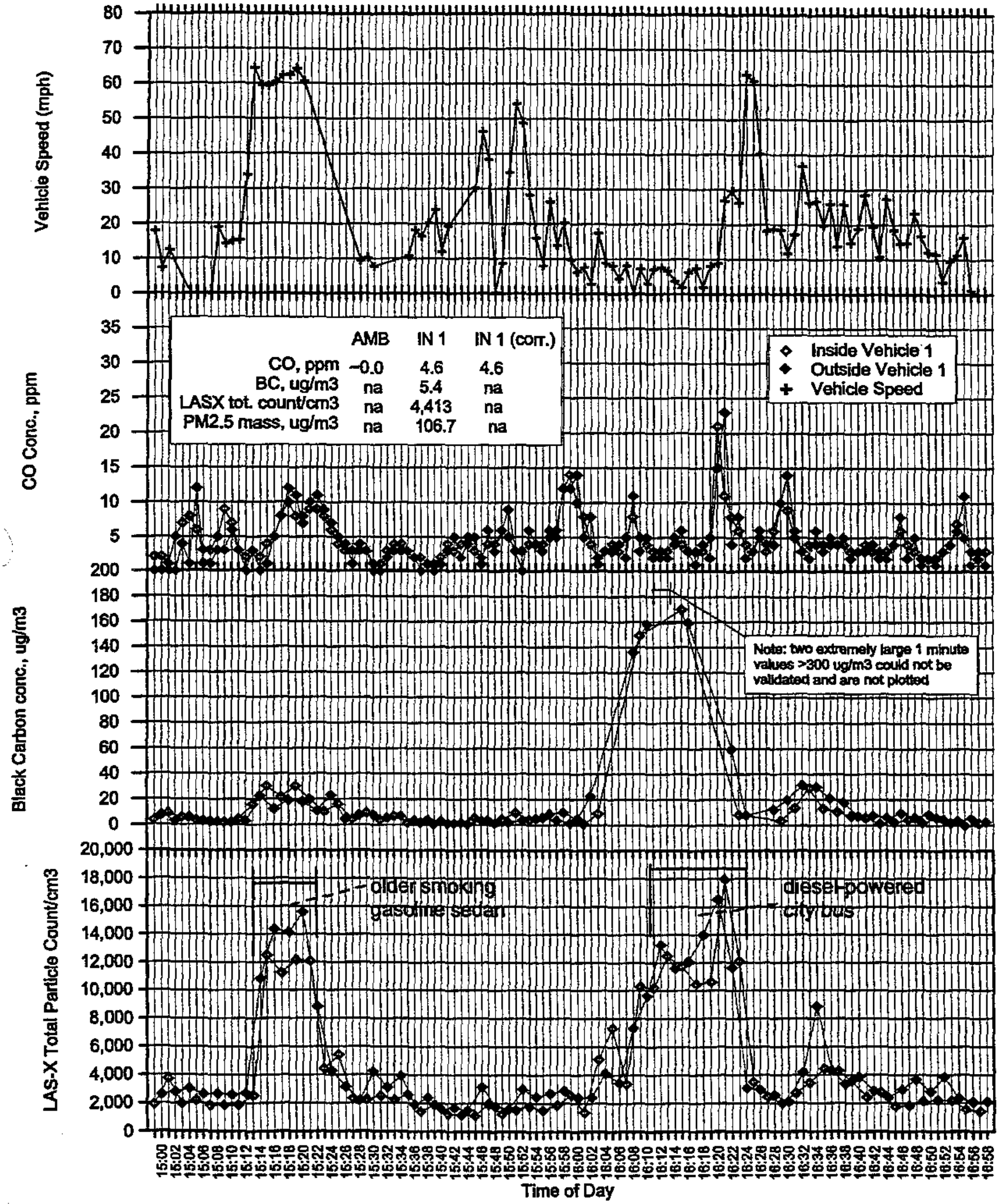
Figure 4-12. ARB Main Study Los Angeles Continuous Data
Vehicle Speed, CO, BC, and Count
Commute #17, 9/27/97 PM, ANR



	AMB	IN 1	IN 1 (Corr.)
CO, ppm	~0.0	3.1	3.1
BC, ug/m3	na	7.6	na
LASX, tot. count/cm3	na	2,621	na
PM2.5 mass, ug/m3	42.3	49.3	7.0

file: com17a

Figure 4-13. ARB Main Study Los Angeles Continuous Data
Vehicle Speed, CO, BC, and Count
Commute #29, 10/3/97 PM, MC



file: com29a

Table 4-9. ARB In-Vehicle Main Study LA Commute Video Observations			
	Commute:	#15, 9/26/97 AM, FR	
Entry #	Time of Day	Observation	Observed Signif. Target Type (if any)
1	6:38:00	in traffic	
2	6:43:00	behind truck	HDD
3	6:52:00	loose truck	
4	6:52:30	behind truck	HDD
5	6:55:00	loose truck	
6	7:04:00	behind truck	HDD
7	7:06:00	school bus ahead of truck	bus type diesel?
8	7:07:00	loose truck and bus	
9	7:15:00	delivery truck	gasoline?
10	7:25:30	smoking charter bus	diesel bus
11	7:39:00	loose bus	
12	7:44:00	behind older sedan	gasoline
13	7:48:00	behind delivery van	diesel?
14	7:55:00	loose van	
15	7:57:00	behind gravel truck	HDD
16	7:59:00	behind semi	HDD
17	8:06:00	behind gasoline truck	HDD
18	8:10:00	behind delivery van	HDD
19	8:20:00	behind smoking tractor (no trailer)	HDD

Table 4-10. ARB In-Vehicle Main Study LA Commute Video Observations			
	Commute:	#14, 9/25/97 AM, FNR (raining)	
Entry #	Time of Day	Observation	Observed Signif. Target Type (if any)
1	9:02:00	on-ramp	
2	9:07:00	small truck	diesel?
3	9:08:00	off-ramp	
4	9:09:20	behind several trucks	HDD's
5	9:12:00	stop and go traffic; behind truck	HDD
6	9:18:00	behind truck	HDD
7	9:26:00	behind several trucks	HDD's
8	9:28:00	heavy spray from truck	HDD
9	9:32:00	stop and go; heavy spray	HDD
10	9:45:00	stop and go; loose truck	
11	9:49:00	behind truck	HDD
12	9:52:00	off ramp (video clock quit)	
13	10:06:00	behind cement truck; stop and go	HDD?
14	10:15:50	loose cement truck	
15	10:20:40	behind delivery truck	gasoline?
16	10:24:00	loose truck	
17	10:28:00	behind tanker	HDD
18	10:29:00	loose truck	
19	10:34:00	behind truck; stop and go	HDD

Table 4-11. ARB In-Vehicle Main Study LA Commute Video Observations			
	Commute:	#26, 10/2/97 AM, AR	
Entry #	Time of Day	Observation	Observed Signif. Target Type (if any)
1	6:38:00	stoplight behind older sedan	
2	6:42:00	stoplight	
3	6:48:00	stoplight behind older pickup truck	
4	6:52:00	behind cement truck	HDD
5	6:56:00	loose cement truck	
6	6:58:00	behind dump truck	diesel?
7	7:00:00	close behind dump truck at stoplight	diesel?
8	7:04:00	loose dump truck	
9	7:06:00	stoplight behind older sedan	
10	7:21:00	behind tanker truck	HDD
11	7:23:00	loose tanker truck	
12	7:33:30	behind older pickup truck	
13	7:34:00	behind delivery truck	diesel?
14	7:36:00	loose truck	
15	7:38:00	behind older van	
16	7:39:00	loose van	
17	7:44:00	behind delivery truck	diesel?
18	7:48:00	video clock stopped	
19	7:49:00	on-ramp	
20	7:49:30	behind tow truck	diesel?
21	7:54:00	cut section of highway	
22	7:59:00	behind delivery truck	HDD
23	8:01:00	loose truck	
24	8:05:00	behind city bus	diesel
25	8:10:00	loose bus	
26	8:12:00	behind city bus in street canyon	diesel
27	8:17:00	loose bus	
28	8:20:00	behind city bus	diesel

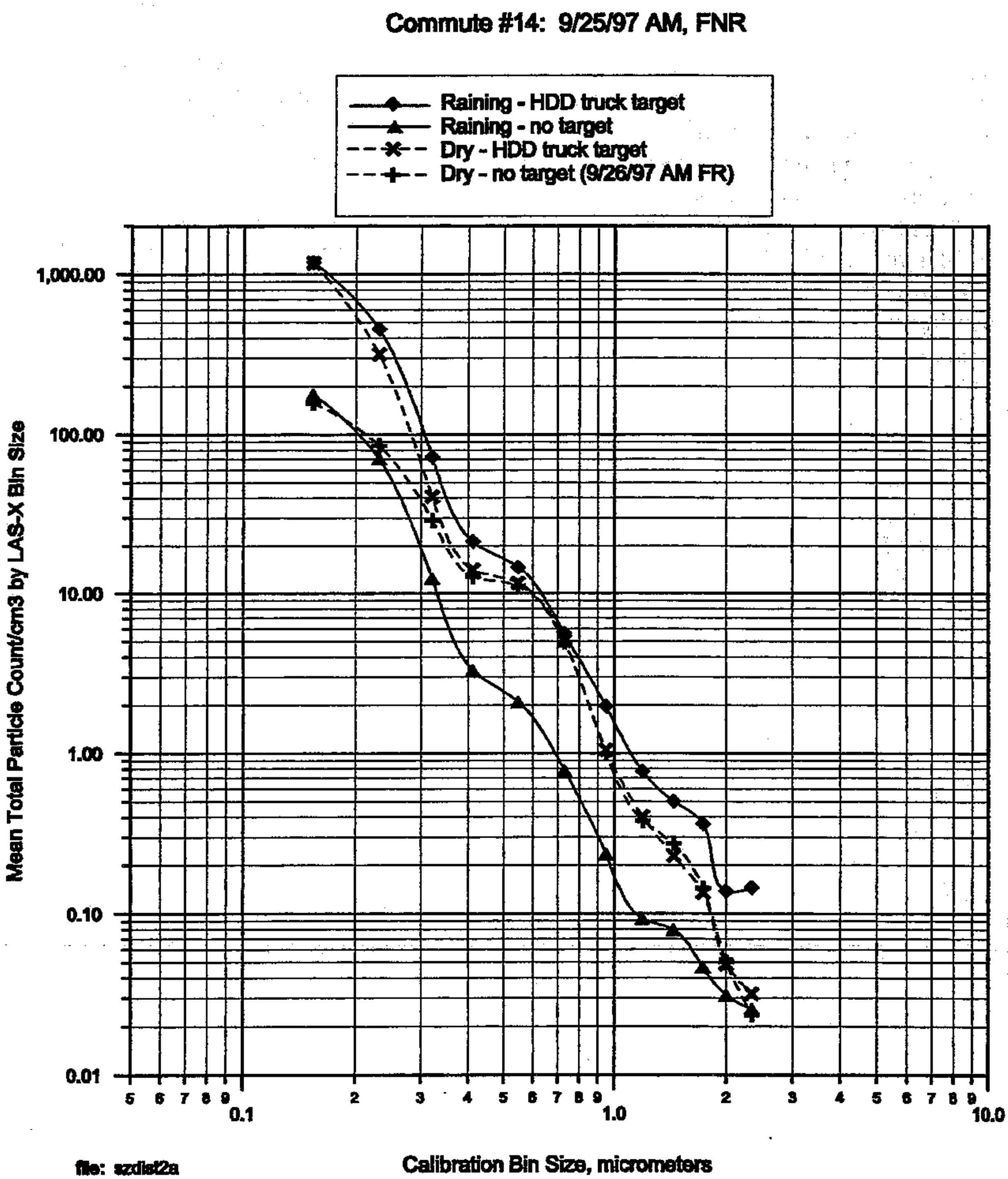
Table 4-12. ARB In-Vehicle Main Study LA Commute Video Observations			
	Commute:	**#17, 9/27/97 PM, ANR**	
Entry #	Time of Day	Observation	Observed Signif. Target Type (if any)
1	02:06:25	behind stopped city bus	ethanol powered
2	2:11:40	loose bus	
3	2:13:00	long stoplight	older sedan
4	2:15:00	very light traffic	
5	2:35:00	downtown	
6	2:39:00	behind stopped city bus	CNG powered
7	2:43:00	behind city bus; stop and go	diesel
8	2:53:00	loose bus	
9	2:56:00	street canyon	
10	3:02:00	behind older sedan	
11	3:24:00	long traffic light - gasoline odor	

Table 4-13. ARB In-Vehicle Main Study LA Commute Video Observations			
	Commute:	#29, 10/3/97 PM, MC	
Entry #	Time of Day	Observation	Observed Signif. Target Type (if any)
1	3:02:00	stoplight	
2	3:04:00	fast-food drive-thru	older sedan
3	3:08:40	target leaves	
4	3:09:00	no traffic	
5	3:10:00	stoplight	
6	3:13:30	on-ramp	
7	3:14:00	sound wall	
8	3:14:30	behind truck	HDD
9	3:15:00	visibly smoking car	older sedan
10	3:23:00	behind wrecker	diesel?
11	3:23:30	off ramp	
12	3:25:00	stoplight	older sedan; diesel schoolbus
13	3:31:00	downtown	
14	3:33:30	street canyon	
15	3:40:00	delivery truck	HDD?
16	3:41:00	heavy traffic	
17	3:43:00	light traffic	
18	3:45:30	on-ramp	
19	3:47:00	cut section	
20	3:50:00	off-ramp	
21	3:51:00	stopped traffic	
22	3:52:00	on-ramp	
23	3:56:00	2nd behind truck	HDD
24	3:59:00	off-ramp	
25	4:01:30	behind parked bus	diesel bus
26	4:04:00	behind bus (#2089)	diesel bus
27	4:04:30	stoplight	diesel bus
28	4:06:00	stop and go	diesel bus
29	4:06:30	loose bus	
30	4:08:00	stop and go	diesel bus
31	4:10:00	behind bus	diesel bus
32	4:19:00	street canyon	diesel bus
33	4:23:30	loose bus	
34	4:26:00	on-ramp	
35	4:29:40	cement truck	diesel?
36	4:32:00	loose truck	
37	4:34:00	stop and go; adjacent truck	HDD
38	4:36:00	cement truck	diesel?
39	4:43:20	behind truck - looks new	HDD
40	4:50:00	adjacent ot truck	HDD
41	4:52:30	off-ramp	stoplight

The more salient graphical features (peaks) were paired with the video logs and marked on the graphs. Figures 4-9 and 4-10 show the inside vehicle real-time data for the highest FR and FNR commutes, respectively. The particle count and black carbon data in Figure 4-9 are dominated by two events trailing a diesel charter bus and a diesel delivery van. CO shows little, if any, elevation during these diesel events. The elevated CO levels at the start of the commute resulted from Vehicle 1's own exhaust intrusion while still in the parking lot. The over-laid summary table indicates that the freeway contribution to the integrated $PM_{2.5}$ mass concentration is 23 $\mu g/m^3$. Figure 4-10 shows a dramatically different commute picture for particles and BC, apparently due to the heavy rain that fell during this commute (the only rainfall noted during the 29 Main Study commutes). While conventional wisdom suggests that rainfall tends to remove the larger particle sizes from the air and minimize resuspension from pavement dust, the $PM_{2.5}$ contribution was just over 38 $\mu g/m^3$, the 2nd highest level of the Main Study. A review of the video showed that while HDD trucks were being followed during this commute, the standing water on the pavement was producing substantial spray from the wheels during the first half of the commute. The rain (and associated spray level) decreased somewhat from approximately 10 to 11 AM. Both the particle count and black carbon data were dramatically elevated during this commute, especially until 10 AM, even though the frequency of HDD targets was roughly the same during the entire period. Plotting selected intervals of the particle count distributions[7] from the FR and FNR commutes in Figure 4-14, shows that a substantially difference in particle count is apparent with and without an HDD truck present. Over-laying HDD truck presence and absence events from the following (9/26/97) dry freeway day, shows that above approximately 0.3 μm, there is little difference in size distribution, suggesting as expected that diesels contribute primarily to the <0.3 μm size range. Above this size, the presence of rain apparently provides a substantial increase in particle count - which apparently translates into significant particle mass. Below ~0.7 μm, the distributions for HDD diesel-influenced events is virtually identical. At the lowest detectable size (0.15 μm) the presence and absence of HDD vehicle graphs merge. A possible explanation is the potential for the particles present on the roadway, prior to the rain (it hadn't rained in LA for a number of days prior to this commute), to be mixed with the water spray and released by droplet drying. The elevation of particle sizes less than 1 μm in size, however, was unexpected. Examination of the particle elemental data for $PM_{2.5}$ and PM_{10} in Tables F-27 thru F-30 for these two commutes, shows substantial increases in both the $PM_{2.5}$ and PM_{10} concentrations for Si, Ca, K, Ti, Fe, and Zn for the rainy commute #14 compared to the drier commute #15. While these elements are normally associated only with larger particle sizes, resuspended pavement dust may have been a significant contributor to the in-vehicle concentrations when following heavy duty vehicles on the rainier day. This phenomenon merits further investigation.

[7] More classical particle size distribution formats are shown in Appendix F, normalizing the particle count by bin size, and providing cumulative % less than relationships. Simple particle count/cm3 by bin size is presented for clarity and provides essentially the same conclusions relating the size distributions.

Figure 4-14. Selected Particle Count Size Distributions from LAS-X Particle Data - Rain vs No Rain



file: szdist2a

The CO levels during commute #14 were very low, except for a short period following an apparently out of tune, gasoline-fueled delivery truck. The collection of an ambient size distribution with which to background-correct the in-vehicle distributions should be considered in future studies to better delineate microenvironmental contributions by particle size.

Figures 4-11 and 4-12 show the continuous data for the highest AR and ANR commutes. Figure 4-11 shows two relatively large particle count peaks, which were both produced by vehicles (a delivery truck and a tow truck) that appear to have been gasoline, instead of diesel powered. Note that the elevated particle counts are not associated with elevated black carbon peaks, characteristic of diesel emissions. Figure 4-15 shows the particle size distributions associated with these two gasoline vehicles. The higher particle counts for the tow truck are probably associated with the pollutant trapping nature of the roadway "cut" section.

Figure 4-12 shows a single large peak for both particle count and black carbon, resulting from following a diesel city bus. Interestingly, during commute #17, an ethanol-powered city bus and a CNG-powered city bus were also followed. Plotting the representative particle size distributions from these three source types (see Figure 4-16) shows that below ~0.3 μm the diesel bus produces substantially higher particle counts (note log scale) than either the CNG or ethanol-powered buses. Above this size, all three vehicles produce approximately the same size distribution. The two highest CO peaks (ignoring the initial self-contamination peak) in Figure 4-11 were associated with an older sedan and a delivery truck, both of which were gasoline fueled. Similarly, the two highest CO peaks in Figure 4-12 were associated with following older gasoline-fueled sedans.

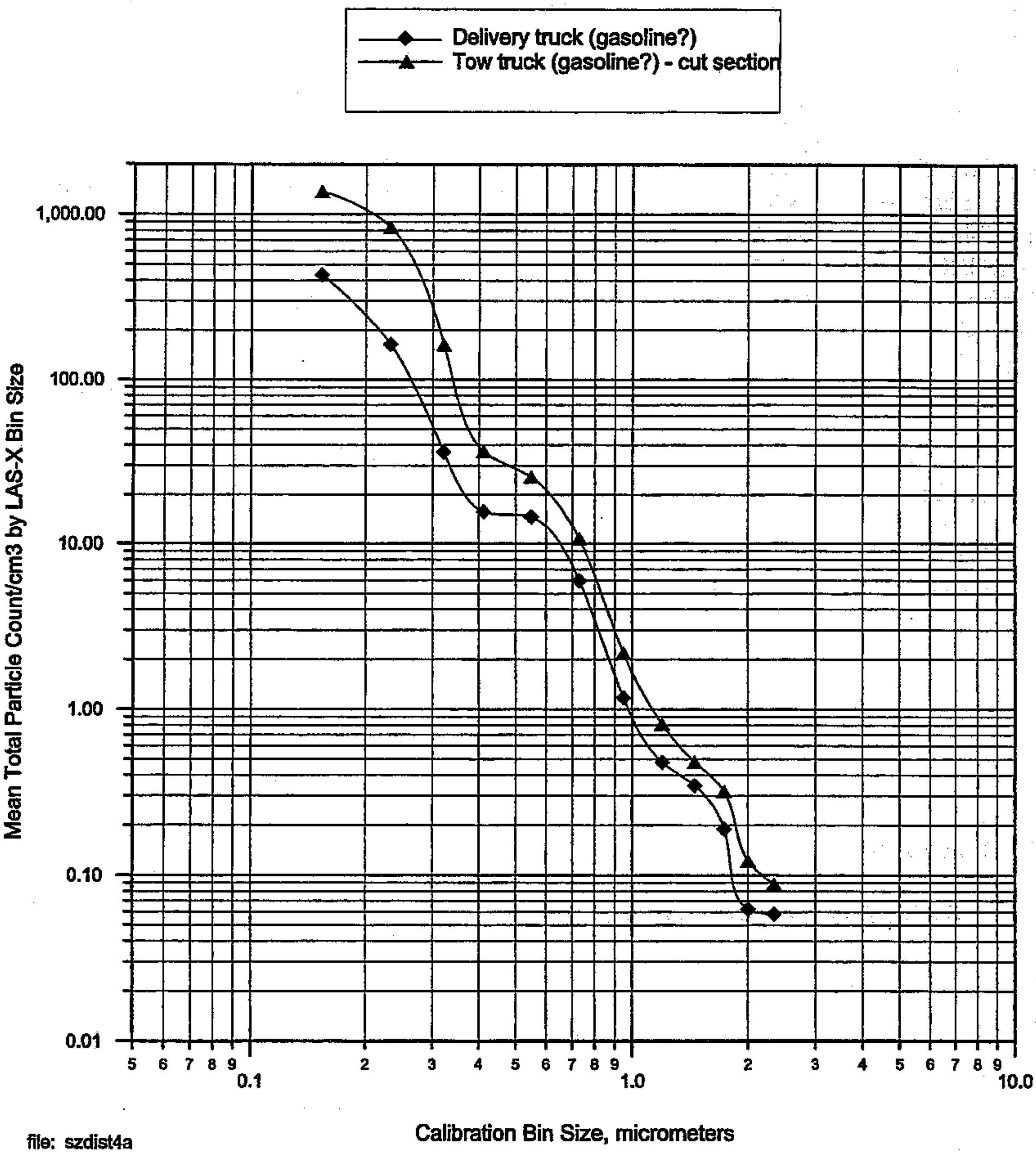
The continuous data for the highest concentration (MC, #29) commute during the Los Angeles portion of the study is represented in Figure 4-13, and again shows that trailing a few individually polluting vehicles can substantially increase the commute-average particle concentrations. The first of the two large particle count peaks were associated with a smoking gasoline-powered sedan. The second peak was from an apparently poorly-tuned (visibly smoking) diesel bus in a downtown street canyon area. Note that while the typical particle count levels ranged from ~100,000 to 200,000/min when not following these two vehicles, they increased to over 700,000/min (11,700 particles/cm^3) for the total ~20 minutes trailing times. Computing a simple time weighted average suggests that 48 percent of the total particle exposure for the 2 hour commute was contributed by 2 poorly tuned vehicles. The size distributions of these two events (see Figure 4-17) were very similar.

4.4.2 $PM_{2.5}$ Fraction of PM_{10}

The size of the $PM_{2.5}$ (Fine particle fraction) relative to PM_{10} (Fine + Coarse fraction) provides an indication of the distribution of particles in the atmosphere (using the AMB) data, and the relative contributions of fine and coarse particles from the commuting microenvironment. This type of analysis is easily confounded, however, since intervening sources (especially for coarse particles) between the ambient site and the microenvironment readily alter the ratio. The experimental errors associated with integrated particle measurements near or below the MQL can also substantially bias computing ratios.

Figure 4-15. Selected Particle Count Size Distributions from LAS-X Particle Data - Probable Gasoline Trucks

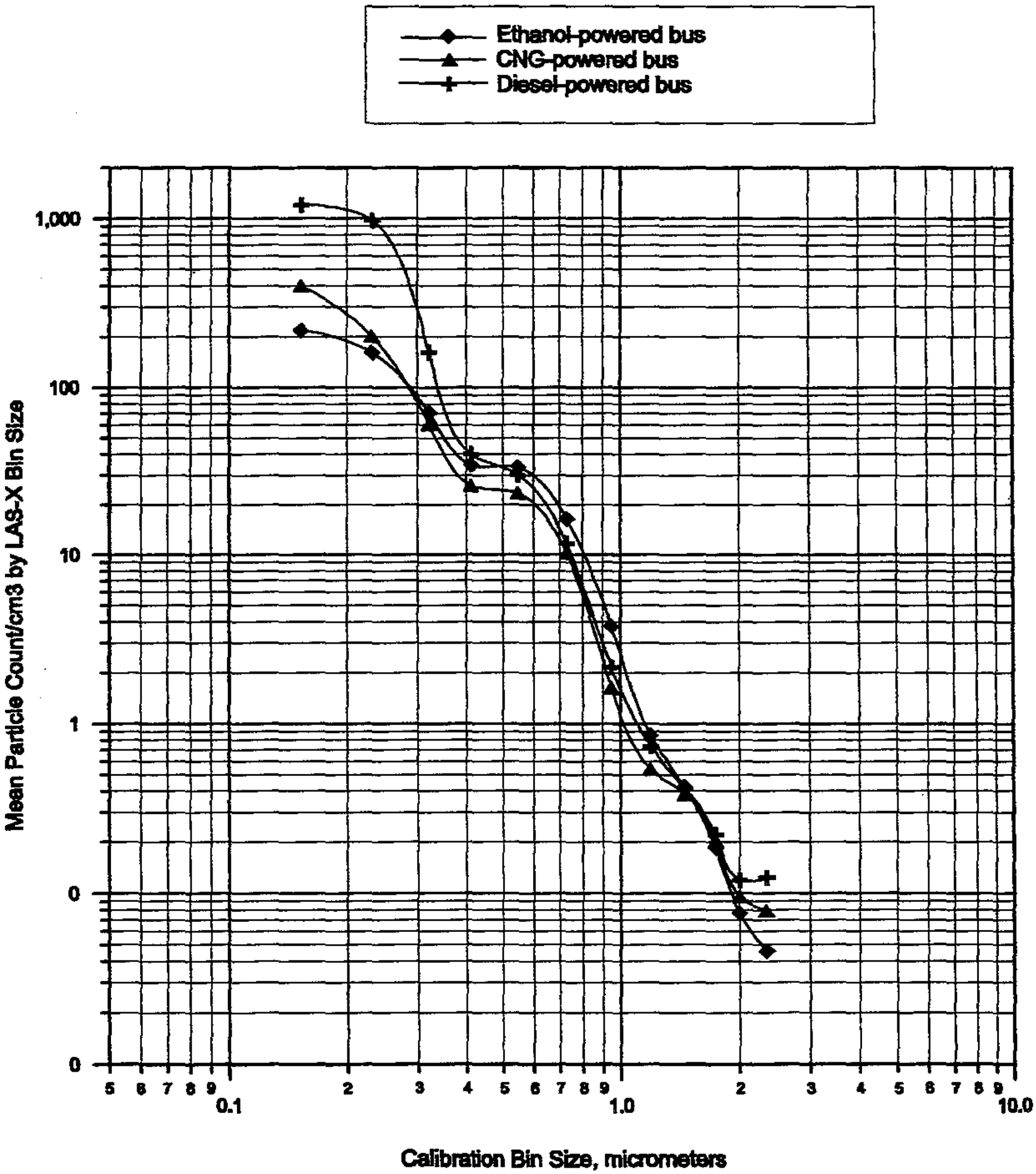
Commute #26: 10/2/97 AM, AR



file: szdist4a

Figure 4-16. Selected Particle Count Size Distributions from LAS-X Particle Data - Bus Fuel Comparison

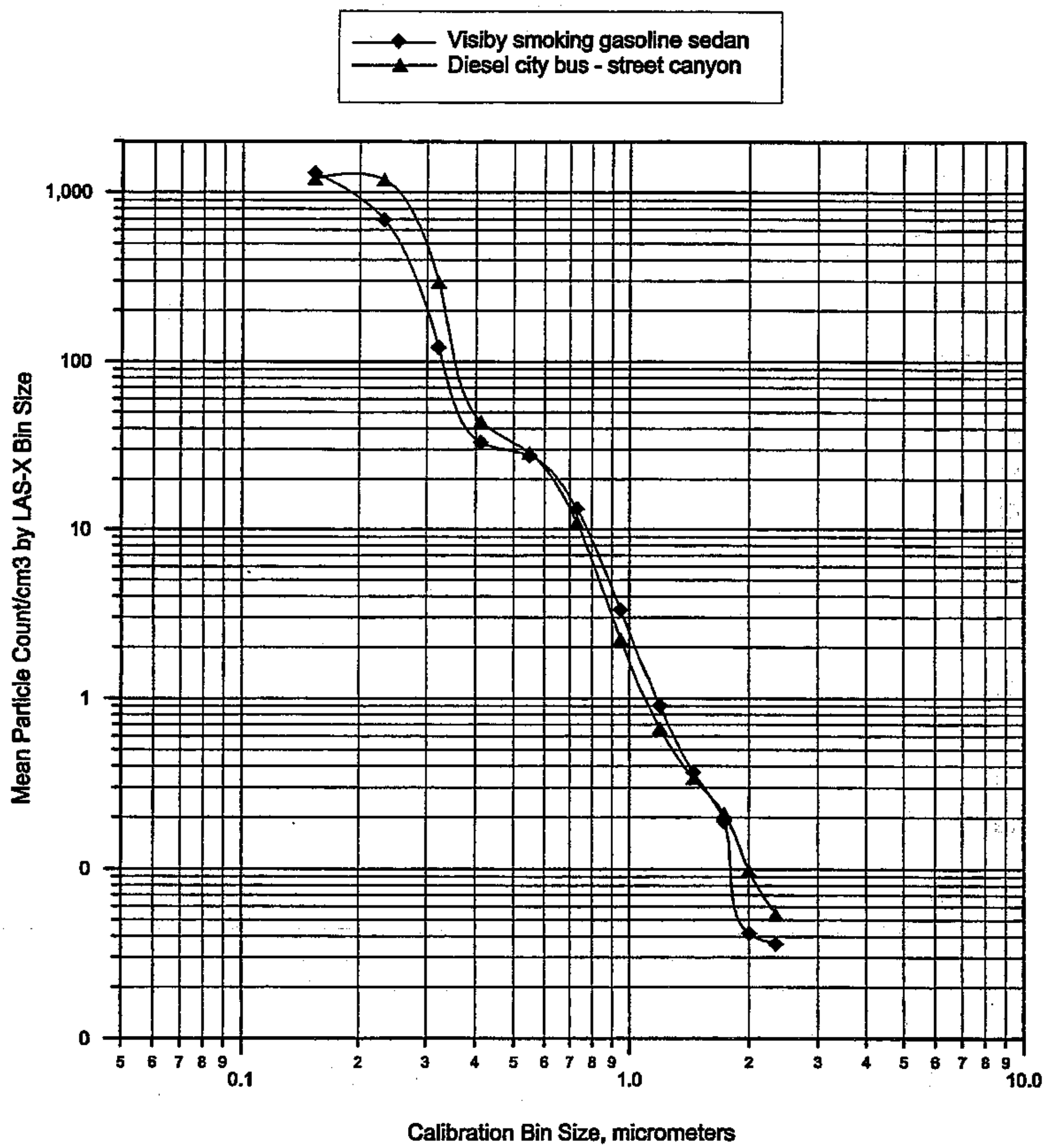
Commute #17: 9/27/97 PM, ANR



file: szdisn3b

Figure 4-17. Selected Particle Count Size Distributions from LAS-X Particle Data - Gasoline Sedan/Diesel Bus

Commute #29: 10/3/97 PM, MC



file: szdist05

Table 4-14 provides a summary of the computed $PM_{2.5}$ to PM_{10} ratios for both Sacramento and Los Angeles for data above the MDL. The much lower Sacramento concentrations, relative to the MDL, provided much less consistent trends, than did the more robust measurements in LA. In general, $PM_{2.5}$ was ~58% of the PM_{10} in LA with a +/- 15% coefficient of variation, while Sacramento was 38%, and more variable at +/- 31 %. As the measurement locations got closer to the vehicles, the Fine fractions tended to become larger proportions of the PM_{10}. The ratios at the LA roadside sites averaged 61%, with similar roadside ratios for Sacramento averaging ~42%. The in-vehicle ratios were ~84% in LA, and ranged between 57 and 84% in Sacramento. The in-vehicle ratios, are partially affected by particle losses, as a function of size, in the vehicle ventilation systems. While vehicle wheels and turbulence generate Coarse particles during re-entrainment of pavement and roadside dusts (dry periods), vehicular exhausts generate Fine particles (typically less than 0.3 μm) from combustion. While $PM_{2.5}/PM_{10}$ ratios can exceed 1.0 as a result of experimental error, the ratio could be expected to approach 1.0 as vehicular exhaust predominated. The limited number of ratios exceeding the expected measurement precisions, supports the excellent quality assessment of the integrated particle data.

Normalizing the ratios to the ambient site ratio for the day, provided a mean of estimating the fractional change resulting from the vehicular microenvironment. Note that the IN 1 normalized ratios averaged approximately 50% higher than the ambient sites for both Sacramento and LA. The ratios at the roadside sites averaged only 10 to 30% higher than those at the ambient site. In general the ratio changes relative to background were reasonably consistent between Sacramento and LA.

Table 4-14. PM2.5 to PM10 Ratios by Commute and Location															
	Ratios computed for data above MDL only						PM2.5 / PM10 Ratios					Ratios nomalized to AMB			
Day	Date	Loc.	DOW	Period	Type	Vent	**IN 1**	**IN 2**	**ROAD 1**	**ROAD 2**	**AMB**	IN 1	IN 2	ROAD 1	ROAD 2
1	9/9	SAC	Tu	AM	FNRH	Hi	0.399	0.776	0.429	0.345	0.496	0.805	1.565	0.865	0.696
1	9/9	SAC	Tu	PM	FNRH	Hi	0.579	1.254							
2	9/10	SAC	We	AM	FRH	Hi	0.367								
2	9/10	SAC	We	PM	FRH	Hi	0.717								
3	9/11	SAC	Th	AM	FRH	Lo	0.605	1.027	0.429	0.353	0.266	2.272	3.861	1.611	1.327
3	9/11	SAC	Th	PM	FRH	Lo			0.523		0.362			1.446	
4	9/12	SAC	Fr	AM	AR	Hi	0.568			0.433	0.329	1.729			1.318
4	9/12	SAC	Fr	PM	AR	Hi	0.639	1.025							
5	9/13	SAC	Sa	midday	R	Hi									
6	9/14	SAC	Mo	AM	AR	Lo	0.483	0.486			0.541	0.894	0.898		
6	9/14	SAC	Mo	PM	AR	Lo	0.676								
7	9/15	SAC	Tu	AM	SB	Hi	0.590	0.525			0.270	2.185	1.944		
7	9/15	SAC	Tu	PM	SB	Hi	0.688	0.814							
				mean SAC ratios:			**0.574**	**0.844**	**0.460**	**0.377**	**0.377**	1.577	2.067	1.307	1.114
					std. dev.		0.114	0.280	0.055	0.049	0.116	0.696	1.272	0.392	0.362
					CV %:		19.9	33.2	11.8	13.0	30.7	44.2	61.5	30.0	32.5
1	9/25	LA	Th	AM	FNRH	Hi	0.967	0.730			0.559	1.730	1.307		
2	9/26	LA	Fr	AM	FRH	Hi	0.738	0.861	0.769	0.522	0.503	1.467	1.713	1.530	1.039
2	9/26	LA	Fr	PM	FRH	Hi	0.826	0.636	0.614	0.857	0.401	2.060	1.587	1.530	2.137
3	9/27	LA	Sa	PM	ANR	Hi	0.918	1.108			0.714	1.285	1.551		
4	9/28	LA	Su	AM	ANR	Hi	1.006	0.900			0.608	1.655	1.481		
4	9/28	LA	Su	PM	FNRH	Hi	0.701	0.699			0.651	1.077	1.074		
5	9/29	LA	Mo	AM	FRH	Low	0.994	1.181	0.571	0.586	0.618	1.610	1.912	0.925	0.948
5	9/29	LA	Mo	PM	FRH	Low	0.688	0.992	0.448	0.450	0.594	1.160	1.670	0.754	0.758
6	9/30	LA	Tu	AM	FRC	Hi	0.800	0.579	0.490	0.630	0.492	1.626	1.177	0.997	1.280
6	9/30	LA	Tu	PM	FRC	Hi	0.746	0.637	0.538	0.619	0.652	1.144	0.977	0.825	0.949
7	10/1	LA	We	AM	AR	Low	1.000	0.406	0.716	0.616	0.666	1.501	0.610	1.075	0.924
7	10/1	LA	We	PM	AR	Low	0.842	0.794	0.715	0.752	0.533	1.581	1.490	1.342	1.412
8	10/2	LA	Th	AM	AR	Hi	0.907	1.231	0.637		0.533	1.701	2.308	1.194	
8	10/2	LA	Th	PM	AR	Hi	0.824	0.784	0.607	0.517	0.648	1.270	1.209	0.937	0.798
9	10/3	LA	Fr	AM	MC	Hi	0.811				0.503	1.612			
9	10/3	LA	Fr	PM	MC	Hi	1.016								
				mean LA ratios:			**0.861**	**0.824**	**0.611**	**0.617**	**0.578**	1.499	1.433	1.111	1.138
					std. dev.		0.113	0.239	0.103	0.124	0.084	0.267	0.422	0.279	0.430
					CV %:		13.1	29.0	16.9	20.2	14.6	17.8	29.5	25.1	37.8

4.4.3 $PM_{2.5}$ Inside/Outside Ratio

The minimal influence of the vehicle ventilation system settings on the pollutant concentrations inside the vehicles was discussed in section 4.2.1. It was noted, however, that the $PM_{2.5}$ integrated particle mass concentrations were significantly reduced inside compared to immediately outside each vehicle. A further review of the $PM_{2.5}$ data, provided quantitative estimates of the aparent particle penetration losses (reduced inside-to-outside ratio) and the resulting "insulating" effect on inside exposures. The mean inside/outside ratio of $PM_{2.5}$ for Vehicle 1 was computed to be 71% for the High vent setting and 59% for the Low setting. Although there is a suggestion of greater losses at the Low setting, the limited number of data points and the concentration variability provided no basis for a distinction between the vent settings. The composite ratios for the Ford Taurus and Ford Explorer (Vehicle 2) were similarly 64% for the High settings and 58 % for Low. Compositing the data for the three vehicles, suggests that an approximate 35 to 50 % reductions in $PM_{2.5}$ particle exposures during commuting is provided by the vehicle "envelope" with the windows closed. No data were collected on inside to outside PM_{10} ratio, but even lower penetration than $PM_{2.5}$ would be expected. Although various physical explanations were attempted to explain the significantly lower $PM_{2.5}$ levels inside the vehicle (e.g. vent system and interior wall losses, non-representative outdoor sampling location, occupant inhalation, etc.), insufficient information was available from which to form a definitive conclusion. The significance of this finding definitely merits additional study to corroborate the results and define the cause.

Although it would be assumed that opening the windows would provide relatively free flow between the inside and outside, no data were collected during the Main Study (except for the special school bus commutes) to support this surmise. The sedan air exchange measurement of 160 ACH @ 60 mph [2.7 air changes/minute] made during the Pilot Study with the windows only partly open (see Figure 3-6) showed substantial air exchange. Even though the bus traveled at slower speeds, its AER was expected to be substantial with the windows open.

4.4.4 Relationships Among $PM_{2.5}$ Integrated Mass, LAS-X Count, and Black Carbon

Particle count concentration is computationally related to particle mass concentration by computing the total particle volume and applying a composite particle density. Fine particle sources influencing in-vehicle concentrations, especially poorly controlled diesel fuel combustion, may produce substantial numbers of fine particles that have only minimal impact on the integrated mass concentration. However, if the (a) the composite ambient density and (b) the particle size distribution are relatively constant, the empirical relationship between total count and mass may be roughly linear. Using only the LA data (since all but one of the non-special commute Sacramento $PM_{2.5}$ concentrations were <MDL), the ability of the LAS-X count to predict integrated $PM_{2.5}$ mass concentrations were assessed graphically (see Figure 4-18). The data indicate that most of the LA commutes, except # 18 fell approximately along a linear regression. The uncertainty in this relationship suggests that the greatest value of the LAS-X total count concentration data are as indicators of the presence of high emitting combustion sources, rather than as predictors of $PM_{2.5}$ mass.

The relationship between $PM_{2.5}$ integrated mass concentrations and black carbon for the non-special commute LA data is shown in Figure 4-19. The uncertainty in the relationship is similar to that of Figure 4-18. The slope of the regression suggests that carbon accounts for approximately 28

% of the $PM_{2.5}$ mass in in-vehicle settings. The relationship between LAS-X total particle count and black carbon, compositing both Sacramento and Los Angeles non-special commute data is shown in Figure 4-20. The uncertainty in the relationship is attributed to a number of factors including differences in ambient air concentration levels between Sacramento and LA, and differences from commute to commute in the influence of diesel emissions.

Figure 4-18. Relationship Between LAS-X Total Count In-Vehicle Concentration (0.15 to 2.5 um) and PM2.5 Concentration (excluding Special Study Commutes)

Note: Neither LAS-X Total Count or PM2.5 mass concentrations are background-corrected

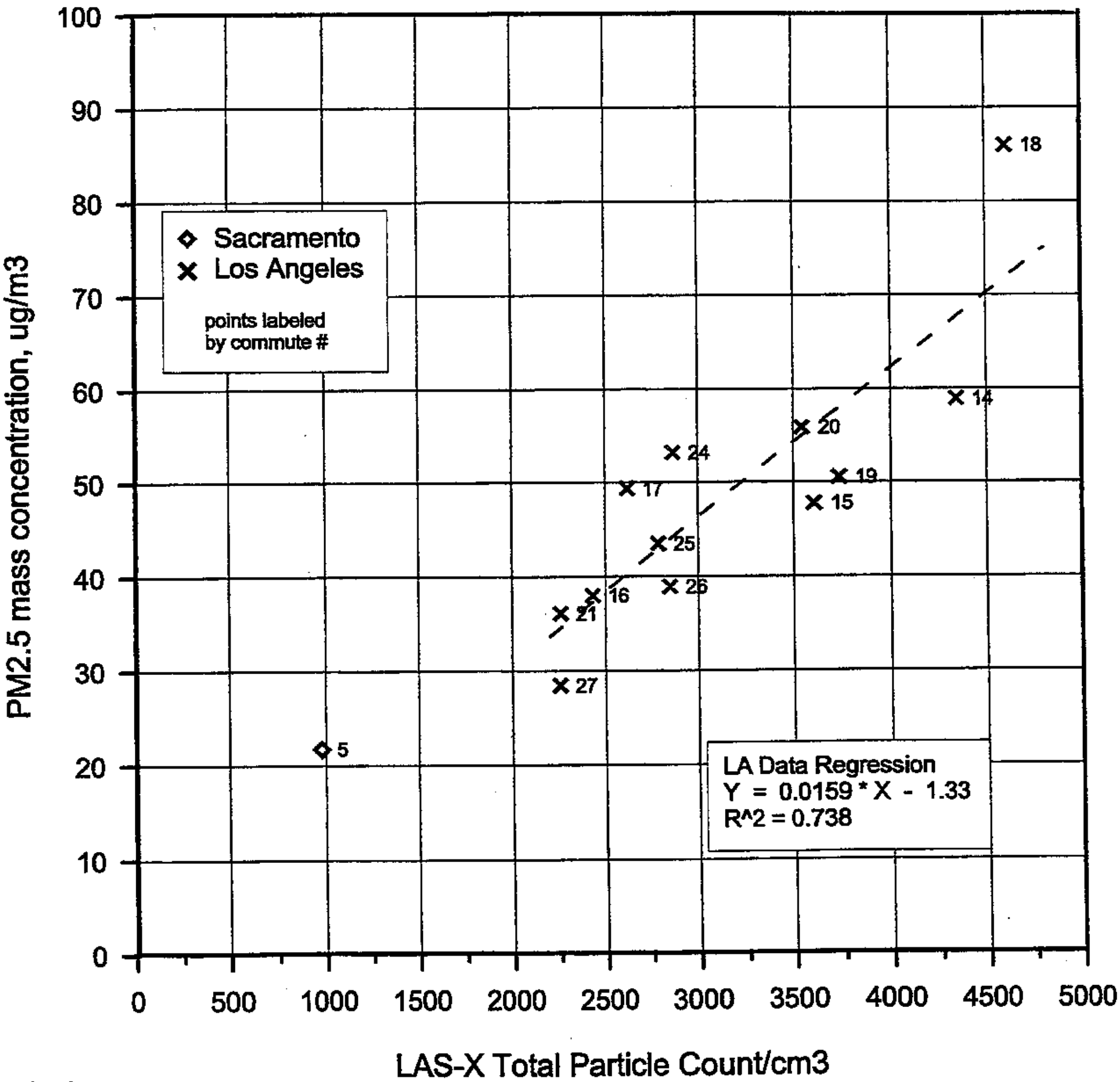


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Figure 4-19. Relationship Between In-Vehicle PM2.5 Mass Concentration and Black Carbon Concentration (excluding Special Study Commutes)

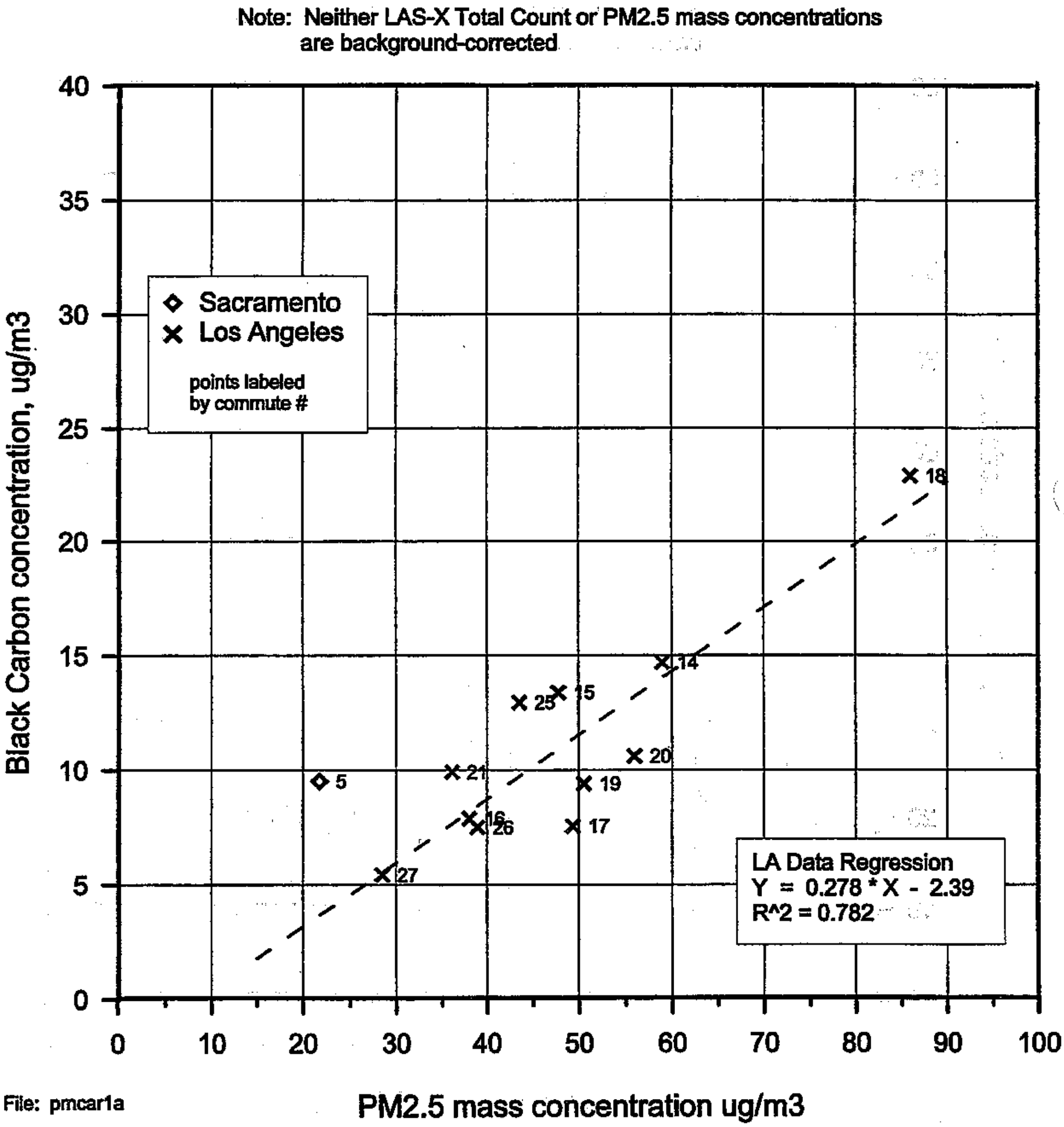

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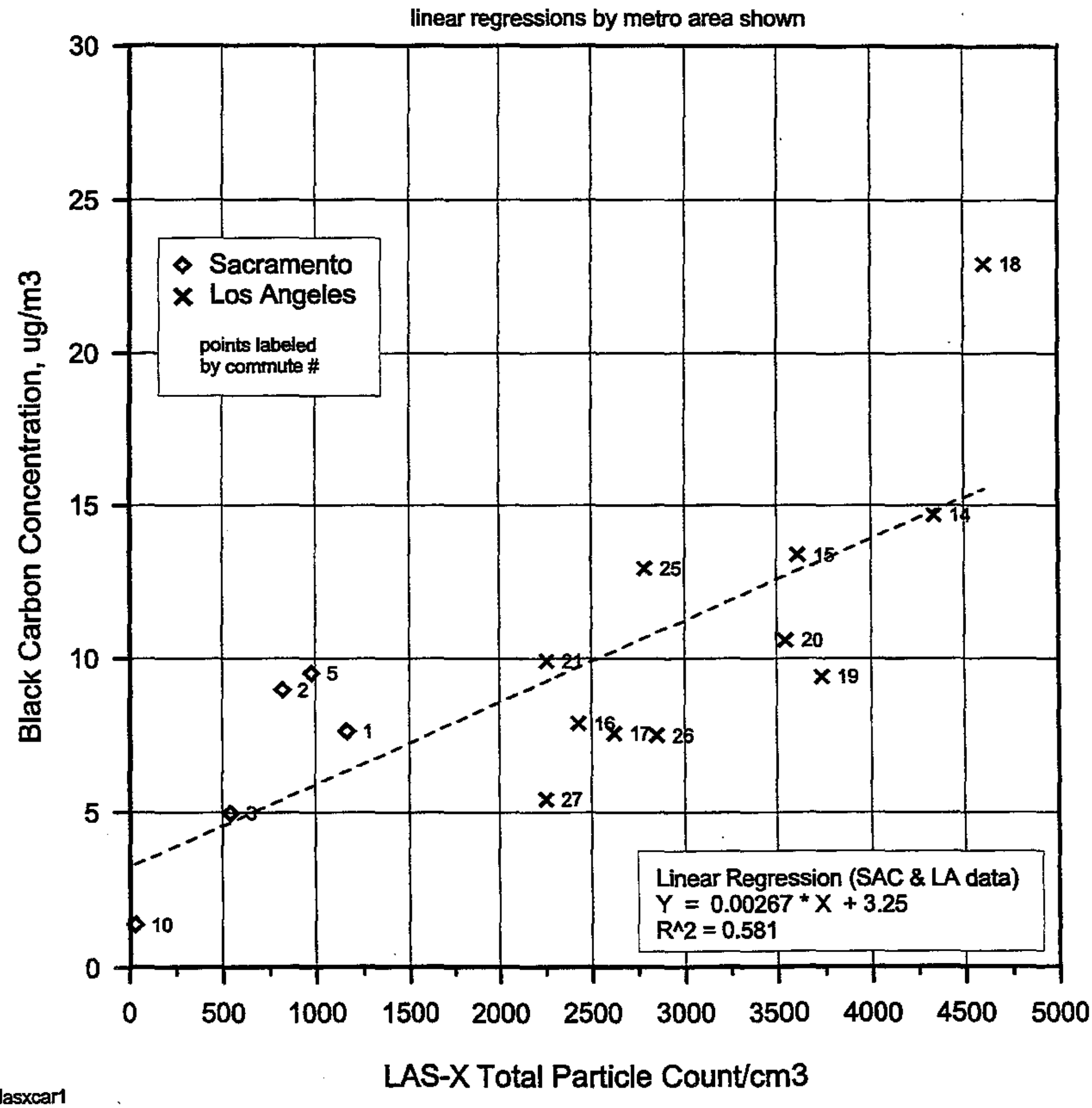
Figure 4-20. Relationship Between LAS-X Total Count In-Vehicle Concentration (0.15 to 2.5 um) and Black Carbon Concentration (Excludes Special Study Commutes)



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4.4.5 Relative Levels: Inside/Outside/Roadside/Ambient

The relative concentration levels of pollutants at the ambient and roadway sites, relative to the actual in-vehicle concentrations is important for predictive purposes. Properly selected ambient monitoring sites should provide a reasonable representation of the population's pollutant exposures for the scale represented by the fixed site. Since some pollutants are known to exhibit stronger spatial gradients than other (e.g. $PM_{2.5}$ is often much more uniformly distributed in a metropolitan area than is PM_{10}), the optional use of a roadway site to better indicate in-vehicle concentrations may be desirable.

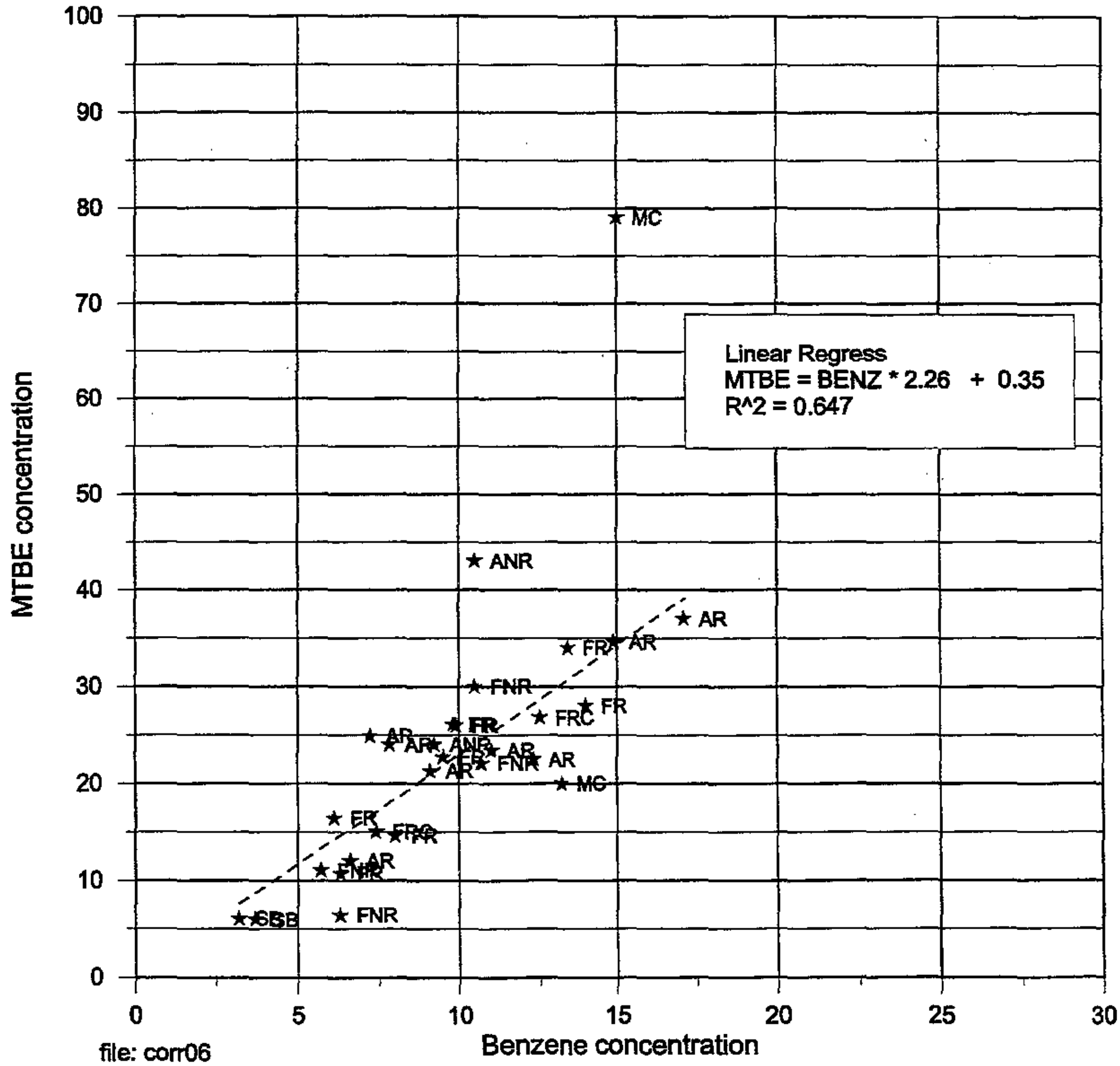
A review of the summary tables 3-4A thru F and 3-5A thru F for Sacramento and LA, provides relative indications of the ranges of individual pollutants measured at roadside and in-vehicle, relative to the measured ambient means for various commute scenarios. For MTBE, the ambient levels were typically 2 to 7 $\mu g/m^3$, while the roadway measurements were only slightly higher at 1 to 14 $\mu g/m^3$. The in-vehicle concentrations, however, ranged from 3 to well over 30 $\mu g/m^3$, suggesting that neither ambient or roadside locations provide estimates within a factor of 2 of the in-vehicle levels. The relatively consistent relationship between the ambient measurements and the in-vehicle MTBE levels (see Figure 3-2) suggests that predictive relationships based on the ambient data are viable. This is similarly true for the gasoline-related VOC's benzene, toluene, and the xylenes, as well as for formaldehyde. Factors such as the influence of the exhausts of single lead vehicles on in-vehicle exposures shown in section 4.4.1, suggests that a more robust data base would be required to actually construct reasonably accurate predictive models relating ambient to in-vehicle pollutant concentrations. Chan et. al. (1991) attempted to apply simple linear regression models to relate roadside and in-vehicle VOC concentrations and found relatively large intercepts and error terms. Similar to this study, they found that sites very close to the roadway, were required to provide even modestly accurately predictions of in-vehicle exposures.

A potentially useful ratio of in-vehicle MTBE/Benzene (see Figure 4-21) was found to be approximately 3. The actual California gasoline ratio for MTBE/Benzene is apparently nearer to 11. Presuming that the measured MTBE and benzene levels in Vehicle 1 were primarily from the exhaust (the vehicle fuel system was carefully checked for leaks), this suggests that these ratios may provide markers for MTBE exposures resulting from exhaust emissions, as compared to those from fuel vapor emissions.

Integrated in-vehicle particle measures were only modestly predictable by ambient and roadside sites, especially for $PM_{2.5}$. PM_{10} relationships are obviously confound by the contributions of intervening significant sources between the ambient, roadside, and in-vehicle measurement locations. The relatively consistent relationship shown in Figure 3-3 for $PM_{2.5}$ also suggests that predictions of in-vehicle levels based on ambient or roadside data are possible.

The very low concentrations measured at both the ambient and roadside sites were consistently below the MDL of the study monitors. This makes it impossible to draw conclusions about predictive relationships for CO.

Figure 4-21. ARB Main Study Raw Vehicle 1 Benzene Against Vehicle 1 MTBE



4.4.6 Concentration Comparisons with Other Studies and Data

This study focused on California driver exposures to pollutant concentrations in California settings. Only limited relevant data were found specific to concentrations of several of the target pollutants (especially MTBE and $PM_{2.5}$ mass) inside California vehicles commuting on California roadways. Shikiya et al. (1989) reported selected VOC's (canister collection), formaldehyde, and metals (undefined size cutpoint) collected during in-vehicle commutes in the Los Angeles area. Although this is probably the most relevant data base for comparison with the current results, significant differences in driving protocol, data stratification by commute type, and averaging time make simple comparisons difficult. Also, of the target analytes, neither MTBE or $PM_{2.5}$ mass (or metals) were reported.

As shown in Table 4-15, benzene and toluene ranges were consistent with the current study. The CO levels were significantly higher in the Shikiya data, probably due to differences in emission controls. Comparing PM_{10} metals showed similar chromium, nickel, and cadmium concentrations, but significantly lower lead levels in the current study by nearly an order of magnitude (note that all metal concentrations are significantly below the current study MDL's – see Table 3-3B). The latter Pb reduction undoubtedly resulting from the phase-out of leaded auto fuel.

Table 4-15 Selected Analyte Concentration Ranges Compared to Shikiya et al., 1989[8]

Analyte	Current Study Range	Shikiya et al., 1989
benzene, $\mu g/m^3$	12.7 – 17.2	13.3
toluene, $\mu g/m^3$	31.5 – 44.4	36.3
CO, ppm	3.5 – 5.1	8.6
PM_{10} Cr, $\mu g/m^3$	0.01 – 0.02	0.012
PM_{10} Ni, $\mu g/m^3$	0.01 – 0.02	0.009
PM_{10} Cd, $\mu g/m^3$	0.00 – 0.09	0.001
PM_{10} Pb, $\mu g/m^3$	0.00 – 0.02	0.218

Chan et al. (1991) reported in-vehicle VOC concentrations on highways in North Carolina, however, MTBE concentrations were not reported. Additionally, the significantly different fuel components and vehicle emission control systems in North Carolina and California, must be considered when comparing the current study with other less specific results. In-vehicle levels of benzene were reported by Chan et al. (1991) to range from ~1 to 43 $\mu g/m^3$, with a mean of 12. The mean ambient background benzene level was ~ 2 $\mu g/m^3$. The ratios of in-vehicle to ambient site VOC concentrations were reported to range from about 6 to 8. These data are reasonably consistent with the current study for Sacramento, but much higher than the ~3 to 5 ratio range in Los Angeles.

Sheldon et al. (1991) reported indoor, outdoor and personal VOC's for Woodland, CA, in June, 1990, and compared these results to previous California VOC studies. The Woodland outdoor benzene median concentration was reported to be 1.1 $\mu g/m^3$, with a personal median concentration of 3.1 $\mu g/m^3$. These benzene concentrations could be compared to the current study data showing a

[8] Current study in-vehicle (IN 1) data range across commute types from Table 3-5A; Shikiya et al., 1989 mean of all commutes from Table 3-1.

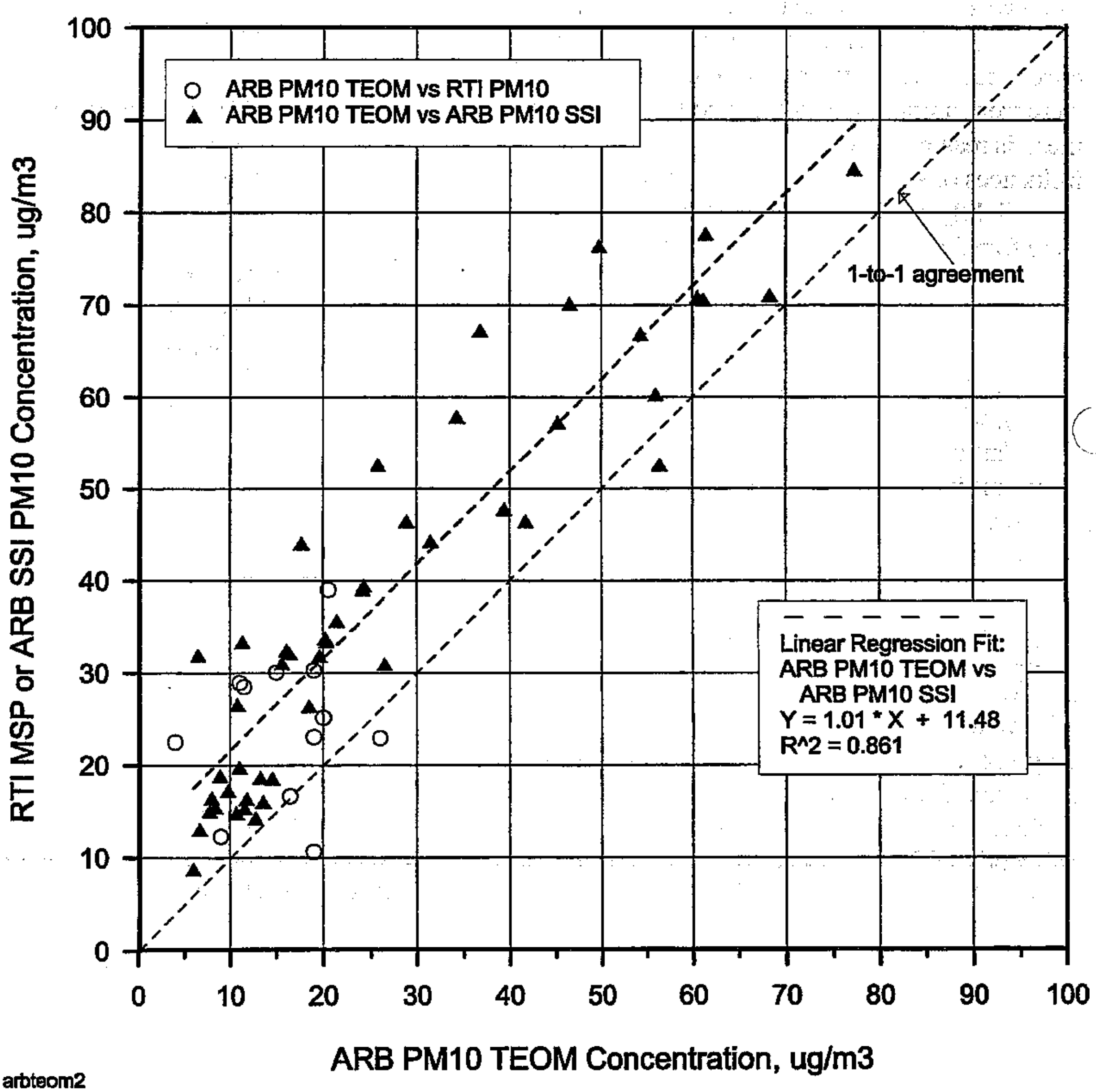
range of vehicular microenvironmental means in Sacramento of ~3 to 12 μg/m^3 and from ~13 to 17 μg/m^3 in Los Angeles. While some data were reported by Sheldon et al. (1991) inside automobiles, none of the measurable in-vehicle VOC's overlapped with the present study. Sheldon et al. (1995) reported benzene and carbon monoxide concentrations in Los Angeles elementary schools in 1991 and 1992. The study surprisingly showed median benzene levels ranging from 3.8 to 15 μg/m^3, which are consistent with the in-vehicle levels of the present study, without the direct influence of a vehicular microenvironment. The corresponding median CO concentrations in the schools reported by Sheldon et al. (1995) ranged from 0.6 to 6.6 ppm, also similar to the in-vehicle CO levels of the present study.

The PTEAM study (Pellizzari et. al, 1992) provided daytime mean 12 hour $PM_{2.5}$ concentrations in Riverside, CA, of 35 μg/m^3, with a mean $PM_{2.5}$ /PM_{10} ratio of 0.49. These data were from a fixed-site that had no influences from nearby localized sources. The concentration mean is reasonably consistent with the ambient data from the Main Study, considering the influences of spatial and seasonal factors. The mean Main Study $PM_{2.5}$ /PM_{10} ratio of 0.58 for LA is only slightly higher than the PTEAM result. No in-vehicle $PM_{2.5}$ concentration data for California were found against which the current study data can be compared.

The continuous black carbon data from the Aethalometer in Figure 4-9, suggests that a typical freeway rush in-vehicle concentration when not behind a "target" vehicle was in the 5 to 10 μg/m^3 range. Figures 4-9, 4-10, and 4-12 suggest that following a HDD "target" elevates this level to the 40 to 100 μg/m^3 range. These findings can be compared with the data of Hansen and Novakov (1990), who reported that elemental carbon levels 50 meters from a diesel bus plume were elevated ~5 μg/m^3 above the background level. Gray et al. (1984) reported a mean elemental carbon level of ~5 μg/m^3 in Southern California. The freeway trailing distances during the Main Study averaged ~50 feet (~16 m) during freeway commutes, these distances were typically only half that during heavy congestion. This undoubtedly could raise the in-vehicle concentrations substantially.

The available ARB data from the ambient sites in Sacramento and Los Angeles were typically over much longer measurement periods and could not be compared directly for most pollutants. Hourly data from an ARB PM_{10} TEOM sampler at the Sacramento ambient site provided the limited comparison data shown in Figure 4-22. Consistent with the findings of others, relative to the TEOM, the study PM_{10} concentrations are consistently higher by approximately 5 to 15 μg/m^3. This could be the result of short term particle volatilizations from the heated TEOM substrate. A brief review of the ambient CO data in Los Angeles at the Pico Rivera site during the Main Study commutes, showed higher AM than PM levels, consistent with the decrease found in this study with wind speed for CO (and MTBE). The ARB mean ambient CO levels at the Pico Rivera site were <2 ppm for both AM and PM, supporting the (<MQL) study findings.

Figure 4-22. Relationship Between ARB Ambient Site PM10 (TEOM) and RTI Ambient Site PM10 (MSP inlets) for 2 Hour Samples Collected During Sacramento Main Study (9/8 - 9/15/97)



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5.0 Summary and Conclusions

5.1 General

An in-vehicle air monitoring study for particles and a variety of organic and inorganic chemicals was conducted in Sacramento and Los Angeles, using vehicles complying with California emission requirements. The study was "successful" in terms of meeting the data quality and data capture goals, as well as addressing the defining study hypotheses. This "Main Study" followed a Pilot Study conducted previously (2/97) that validated the measurement methodologies needed to collect data of acceptable quality, during relatively short commute sampling periods (2 hours). The value of the Pilot Study in producing robust measurement methodologies was fully realized in the exceptionally high data capture rates (for such a complex Main Study) and the excellent data quality. The data quality objectives were met for all pollutant measures, except the particle metals, given the limited ability of the XRF analyses to provide robust quantitation for the target analytes.

A wide range of pollutants were studied, including a suite of VOC's, formaldehyde, $PM_{2.5}$ and PM_{10} particle mass and elemental composition, plus real-time CO, black carbon, and particle count by size. Vehicular commute characteristics were also successfully recorded, including speed, lead vehicle trailing distance, Level of Congestion, and the fraction of leading vehicles that were diesel. A continuous video record subsequently permitted associating the type of lead vehicle with selected in-vehicle concentrations for five LA commutes, using the real-time pollutant measures.

The balanced factorial study design represented a variety of routine commuting scenarios on freeway and arterial roadways, during rush and non-rush hour periods, during both AM and PM time windows, and for several vehicle types, including two different sedans and a sport-utility vehicle. Thirteen commutes were driven in Sacramento in early September, 1997, while 16 additional commutes were subsequently driven in Los Angeles in late September and early October, 1997. Only two duplicates were conducted for each scenario, providing a somewhat limited data base from which to conduct statistical analyses. Commuting routes were selected that were reasonably typical of the most frequently traveled scenarios, and included a comparison of freeway carpool and non-carpool lane commutes. A driving protocol was also defined that highlighted trailing behind heavy duty diesel (HDD) vehicles and diesel city buses when possible, to estimate their contributions to selected pollutants. This focus on trailing specific polluting vehicles provided "high-end" estimates of the in-vehicle concentrations, especially for particle mass and black carbon. The ease of following these "target" vehicle types during non-rush commutes, may have significantly affected the representativeness of these concentrations to represent the non-rush scenarios. Several special studies were conducted, including measuring concentrations inside a commuting California school bus in Sacramento, inside a sedan commuting in a Los Angeles carpool lane, and in a sedan intentionally focusing on situations that may provide maximum vehicular concentrations.

The continuous measurement of particle count by size using a calibrated LAS-X optical particle counter, and black carbon using an Aethalometer, worked well on the mobile sampling platform inside the primary sedan. The primary problem during the commutes was the erratic operation of the on-board AC power system for these two monitors. Unexpected power failures were encountered that interrupted the data collection computer and software on several commutes. The application of an alternating sampling scheme (1 minute inside, 1 minute outside) permitted one continuous monitor of each type to be used for both measurement locations.

5.2 Specific Summary Highlights

In order to provide the clearest summary of salient study highlights, a bulleted format is used.

Methodology

- Data capture rates were excellent for all pollutant measures, especially when the difficulties associated with sampling in a mobile environment are considered.
- Following a selected "target" vehicle for any extended periods was least likely to occur during congested freeway rush commutes, suggesting that these commutes probably produced the most representative concentration levels.
- While VOC commuting concentrations were well within the analytical sensitivity range, most of the pollutant measures were near their measurement quantification limits in many cases, due partly to the very short sampling period, and also to low concentrations in some scenarios.
- The VOC canister sampling methodology provided excellent data quality,
- $PM_{2.5}$ and PM_{10} gravimetrically-determined concentrations were successfully determined, even though the samples were integrated over very short 2 hour periods at only 4 lpm (0.48 m^3).
- The relatively low levels of CO currently found in commuting California vehicles, posed a significant measurement problem for portable monitors with an MQL of 2 ppm.
- The DNPH tube formaldehyde collections provided consistent data quality, but were limited to in-vehicle collections only. The LA sample collections was supported by SCAQMD.
- Continuous monitoring of in-vehicle CO concentrations could be readily associated with emissions from older, poorly tuned gasoline-powered vehicles just ahead of the study vehicles.
- Continuous monitoring of in-vehicle particle count and black carbon concentration can be readily associated with emission of diesel-powered and poorly tuned gasoline-powered vehicles just ahead of the study vehicles.
- The additional LA work, supported by SCAQMD, added significantly to the understanding of factors influencing in-vehicle concentration levels - especially the influence of leading diesel vehicles.
- The use of an outside sampling tube for collecting particles was shown to result in particle losses during transit of 10 to 25%, depending on the particle size. The estimated influence of the outside sampling line on $PM_{2.5}$ mass concentration was ~19 to 21 %.

Pollutant Measures

- Most pollutant levels were elevated inside and outside the vehicles, relative to either the roadside or ambient concentrations.
- Most pollutant levels were extremely low at the rural site, relative to any of the vehicular or roadway locations.
- Most pollutant levels were at least somewhat higher in Los Angeles than in Sacramento, undoubtedly due in part to the larger base of vehicular emissions.
- Particle concentrations were typically significantly higher outside - attributed to losses in the vehicle ventilation systems, while insignificant differences were observed between inside and outside of the same vehicle for gas phase pollutants.

- Inside vehicle pollutant concentrations for some individual commutes were substantially influenced by the tailpipe emissions from single polluting "target" lead vehicles.
- An estimate of the relationship between vehicle spacing (to a polluting "target" vehicle) and the in-vehicle concentration level, could not be reasonably quantified from the study data. While it was clear that concentrations generally diminished with increasing trailing distance, too many uncontrolled variable (e.g. exhaust location, adjacent lane exhausts, emission rate changes during acceleration, etc.) confounded simple efforts.
- The difficulty in following a selected "target" vehicle was least likely to occur for an extended period during freeway rush commutes, suggesting that these commutes are produced the most representative concentration levels.
- The approximate in-vehicle study pollutant concentration ranges (not ambient corrected) by city are provided in Table 5-1.

Table 5-1. Summary of Approximate In-Vehicle Pollutant Concentration Mean Ranges in Sacramento and Los Angeles

NOTE: Concentrations are <u>not</u> ambient corrected

Pollutant	Sacramento Ranges	Los Angeles Ranges
Isobutylene, $\mu g/m^3$	3 to 14	12 to 25
1,3-Butadyiene, $\mu g/m^3$	1 to 4	2 to 6
Acetonitrile, $\mu g/m^3$	18 to 345	6 to 375
TCFM, $\mu g/m^3$	<MQL	<MQL
DCM, $\mu g/m^3$	1 to 4	1 to 5
MTBE, $\mu g/m^3$	3 to 36	20 to 90
ETBE, $\mu g/m^3$	0 to <1	0 to <1
Benzene, $\mu g/m^3$	3 to 15	10 to 22
Toluene, $\mu g/m^3$	7 to 46	22 to 54
Ethylbenzene, $\mu g/m^3$	2 to 10	5 to 12
m,p-Xylene, $\mu g/m^3$	5 to 38	18 to 45
o-xylene, $\mu g/m^3$	2 to 13	6 to 16
PM10, $\mu g/m^3$	20 to 40	35 to 105
PM2.5, $\mu g/m^3$	6 to 22	29 to 107
Formaldehyde, $\mu g/m^3$	5 to 14	0 to 22
CO Mean, ppm	0 to 3	3 to 6
PM2.5 Sulfur, $\mu g/m^3$	0.1 to 0.9	0.7 to 3.9
Black Carbon, $\mu g/m^3$	0 to 10	3 to 40
LAS-X, particles/cm3	10 to 1,100	2,200 to 4,600

Notes: means of 2 to 4 commutes; <MQL – no quantifiable data

- Of the non-target particle elements, only Fe, K, Na, Si, Cu, and P were routinely elevated above the MQL for $PM_{2.5}$ for Sacramento or LA. For PM_{10}, Na, Mg, Al, Si, P, K, Ca, Fe, Cu, and Zn were frequently elevated above the MQL.

- Total LAS-X particle count (0.15 to 2.5 µm) was a fair predictor ($R^2 = 0.74$) of integrated $PM_{2.5}$ mass concentration.
- Both total LAS-X particle count and black carbon appeared to be excellent indicators of the influence of diesel vehicle exhaust on in-vehicle concentrations.
- Black carbon comprised approximately 28 % of the in-vehicle $PM_{2.5}$ integrated mass during the Los Angeles commutes.
- The ambient backgrounds were subtracted from the in-vehicle concentrations for most pollutants to estimate the vehicular microenvironmental contributions during specific commuting scenarios. For freeway rush commutes, the ranges of approximate incremental contribution for three selected pollutants were:

  MTBE: 18 to 20 µg/m³ in Sacramento, and 23 to 24 µg/m³ in LA
  $PM_{2.5}$: 1 to 9 µg/m³ in Sacramento, and 0 to 12 µg/m³ in LA
  Carbon Monoxide: 2.1 to 3.1 ppm in Sacramento, and 4.6 to 4.9 ppm in LA

Vehicular Measures

- The mean vehicular speed for freeway commutes was 33 mph in Sacramento, and 42 mph in LA.
- The mean commute miles traveled (in 2 hrs) on the freeway was 68 miles in Sacramento, and 84 miles in LA.
- The mean vehicular spacing for freeway commutes was 69 feet in Sacramento, and 50 feet in LA.
- The approximate vehicle air exchange rates ranged from 6 to 98 ACH for 3 different vehicles over the speed range from 35 to 55 mph.
- The constant speed air exchange rate of a 1997 Ford explorer was found to range from 2 ACH for 0 mph and a low vent setting to 56 ACH for 55 mph and a medium vent setting.

5.3 Conclusions/Recommendations

One of the most significant results of this effort was the development of the methodologies to address hypotheses regarding in-vehicle concentrations, during both the Pilot Study and the Main Study portions of the field sampling. The in-vehicle sampling during simulated 2 hour commutes in California settings, using both continuous and integrated measurement methods, provided robust data bases for both gas and particle species. These measures included those integrated over the 2 hour period - VOC's, particle mass (including $PM_{2.5}$), formaldehyde, and three continuous measurements - CO, black carbon, and particle count <2.5 μm.

The influences of specific variables on in-vehicle concentrations were assessed by utilizing a balanced factorial design that defined specific driving scenarios and locations. The variables studied included the influences of: (a) vehicle type, (b) vehicle ventilation settings, (c) roadway type (freeway vs arterial), (d) level of freeway congestion (rush vs non-rush), and (e) time of day (AM vs PM). These variables were studied in two locations, Sacramento, CA and Los Angeles, CA. The limited amount of data collected for each scenario (maximum of 4 commutes per scenario) and the driving protocol focusing on a specific target vehicle type (heavy duty diesels), however, significantly limited the ability to address these influences statistically. Comparisons of composited scenario means were evaluated to study each influence variable and subjective observations drawn. These observations suggested the following conclusions regarding the specific study objectives.

- The influence of vehicle types (1991 Chevrolet Caprice, 1997 Ford Taurus, and 1997 Ford Explorer) on in-vehicle concentration levels was determined to be minimal, due possibly to the rapid air exchange rates that occurred with all vehicles tested at typical commuting speeds. Although significant differences between air exchange rates for each vehicle type may exist at low speeds (influenceing in-vehicle concentrations), the absence of low speed conditions during the field testing prevented this assessment.

- The influence of ventilation settings on in-vehicle concentration levels was determined to be minimal, also due possibly to the rapid air exchange rates that occurred at all vent settings tested.

- The influence of roadway types (freeway, arterial, rural) on in-vehicle concentration levels was very significant for selected pollutants for both Sacramento and LA, but was found to be variable and complex. The substantial influence of single (polluting) lead vehicles – which are present on all roadway types - on in-vehicle concentration levels appears to be an important confounding factor. Another important factor (not directly addressed experimentally) that is related to roadway type, appears to be the trailing distance to the lead vehicle, often dictated by the traffic density.

- The influence of freeway congestion level (rush, non-rush) was also found to be complex, but appeared to be most significantly influenced by the associated parameter of spacing distance to the leading vehicle. The limited (and variable) data set made it difficult to provide a definitive conclusion. In general, the Freeway Rush commutes did appear to show significantly higher background-corrected in-vehicle concentrations than did the Non-Rush commutes.

• The influence of time-of-day (AM or PM) was also found to be complex, and primarily a function of setting (Sacramento or LA), Level of Congestion, and the local meteorology. While Sacramento had a significantly higher PM Level of Congestion (and associated in-vehicle concentrations), LA concentration data appeared to be most significantly influenced by the AM to PM change (a substantial wind speed increase) in local meteorology.

In general, the vehicle-specific influences (vehicle type and vehicle vent setting) appeared to be minimal factors (especially relative to other variables) affecting in-vehicle concentrations under the conditions tested. The remaining categorical factors (roadway type, freeway congestion level, and time-of-day) had variable influences, most often controlled by more specific underlying factors, including: (a) the experimental driving protocol (trailing specific polluting target vehicles), (b) the often pronounced influence of emissions from the lead vehicle, (c) spacing to the lead vehicle, and (d) the local meteorology (wind speed). The combination of the limited number of commutes (max of four for each influence category, and a study design that did not specifically address these underlying variables, makes it difficult to draw more substantial conclusions.

Salient Additional Conclusions:

Some of the additional findings of this study may prove to be of greater value than those addressed by the original study objectives, including:

• The role of single polluting vehicles immediately in front of the test vehicles was substantial, even for short periods, occasionally accounting for 30 to 50 % of the total in-vehicle commute exposure.
• "Target" Ethanol or CNG-fueled city buses provided in-vehicle total particle count levels than were 3 to 5 times lower than diesel buses, and black carbon in-vehicle concentrations that were 60 to 80 μg/m^3 less.
• "Target" older gasoline-powered sedans were most consistently the cause of elevated in-vehicle CO levels, especially at stoplights.
• The ventilation systems of the test vehicles (with the windows closed) significantly reduced the penetration of particle mass <2.5 μm by 20 to 40 %.
• Passenger exposures inside a California school bus was quite low, reflecting the generally lower concentrations in residential neighborhoods, compared to settings with more vehicular influences.
• Carpool lane commutes substantially reduced in-vehicle pollutant concentrations by 30 to 60 %, and additionally reduced total commute exposures by reducing total commuting time.
• Maximum concentration situations during commutes (e.g. closely trailing a diesel city bus in a street canyon) could readily double the short-term in-vehicle concentrations for selected pollutants.
• Roadside pollutant measurements provided significantly better indications of in-vehicle pollutant concentrations than did ambient sites, but were still low by factors of 2 or more many commuting scenarios.
• Correcting the in-vehicle concentrations by subtracting the ambient background levels,

provided a more robust method of assessing the contribution of the commuting microenvironment to total air exposure.

Salient Recommendations:

Specific recommendations related to in-vehicle concentration measurement studies include:

- VOC's by canister collection and GC/MS analysis methodologies can readily be used for 2 hour commute averages, as can DNPH formaldehyde collections with HPLC analysis.
- Extraordinary care must be taken to obtain reliable gravimetric $PM_{2.5}$ and PM_{10} concentrations over such short durations (and low flowrates) – but are possible. The design of future particle exposures studies over such limited integration intervals, should consider longer periods to improve the MQL's.
- An outside sample line should only be used (to compare inside/outside particle ratios), if some means (similar to the size distribution comparison conducted here) is available for estimating particle losses.
- Refinements and improvements are needed for real-time particle samplers, which are still too bulky to use easily in private automobiles without unduly altering the normal environment and/or the activities of the occupants.
- The integrated sampling methodologies for NO_2 and PAH's need to be improved to collect measureable, short-term (2-hour) samples inside commuting vehicles.
- Continuous in-vehicle particle counting is only recommended for future studies if the device has been specifically calibrated for the type of aerosol to be encountered.
- Continuous black carbon measurements using the Aethalometer were very easy to make experimentally, but should be compared in future studies with limited integrated collections on quartz substrates and thermal decomposition analysis methodology to verify the measurement accuracy.
- The relationship between trailing distance and in-vehicle concentration should be investigated to provide better guidance on the potential mitigating influences of following less closely.
- Further quantification of the advantages of carpool commuting relative to pollutant exposures should be considered.
- Further measurements and/or modeling are suggested to estimate the relative contributions of ambient versus vehicular pollutants in the commuting microenvironment.
- Further work is suggested evaluating the relative importance of single lead vehicles on in-vehicle exposures, especially in terms of the relationship of the emission rates of older (compared to newer, better-controlled) vehicles to in-vehicle exposures.
- Further work is suggested on the potential impact of individual poorly-tuned (or maintained) diesel vehicles on black carbon and particle mass in-vehicle concentrations.
- The potential for high concentrations of fine particle levels during rain events should be investigated to determine if the phenomenon is reproducible and the mechanisms by which in-vehicle particle concentrations are being elevated.

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7.0 Glossary

Salient abbreviations, acronyms and words peculiar to this report are identified as follows:

Organizations
AD - Aerosol Dynamics, Inc.
ARB - Air Resources Board of the California Environmental Protection Agency
DRI - Desert Research Institute
EPA - Environmental Protection Agency
RTI - Research Triangle Institute
SCAQMD - South Coast Air Quality Management District
SR - Sierra Research, Inc.

Units
$\mu g/m^3$ - micrograms of pollutant per cubic meter of sampled air
ppm - parts per million of pollutant by volume
AER - Air Exchange Rate
ACH - Air Changes per Hour
LAS-X - particle counter model identification manufactured by Particle Measurement Systems, Inc.

Pollutant Acronyms
DCM - dichloromethane
ETBE - ethyl-tertiary-butyl ether
MTBE - methyl-tertiary-butyl-ether
PM_{10} - EPA designation for particles nominally <10 μm in aerodynamic diameter
$PM_{2.5}$ - EPA designation for particles nominally <2.5 μm in aerodynamic diameter
TCFM - trichloro-fluoro-methane
VOC - Volatile Organic Compound

Study Scenario Abbreviations
AMB - ambient site
ANR - Arterial Non-Rush
AR - Arterial Rush
FNR - Freeway Non-Rush
FR - Freeway Rush
FRC - Freeway Rush Carpool
IN 1 - inside vehicle 1
IN 2 - inside vehicle 2
LA - Los Angeles
SB - School Buss commute
MC - Maximum Commute
OUT 1 - outside vehicle 1
OUT 2 - outside vehicle 2

R - Rural
ROAD 1 - roadside site 1
ROAD 2 - roadside site 2
SAC - Sacramento
SUV - sport utility vehicle
Vehicle 1 - lead test vehicle, additionally outfitted with continuous monitors and vehicular measures
Vehicle 2 - test vehicle following Vehicle 1, or in an adjacent lane

Measurement Abbreviations
HPLC - high pressure liquid chromatography
GC/MS - gas chromatography followed by mass spectrometry (VOC analysis)
SUMMA - VOC canister surface passivation type
XRF - x-ray fluorescence (elemental analysis)

Miscellaneous
"Target" Pollutant - pollutant selected to be specifically measured, even though others in the class are reported (e.g. MTBE as a target for VOC's, formaldehyde, as a target aldehyde)
"Target" Vehicle - the vehicle immediate in front of the study vehicle, selected to follow by the driver
Level of Congestion – designation describing six subjectively-judged traffic density categories, ranging from 1 (extremely light) to 6 (extremely heavy).
HDD - heavy duty diesel
HSC - Health and Safety Code of the state of California
MDL - minimum detection limit
MQL - minimum quantification limit (3 times the MDL, if the MDL is defined)
PEM - personal exposure monitor

APPENDICIES

Appendix A

Pilot Study Report: Measuring Concentrations of Selected Air Pollutants Inside California Vehicles

February 1, 1998

PILOT STUDY REPORT:
MEASURING CONCENTRATIONS OF SELECTED AIR POLLUTANTS INSIDE CALIFORNIA VEHICLES

ARB Contract 95-339
RTI Task 93U-6786-001

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Disclaimer

The statements and conclusions in this report are those of the contractor(s) and not necessarily those of the California Air Resources Board. The mention of commercial products, their sources, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

Acknowledgments

This Pilot Study project integrated the technical skills and personnel from a prime contractor, Research Triangle Institute (RTI), and two subcontractors, Sierra Research, Inc. (SR), and Aerosol Dynamics, Inc.(AD). SR provided the mobile sampling platform used in all commutes, on-board instrumentation to measure and record traffic conditions, drivers and a navigator (primary vehicle only) for all vehicles, and rental vehicles. SR also selected the commuting routes used for each phase of the study. AD provided the characterization of "real" California aerosol, calibration of the optical particle counter for these aerosols, and the (leased) Aethalometer for monitoring elemental carbon. AD also provided aerosol monitoring consulting, and assisted in the initial installations of the particle counter and Aethalometer. RTI provided all other equipment and technical services associated with both the Pilot and Main Studies, including the overall study design and project direction, field project direction, field operations technical staff, ICP/MS metals' analyses (Pilot Study only), automated data collection, analyses and interpretations, quality assurance summaries, and reporting. Staff from ARB assisted in the field operations by providing local logistical coordination, and collecting samples and data from the ambient monitoring sites. SCAQMD provided logistical support in Los Angeles.

Specific individuals contributing to this project included:

RTI - Charles Rodes and Linda Sheldon (overall project direction), Don Whitaker (field management), Phil Lawless (filter weighing coordination and automated data collection), Mike Roberds (field operations - Pilot Study), Randy Newsome (sampling equipment design and construction, field operations - Main Study Sacramento), Tyson Mew (field operations - Sacramento), Andy Clayton (data analysis), Doris Smith and Jim Flanagan (quality assurance), Peter Grohse (ICP/MS analyses), Libby Cain (report preparation).

Sierra Research - Frank DiGenova (subcontract direction and field support, navigation), John Lee (traffic data collection, driving, navigation), Josh Willter (driving)

Aerosol Dynamic - Susanne Hering (subcontract direction, aerosol measurement consulting, and field support), Mark Stolzenburg (aerosol characterization, particle counter calibration, field support), Nathan Kreisberg (aerosol characterization, particle counter calibration, aerosol modeling).

ARB - Steve Hui (logistical support in Sacramento collection of ambient monitoring data, sampler assistance - Pilot and Main Studies), Peggy Jenkins (sampler assistance - Pilot Study)

TABLE OF CONTENTS

Preface

This report summarizes the field monitoring activities and the data collected from a Pilot Study conducted to a assess the capabilities of methodologies for assessing in-vehicle air concentrations in California vehicles for a number of selected pollutants. The report is presented in a bulleted form, rather than a narrative style to focus on the key study design elements that either worked successfully or required consideration and improvement before subsequently implementing the Main Study. Extensive data analyses and inter-comparisons of the concentration data with other vehicular studies is not justified, given the limited number of commuting scenarios and the study design focus on testing and refining methodologies. A separate report summarizing the much more robust Main Study to follow the Pilot Study will focus on characterizing in-vehicle concentration levels.

1.0 PROGRAM DESCRIPTION

1.1 BACKGROUND:

The California Health and Safety Code (HSC) Section 39660.5 requires the California Air Resource Board (ARB) to assess human exposure to toxic pollutants. The ARB is also required to identify the relative contribution of indoor concentrations to total exposure, taking into account both ambient and indoor air environments. In order to assess a population's pollutant exposure, it is necessary to account for the important microenvironments where people spend their time. This requires information on how much time people spend in specific microenvironments and the corresponding pollutant air concentration in those microenvironments. Although the ARB has representative data on Californian's activity patterns (Wiley et al., 1991a, 1991b), very little pollutant concentration data are available for many microenvironments including vehicle passenger compartments.

1.2 STUDY DESIGN AND OBJECTIVES

This overall goal of this program is an in-vehicle air monitoring study primarily for particles and a variety of organic and inorganic chemicals. The results of this program will be used by ARB to determine the need for, and feasibility of, additional in-vehicle pollutant measurements in future studies. The results will also be used by the ARB to improve estimates of current Californian in-vehicle exposures to selected pollutants, and to assess the relative contribution of in-vehicle exposure to total air exposure for these pollutants. In addition, the results may be used to identify actions that driver and passengers may take to reduce their in-vehicle exposures to air pollutants.

Table 1-1 lists the pollutants for monitoring in this program, and notes that some pollutants will be monitored in a Pilot Study only as a range-finding exercise. Primary emphasis was placed on obtaining reliable concentration data for particles and methyl *t*-butyl ether (MTBE). Measurements were obtained during actual commutes, inside passenger vehicles, immediately outside the vehicles, along the roadway where the vehicles travel, and at ambient monitoring sites. Measurements were made using driving scenarios that are likely to produce the full range of probable in-vehicle concentrations, but emphasis was given to scenarios likely to result in high in-vehicle exposures. Table 1-1 also lists the other data that were collected in addition to the chemical measurements and the required driving scenarios specified by ARB.

TABLE 1-1. Study Design Elements

Pollutants:	$PM_{2.5}$ particles, PM_{10} particles, metals, VOC's (methyl *t*-butyl ether, ethyl *t*-butyl ether, 1,3,-butadiene, benzene, toluene, xylenes, ethyl benzene + 5 other VOC's), CO, NO_2, formaldehyde, particle size distribution[a], black (elemental) carbon[a], PAHs[a]
Other Measurement:	Vehicle speed, traffic density (level of congestion), trailing distance (to vehicle in front) roadway traffic count (representative), meteorology (wind speed, wind direction, relative humidity, and temperature); route/drive characterization
Driving Scenarios:	Freeway - rush Freeway - rush - carpool Freeway rush - right lane Freeway - non rush Arterial roadway - rush Arterial roadway - non-rush Rural roadway School bus commuting

[a] Proposed for Pilot Study only.

As a first step in developing a study design, a list of potential research objectives were formulated taking into account ARB's program goals as well as the important factors that can effect in-vehicle pollutant concentrations. These research objectives were finalized based on inputs from the ARB and results of pilot testing. The finalized research objectives were then used to define the data collection requirements and the data analysis approach for the Main Study. The design objectives considered for this program are given in Tables 1-2A and 1-2B organized by factors which can influence in-vehicle air concentrations.

TABLE 1-2A. Specific Research Design Objectives Grouped By Factor Type For Both the Pilot and Main Studies

[Pilot Study (only) Objectives are **bold**; Main Study objectives are in *italics*]

Methodology

A1. Demonstrate in a Pilot Study that the measurement techniques selected for each contaminant are capable of meeting the study requirements

Data Base Development

B1. Measure the concentrations of selected pollutants (PM_{10} and $PM_{2.5}$ particle mass, selected metals, selected VOC's, carbon monoxide, nitrogen dioxide, and selected PAH's) inside and outside California vehicles during commutes consisting of selected scenarios that define an expected range of exposures from "best" to "worst" case.

Driver Selected Options

C1. Evaluate the differences between inside and outside vehicle contaminant concentrations and their relationships to 3 driver (or passenger) adjusted ventilation control settings, to provide three air exchange rates (AERs).

C2. Evaluate the modification of the particle count and mass size distributions by the ventilation system as a function of 3 driver (or passenger) adjusted air exchange rate in a selected vehicle. *[Note: particle count/size distribution measurements were subsequently added to the Main Study]*

C3. Evaluate the influence of 3 freeway lane positions (carpool, normal, and slow-lane) on in-vehicle concentrations.

Vehicle Factors

D1. Evaluate the influence of 4 vehicle types (2 different sedans, a van, and a school bus) on occupant exposure levels.

D2. Evaluate the influence of 3 different lead-vehicle types (gasoline, light duty diesel [deleted by technical direction], heavy duty diesel) on occupant exposure levels.

Roadway Factors

E1. Evaluate the influence of 3 roadway types (freeway, arterial, and rural) on in-vehicle concentrations.

E2. Evaluate the influence of "worst-case" roadway settings (street canyon in LA compared to flat terrain in LA) on in-vehicle concentrations.

TABLE 1-2B. Specific Research Design Objectives Grouped By Factor Type For Both the Pilot and Main Studies (cont'd)

Traffic Factors

F1. Evaluate the influence of 2 freeway conditions (rush hour and non-rush hour) on in-vehicle concentrations.

F2. Evaluate the influence of the average traffic speed (occupant vehicle) and density (visual observation) on in-vehicle concentrations.

F3. Evaluate the influence of the average freeway traffic speed and density (closest available CalTrans data) on in-vehicle concentrations.

F4. Evaluate the influence of following distance on in-vehicle concentrations.

Meteorological Factors

G1. Evaluate the influences of meteorological variables (wind speed, wind direction, temperature, relative humidity and rainfall) on in-vehicle concentrations.

G2. Evaluate the influences of selected meteorological variables (wind speed and wind direction) on the associations between roadside (RS) measurements and in-vehicle concentrations.

G3. Evaluate the influence of selected meteorological variables (wind speed and wind direction) on the associations between ambient (AM) fixed site measurements and in-vehicle concentrations.

Temporal Factors

H1. Evaluate the influence of weekday versus weekend on in-vehicle concentrations [deleted by technical direction].

H2. Evaluate the variability of CO and fine particles inside and outside vehicles.

H3. Evaluate the short term temporal variability in particle number and mass size distributions outside and inside a selected test vehicle *[Note: particle count/size distribution measurements were subsequently added to the Main Study]*.

Spatial Factors

I1. Determine the relationships of inside and outside vehicle concentrations to contemporaneous roadside and fixed-site ambient monitoring locations.

The program was conducted in two phases. Phase 1 is a Pilot Study; Phase 2 is the Main Study. Work on the Pilot Study was designed to address the following four objectives:

- To evaluate monitoring methods proposed for the Main Study,
- To collect monitoring data in Sacramento for the pollutants and other parameters proposed for the Main Study,
- To collect monitoring data in Sacramento for additional pollutants including real-time measurements for particles and carbon black and integrated measurements for PAH's, and
- To evaluate both method performance data and collected monitoring data to help define/finalize the research objectives and to develop study design for the Main Study.

This report describes the performance of the methods that were used during the Pilot Study. Method results and sample analysis data are then given. We have also provided conclusions drawn from this Pilot Study and have made recommendations for the Main Study.

1.3 EXPERIMENTAL DATA CAPTURE MATRIX

The Phase 1 Pilot Study field sampling was conducted from 2/26 to 3/3/97 in the Sacramento, California metropolitan area by the Research Triangle Institute (RTI), and its subcontractors, Sierra Research and Aerosol Dynamics. A total of 7 commutes (6 rush-hour freeway and 1 rural), each lasting approximately 2 hours, were driven using a specially-designed test sedan (a 1991 Chevrolet Caprice) provide by Sierra Research as a mobile sampling platform. The test vehicle was outfitted to collect inside and outside samples and measurements for almost all pollutant (PM_{10} and aldehydes were inside only). The inside vehicle measurements were collected near the driver's breathing zone to estimate the exposure concentrations. Outside samples were collected by drawing air from the front of the vehicle at ~ 20 LPM to a distribution manifold inside the car. The typical commute was 80 miles in length at an average speed of 37 mph. The freeway commute hours were 7 to 9 AM (3 commutes) and 4 to 6 PM (3 commutes). The freeway routes were selected based on historically elevated traffic density data. The rural commute was 107 miles at 48 mph.

Simultaneous samples and measurements for most of the same pollutants were collected in the vehicle, at 4 Roadside sites (freeway commutes only), and at the most proximal ARB fixed-site Ambient monitoring station. An access permit had previously been obtained from CalTrans to install and service the 4 Roadway sites at ARB-selected locations along the commuting route. The Roadside sites were located within 20 feet of the pavement, on the west side (predominantly downwind) of freeway. A driving protocol was established to highlight following heavy-duty diesel vehicles, where possible, to estimate maximum commuting pollutant concentration levels.

Three ventilation control settings in the 1991 Caprice were standardized to demonstrate their influence on the air exchange rate in the test car and, more importantly, their influences on-in-vehicle pollutant concentrations. These settings provided low, medium, and high levels of ventilation, with air exchange rates measured at a constants speed of 55 mph to be 39, 98, and 160 air changes/hour, respectively. For the Caprice, <u>High</u> AER was achieved with both front windows approximately 1/3 open, the vent setting open and the fan speed set to medium-high. <u>Medium</u> AER was achieved with all windows closed, the vent setting open and the fan speed set to medium-high. <u>Low</u> AER was achieved with all windows closed, the vent closed (recirculate) and the fan speed set to "OFF". These ventilation setting scenarios are also designated as Vent 3, Vent 2, and Vent 1, respectively.

The Pilot Study measurements included 2-hour integrated samples ($PM_{2.5}$ and PM_{10} particles, VOC's, and NO_2 at all locations, plus PAH's and aldehydes at selected sites). Continuous measurements for CO were made at all locations. Particle size distribution using an optical particle counter (PMS LAS-X) and black carbon data (Aethalometer) were collected inside and outside the car. In order to increase the accuracy of estimated mass concentrations from the particle counter, the unit was calibrated by Aerosol Dynamics using real California vehicular and ambient aerosols. Continuous monitoring data were reduced to 1-minute averages to provide a data base of 120 values for each 2 hour commute. Summaries of the integrated samples and continuous data collected during the Pilot Study are given in Tables 1-3 and 1-4, respectively, defining the sampling matrix employed. The tabular data also indicate a high percentage of valid data collections. More detailed descriptions of the field monitoring and monitoring methods are provided in Sections 3 and 4.

Table 1-3. ARB In-Vehicle Exposure Pilot Study Integrated Sample & Data Capture Matrix

Integrated Sample Collection

Sample Type	Total Inside I	Total Outside O	Total Ambient A	Total Rdsde 1 R1	Total Rdsde 2 R2	Total Rdsde 3 R3	Total Rdsde 4 R4	All Dups	Total Planned	Total Valid	Total Quest.?	Total Invalid
Particles (2.5u)	8[7]	8[7]	8[7]	4	4	4	4	2	42[39]	37	4	0
Particles (10u)	8[7]	----	8[7]	4	4	4	4	2	34[32]	32	2	0
VOC's (multisorb)	8[7]	----	----	----	----	----	----	2	10[9]	9	0	0
VOC's (canister)	8[7]	8[7]	8[7]	4	4	4	4	2	42[39]	40*	0	0
Aldehydes (DNPH)	8[7]	----	----	----	----	----	----	2	10(9)	8	0	1
PAH's (quartz filter)	3[4]	3[4]	3[4]	----	----	3	----	2	14[15]	13	0	2
NO2 (mol sieve)	16[14]	16[14]	16[14]	8	8	8	8	4	84(78)	78	0	0

Notes: The original plan to conduct 6 freeway-influenced commutes and 2 rural commutes was modified by ARB technical direction to include only 1 rural commute

[N] bracketed number reflects revised number from deleting 1 rural commute and adding 1 PAH sample

Field blanks and field controls not included in this table.

Although the Inside and Outside Car samples for 2/26 AM were valid, the car was parked a significant portion of the time

Only particle samples have been analyzed (for mass only) as of 3/18/97

*One additional canister sample was collected to assess the car interior and equipment VOC contributions

Invalidations: 1 aldehyde sample - insufficient battery charge; 2 PAH samples - pump failures

Table 1-4. ARB In-Vehicle Exposure Pilot Study Continuous Data Capture Matrix

Continuos Data Collection

Data Type	Total Inside I	Total Outside O	Total Ambient A	Total Rdsde 1 R1	Total Rdsde 2 R2	Total Rdsde 3 R3	Total Rdsde 4 R4	All Dups	Total Planned	Total Valid	Total Questionable	Total Invalid
LAS-X	8[7]	8[7]	----	----	----	----	----	----	16[14]	8	2	4
Aethalometer (black carbon)	8[7]	8[7]	----	----	----	----	----	----	16[14]	8	2	4
T & Rh in car	8[7]	----	----	----	----	----	----	----	8[7]	7	0	0
CO (Draeger)	8[7]	8[7]	8[7]	4	4	4	4	2	42(39)	38	0	1

Notes: [N] bracketed number reflects revised number from deleting 1 rural commute and adding 1 PAH sample

One continuous data entry implies collection of 120 one minute values (one commute)

Invalidations: Power failures in the car voided 100% of 2/26 AM & PM LAS-X & Aethalometer data and 25% of 2/27 PM; 1 CO collection lost in download failure

2.0 SUMMARY AND RECOMMENDATIONS

2.1 METHODOLOGIES

This section summarizes the salient highlights of the Pilot Study methods described subsequently in Sections 3 (Field Monitoring) and 4 (Monitoring Methods). Since a primary objective of the Pilot Study was to evaluate methods, the implications and recommendations for the Main Study [MS], relative to each Pilot Study highlight are summarized. More detailed discussions and recommendations are provided in Sections 3, 4 and 5. A summary of the data highlights are found in the Measurement Data Section (2.2). In order to identify and coordinate all corrective actions needed prior to the Main Study, a summary of critical milestones was prepared and is included in Appendix A.

2.1.1 PILOT STUDY PREPARATIONS

Prior to the commencement of field sampling, a number of activities were completed to enhance the quality and completeness of the collected data.

- Obtaining the encroachment permit from CalTrans to access the Roadside monitors in the Sacramento area required significantly more effort than was expected.
  [MS Recommendation(s): If roadside monitors are used in the Main Study, the same locations should be considered to simplify the permitting process.]

- The design and construction (by RTI) of a special, computer-controlled manifold system permitted both simultaneous and sequential inside and outside vehicle measurements on a 1 minute cycle.
  [MS Recommendation(s): The manifold system worked well and will be used in the Main Study without modification]

- The design and construction (by RTI) of a portable backseat monitoring platform supporting all integrated and continuous monitoring systems and the video camera proved adequate, except for periodic vibrations induced into the video camera.
  [MS Recommendation(s): The platform will be utilized as designed with the exception of the video cameral support, which has been replaced by a "steady-cam" mount.]

- The selection (by Sierra Research) of optimum freeway and rural commuting routes that would highlight the range of expected exposure concentrations, while being representative of typical Sacramento commutes.
  [MS Recommendation(s): The same procedures will be follow to select the Main Study commuting routes]

- The calibration (by Aerosol Dynamics) of the PMS LAS-X continuous particle monitor with actual vehicular and ambient calibration aerosols, including characterization of the particle densities by particle size, proved invaluable. These calibration steps greatly enhanced the ability to computed mass concentrations from the particle count data.

[MS Recommendation(s): If the LAS-X is used in the Main Study, the same unit and calibration data will be applied]

2.1.2 FIELD MONITORING

The projected collection of 95% valid integrated samples and continuous data was successfully met for all pollutants, except for $PM_{2.5}$ gravimetric mass concentrations (see Section 2.1.3.1). In general all of the Pilot Study field monitoring objectives were successfully met. Overcoming some of the unforeseen problems in a timely manner at the outset of sampling, however, required a substantial application of time and intellect by study personnel.

- The successful collection of continuous data inside the test car required a substantial amount of effort and several design corrections to the mobile power system inside the vehicle.
  [MS Recommendation(s): If continuous monitors are utilized in the Main Study, a more robust and electrically-filtered power system will be required. A replacement system for the car has been ordered (by Sierra Research to be installed prior to the Main Study.)]

- The attempt to follow specific vehicle types as part of the driving protocol was partially successful, but to a lesser degree than was expected. It often proved difficult to target (move behind) and remain behind a selected vehicle in heavy traffic. In some cases, it was also difficult to determine whether light- and medium-duty vehicles were actually diesel-fueled.
  [MS Recommendation(s): The protocol to follow selected vehicle types should be revised to target only heavy duty diesels and visibly smoking automobiles (in that order).]

- The collection of samples at the Roadside and Ambient sites were relatively uneventful, except for the commuting time required to set-up and retrieve the samplers. Measurements at the roadside were significantly higher than the ambient sites, but were much lower than the in-vehicle concentrations. The Roadside site setup labor added significantly to the man-power needed for successful data collection. ARB personnel provided valuable assistance by servicing the Ambient monitoring site.
  [MS Recommendation(s): Discussions are currently continuing as to the resources available and the ability of this study design to adequately demonstrate that Roadside monitors can be used to predict in-vehicle pollutant concentrations. The additional labor requirements to deploy and service the Roadside stations , however, influences their cost-effectiveness. The number of Roadway sites to be used in the Main Study is still under discussion.]

- The requirement to change the NO_2 tubes at all sites between hours 1 and 2 to collect hourly data substantially added to the man-power burden needed in the field, especially during heavy traffic periods.
  [MS Recommendation(s): ARB has currently determined that the additional information provided by the integrated NO_2 measurements were not cost-effective and has eliminated NO_2 measurements from the Main Study]

- The rural commute with its very low traffic densities substantially taxed the Minimum Quantification Limits for almost all of the methods resulting from the very low pollutant levels. Apparently the emission rates from the exhausts of California gasoline-powered automobiles are currently effectively controlled for the measured pollutant - when the vehicle engine and emission systems are functioning properly.
  [MS Recommendation(s): The low concentrations observed for all pollutants during rural commutes suggested that a de-emphasis of these situations should be considered. A greater emphasis in the Main Study is being discussed for those scenarios that produce the highest exposures.]

- The 1991 Caprice data collection system with a driver and navigator worked as planned to collect vehicle spacing data, Level of Congestion, vehicle speed, periodic driving diaries, and video records of each commute, but some of the data proved difficult to accurately collect or was not found useful in the data analysis.
  [MS Recommendation(s): The collection of data using the manual switchbox will be greatly simplified for the Main Study to summarize only Level of Congestion (traffic density categories), freeing the navigator to provide a more detailed diary to accompany each video. The automatic computer collection of vehicle speed and lead-vehicle spacing will be continued.]

- An insurance issue concerning overnight parking security and the personnel authorized to drive the Sierra test sedan complicated the logistics of preparing the vehicle for sampling.
  [MS Recommendation(s): An agreement between RTI and Sierra Research will be in effect prior to the Main Study to provide insurance coverage for the test vehicle to eliminate these problems]

2.1.3 MONITORING METHODS

This section summarizes the performance highlights of the measurement methods for the Main Study. Additional details on the methodologies can be found in Section 4 or the Pilot Study Operation Manual (not presented here).

2.1.3.1 Particle Mass

The collection of $PM_{2.5}$ and PM_{10} particle samples proceeded smoothly in the field. Subsequent review of the inlet hardware, however, identified defective internal sealing ring problems with some of the $PM_{2.5}$ units (not the PM_{10}).

- The flow control systems used for 2.0 and 4.0 LPM integrated sampling met specifications.
  [MS Recommendation(s): No changes will be made for the Main Study in the flow check or flow control set-up procedures. A new single-channel 4.0 LPM pump system will be available for the Main Study to minimize the labor and space required to use the dual channel pumps employed in the Pilot Study.]

- Defective internal sealing rings in several of the $PM_{2.5}$ inlet impactors produced random leaks that were not identified properly with the existing leak tests.

[MS Recommendation(s)s: (1) The (manufacturing QC and design) problems with MSP inlets were identified and corrected by the manufacturer, (2) The leak test procedure is being revised (by RTI), (3) The modified inlet design will be operated (by RTI) briefly in side-by-side testing with ambient $PM_{2.5}$ monitors to validate the corrections. The modified $PM_{2.5}$ MSP inlets are expected to be fully satisfactory for the Main Study]

- The PM_{10} MSP sampling inlets functioned acceptably to collect integrated particle samples, except that the flowrate (2.0 LPM) was too low to provide an adequate sample volume and a reasonable MQL in a 2-hour commute.

  [MS Recommendation(s): Higher flowrate (4.0 LPM) inlets will be provided (by RTI) to double the collected volume and halve the MQL for PM_{10} in the Main Study.]

- Weighing the Teflon filter in an air conditioned (but otherwise uncontrolled for temperature and relative humidity) space in the motel work room generally proved adequate to meet the expected detection limit of 2.0 µg/filter, based primarily on the precision of successive weighings of the same filter. This detection limit inexplicably increased, however, to 3.4 µg during the post-weighing period, significantly increasing the MQL for both $PM_{2.5}$ and PM_{10} samples over a 2-hour commute.

  [MS Recommendation(s): In order to reduce the MQL as much as possible for the Main Study, every effort must be made to optimize the balance performance. A pre- and post-weighing location that is more temperature controlled and less draft-prone balance environment will be sought for both Sacramento and Los Angeles.]

- Testing the outside sampling line and the manifold with the particle counter to evaluate ambient particle transport losses as a function of particle size showed that polyethylene tubing material had significantly fewer losses (~10% vs ~20% based on particle count) than the originally proposed Teflon material. The testing also showed that it was feasible to correct the individual LAS-X measurement channel data for the sampling line losses. This calculation is possible for the LAS-X data, since fractional loss information for each portion of the size distribution are available. The outside $PM_{2.5}$ particle counts computed from the continuous data were corrected for sampling line losses. The gravimetric $PM_{2.5}$ outside measurements, however, should not be corrected in the same manner, given the experimental nature of the LAS-X count to mass conversion. The integrated $PM_{2.5}$ loss in the sampling line were estimated to be less than 5%. A summary table will be prepared for the Main Study of the estimated correction factors for the gravimetric outside $PM_{2.5}$ mass concentration results for each commute.

  [MS Recommendation(s): Polyethylene tubing will be retained for the Main Study outside sampling manifold. Loss testing will be repeated, immediately prior to the Main Study to verify the Pilot Study results. Additionally, the line length will be shortened by 1/2 by moving the intake from the front of the grill to the base of the windshield. This should not only reduce (the minimal) losses, but place the line intake closer to the inside ventilation intakes for the vehicles. ARB has decided that the maximum ventilation setting for the Main Study will not utilize an open vehicle window (as did the Pilot Study), thus emphasizing the location of the vent system intakes.]

2.1.3.2 Elemental Analyses

Particle filters were digested for analysis. Digests were analyzed by ICP/MS for Cr, Si, Sr, Br, Ca, Ti, Fe, Zn, and Cu, and by GFAA for Pb, Cd, Ni, and Mn. Ion Chromatography was used for S, P, and Cl analyses. This scheme was a departure from the analysis plan requested of our trace metals laboratory, in that the increased sensitivity of ICP/MS was requested for Pb, Cr, Ni, and Mn. The laboratory substituted GFAA when an instrumental problem arose with the ICP/MS unit in order to meet the analysis schedule. XRF was not used in the Pilot Study, given its higher expected MQL for most metals as compared to ICP/MS and the very low observed particle concentrations.

Results of method controls and method blanks (reagents without filters) suggested that the proposed method (ICP/MS) could be used to analyze for the target elements on the Gelman Teflo® filter samples. Instrumental sensitivity, especially for GFAA was not sufficiently low to give high percent measurable for many of the elements including lead, cadmium, nickel, phosphorus, potassium, iron, and bromine. Erratic lab blank levels (reagents with filters) for several metals further increased the detection limits. The number of blank filters analyzed during the Pilot Study (only 2) was inadequate to characterize the background levels, given the sample-to-sample variability observed for some metals, strongly suggesting further work on blank metals' levels is needed.

- Given the altered analysis scheme used by the laboratory, the performance of the ICP/MS could not be evaluated for Pb, Cd, Cr, and Mn.
  [MS Recommendation(s): The correct scheme will be followed in the Main Study.]

- The increased cost of ICP/MS over XRF (~ a factor of 3) may not warrant the improvement in detection limit for some metals, given the elevated backgrounds of metals in the Gelman Teflo® filters. Elevated and erratic (based on only 2 measurements) background levels were observed for calcium, chlorine, copper, potassium, phosphorus, silicon, strontium, titanium, and zinc. None of these elements was required by the RFP.
  [MS Recommendation(s): The number of filters to be analyzed and the analysis method to be applied to the Main Study filters is under discussion. A better understanding of the frequency of elevated background levels in the Gelman filter batch purchased for this study will be addressed by analyzing (at RTI at no-cost to the project prior to the Main Study) at least 10 (versus 2 previously) blank filters for metals by ICP/MS.]

2.1.3.3 VOC Canister Method

Overall, the canister method showed good performance for all of the target VOC's.

- Method quantitation limits were sufficiently low to provide high percent measurable for all targets, except ethyl *t*-butyl ether (ETBE). Presumably, ETBE was not in use as a gasoline additive at the time of field monitoring and was, therefore, not present in air samples.
  [MS Recommendation(s): No changes will be made in the analysis methodology for the Main Study VOC samples.]

- Recoveries for 1,3 butadiene (76 %) and methyl *t*-butyl ether (78 %) were slightly low which may have been due to prolonged storage of the samples prior to analysis.

[MS Recommendation(s):. More rapid turn-(<7 days) around time of canisters will be used in the Main Study, not only to minimize storage losses, but to provide the number of canisters needed for collect all samples.]

2.1.3.4 Nitrogen Dioxide

- Method performance data indicated that the method was not sufficiently sensitive to reliably measure nitrogen dioxide in 1-hour air samples at the low levels found in the ambient air and in automobile samples. Precision was poor for several field samples that were at or below the method detection limit.

[MS Recommendation(s): NO_2 will not be collected during the Main Study by ARB technical direction.]

2.1.3.5 PAH's

- Recoveries of target PAH's from method controls and NIST SRM's were good. In addition, recoveries of surrogate standards in all filter samples was acceptable. Levels of PAH's in the single field blank were either very low or not detectable. Unfortunately, PAH's were not measured in any of the samples at concentrations higher than the MQL. Method sensitivity could be increased by a factor of two by increasing the flow rates for the sampling pumps. Alternatively, RTI is acquiring a new GC/MS system that will have much lower detection limits (~0.1 pg/μL) compared to the systems currently in use (5 pg/μL). The feasibility of using this system for analyzing PAH samples could be evaluated. It should be noted however, that the MQL's report for this pilot study (1.0 ng/m^3) is the same order of magnitude as the 0.9 ng/m^3 level that the California Office of Environmental Health Hazard Assessment suggests is required to cause 10^{-6} excess cancer risk over a 70-year exposure period, i.e. the methodology was sufficiently sensitive to suggest that even the highest measured PAH levels in the Pilot Study were below this elevated risk level.

[MS Recommendation(s): No PAH samples are planned for the Main Study.]

2.1.3.6 Formaldehyde

- Method performance data indicated that the method should provide sufficient accuracy, precision, and sensitivity to measure formaldehyde in automobile air samples in the Main Study.

[MS Recommendation(s)s: No changes in the aldehyde methodology are required.]

2.1.3.7 Carbon Monoxide

Method quantitation limits were set at 2 ppm based on information from the instrument manufacturer (Draeger). Results for duplicate monitors showed agreement in 1-hour average readings within the 2 ppm specifications for the elevated inside and outside of vehicle levels.

- Almost all Roadside and Ambient CO concentration readings during the 120 minute commutes were below the MQL in the Pilot Study, producing almost no meaningful data to attempt correlations analyses between inside-vehicle concentrations and the roadside.

[MS Recommendation(s): The 2 ppm MQL is considered acceptable for the Main Study, especially for the higher CO levels from greater traffic densities expected in Los Angeles.]

2.1.3.8 Particle Size Distribution

Overall the LAS-X particle counter worked well and provided valuable information on real-time particle counts and concentrations. The particle counter's undoubtedly better MQL (estimated to be at least a factor of 5) is difficult to appreciate, since it is not a gravimetrically-based device. The value of a real-time measurement is readily apparent in identifying the contributions of short term events and in the results of mitigation strategies to reduce levels.

- When the on-board power system was functioning properly (adequate voltage level and suitably filtered) in the car, the LAS-X operated smoothly, requiring little attention during sampling and no unplanned maintenance.
  [MS Recommendation(s): The limited manpower required to operate the LAS-X combined with its excellent performance supports its inclusion in the Main Study.]

- The LAS-X data analysis and reduction to estimated $PM_{2.5}$ concentrations was very labor-intensive.
  [MS Recommendation(s): Since the LAS-X data are collected and stored on a computer, the data reduction can be accomplished at a later date, if resources permit. This could be valuable for studying a few selected commutes in the Main Study to highlight the range between minimum and maximum $PM_{2.5}$ concentration scenarios.]

- The LAS-X one minute particle count averages correlated strongly with the Aethalometer black carbon analyzer, especially when the car was following a vehicle (gasoline or diesel powered) with a visibly smoking exhaust.
  [MS Recommendation(s): The ability of the LAS-X to identify elevated particle exposure levels for single vehicles, supports its inclusion of the LAS-X in the Main Study.]

- The LAS-X one minute computed $PM_{2.5}$ mass concentrations provided greater detail during the commute of the actual exposure levels, as compared to the total commute gravimetric, integrated average.
  [MS Recommendation(s): If the Main Study particle concentration levels are similar to or lower than those from the Pilot Study, the LAS-X estimated $PM_{2.5}$ concentrations may provide the only useable particle data.]

2.1.3.9 Black (Elemental) Carbon

- When the on-board power system was functioning properly in the car, the Aethalometer operated smoothly, requiring little attention during sampling and no unplanned maintenance.
  [MS Recommendation(s): The limited manpower required to operate the units, supports its inclusion in the Main Study, especially since the data analyses are relatively straightforward. Unlike the LAS-X, which is owned by RTI, the Aethalometer would have to be leased from the manufacturer.]

- The expected correlation of the LAS-X and Aethalometer was observed when 1 min averages were compared, but the expected correlation with PAH integrated concentration levels could not be determined from the Pilot Study data because of the low PAH concentrations.

[MS Recommendation(s): The strong correlation with the Aethalometer suggests that the LAS-X could ultimately be used to predict in-vehicle black carbon levels for similar scenarios. Insufficient data were collected during the Pilot Study, however, from which to construct this relationship for the Main Study]

- The Aethalometer readily indicated the presence of smoking gasoline and diesel exhausts (as did the LAS-X), when the Caprice was behind these vehicles. The Aethalometer could be expected to be significantly more sensitive to vehicular soot particles than the non-specific LAS-X particle counts.

[MS Recommendation(s): This capability also supports the inclusion of the Aethalometer in the Main Study, if resources to cover the monthly lease and reduce the data permit.]

2.1.3.10 Air Exchange Rate

There were no logistical problems with implementing this procedure. There was, however, no way to assess the accuracy of the method. Review of the CO decay rate data showed that a simple 1st order decay model was followed closely by the Pilot Study measurements for all of the ventilation levels.

- The main drawback to the AER method as applied in the Pilot Study was that it represented air exchange rate for a specific vehicle ventilation settings at a specific vehicle speed. Measurements of AER were not made during the test runs to obtain commute averages, thus the composite AER during the test run could be significantly different from those measured at a constant speed. While the measured AER data do not exactly correspond to the conditions during the real commutes, they will be continued in the Main Study to provide a relative indication of ventilation between scenarios.

[MS Recommendation(s): Air exchange rate is a valuable measurement for assessing on a relative basis (at the same constant speed) the inside-to-outside concentration relationships. It will be determined for each test vehicle in the Main Study to determine whether those measured for the Caprice sedan in the Pilot Study were representative of newer vehicles. If resources permit, additional AER measurements will be made over a range of vehicle speeds.]

2.1.3.11 In-Vehicle Traffic Data

- The switch box procedures for collecting roadway information were cumbersome and time consuming for the navigator. The utility of these data (switch settings used are provided in Appendix B) was not apparent during data analysis and did not justify the extra labor required to collect the data. Most of the information about targets and scenarios was readily captured by the audio and video on the video tape record.

[MS Recommendation(s): Only Level of Congestion data will be recorded by the navigator using the switchbox in the Main Study.]

- The interpretation of single events during commutes using the continuous in-vehicle monitoring data proved difficult if careful alignment of the various data collection time clocks (e.g. video, CO data logger, in-vehicle computer, LAS-X logger, and Aethalometer logger) was not accomplished.
  [MS Recommendation(s): Greater care must be taken in the Main Study to synchronize time clocks at the start of each commute within 15 seconds. A time synchronization procedure will be implemented in the Main Study at the kick-off meeting, requiring all time settings (including video camera clock) and data entries to be coordinated with the RTI field manager.]

- The videotapes of the drives provided information on roadway conditions (e.g. barrier walls, cut sections) and target vehicles, however, reviewing the tapes and correlating the events with pollutant levels was very labor intensive.
  [MS Recommendation(s): Videos will be made for each commute during the Main Study and archived for future data/information analyses, if additional resources are available for this activity.]

- The traffic speed and trailing distance (from the vehicle immediately in front) provided useful information on the commutes, however, associating these data with pollutant levels and scenarios was very labor intensive.
  [MS Recommendation(s): These data are collected automatically and will be collected in the Main Study. The amount of data reduced and summarized, however, is still under discussion.]

2.2 MEASUREMENT DATA SUMMARY

The individual analytical concentration data for each sample collected are given in Section 5. A summary of the composite means of the six freeway commutes, plus the single rural measurement for comparison, are shown in the extended Tables 2-1A, 2-1B, and 2-1C. These tables have been prepared primarily to simplify the review of the composite concentrations levels from various scenarios. Note that compositing can provide somewhat misleading interpretations, in that the number of observations in each category are small and not necessarily the same. See the footnotes following Table 2-1A describing formats, and the additional explanatory notes following Table 2-1C for clarifying information.

2.2.1 General Observations

- Measurements of $PM_{2.5}$ and PM_{10} integrated particle concentration for 2-hour periods at 4 LPM and the expected higher concentrations in the Main Study should have (barely) adequate detection limits and precisions to characterize inside and outside exposure levels. The combination of limited data collection in the Main Study and only modest precision of the integrated methods, may make it impossible to readily distinguish the proportion of in-car particle concentrations due to vehicular emissions, as compared to those from the background. The strong performance of the LAS-X monitor in predicting $PM_{2.5}$ concentrations suggests that it should be seriously be considered for inclusion in the Main Study to collect data. Given the current limitation on resources, however, its inclusion would require (a) minimal effort to make it functional (operate on the Caprice power system), and (b) only limited data analyses and interpretation would be applied.

[MS Recommendation(s): Supplement the optimized gravimetric measurements with the LAS-X computed $PM_{2.5}$ estimates.]

Table 2-1A. Summary Table of Measurements Comparing Six Freeway Commutes (Mean) with One Rural Commute

	Commute	Ambient	Out-Car Mean	In-Car Mean	In-Car Range	Roadside Mean	Roadsid[e] Range
VOC's ($\mu g/m^3$)							
1,3-Butadiene	Freeway	0.53	2.63	2.57 (0.28)[1]	1.4 - 3.1	1.24	0.83 - 1.6
	Rural	0.0	0.0	0.0 (0.0)		na[2]	na
MTBE	Freeway	3.93	13.00	13.98 (9.03)	8.9 - 19.0	7.22	6.15 - 8.5
	Rural	1.0	1.4	1.6 (0.0)		na	na
ETBE	Freeway	0.0[3]	0.0	0.0	na	0.0	0.0
	Rural	0.0	0.0	0.0		na	na
Benzene	Freeway	na	na	na	1.7 - 4.6	na	na
	Rural	na	na	na		na	na
Toluene	Freeway	10.17	24.17	26.33 (29.83)	15 - 37	14.62	11.68 - 19.
	Rural	3.2	4.6	5.8 (5.0)		na	na
m,p-Xylene	Freeway	4.38	15.00	16.83 (18.63)	10 - 21	7.67	5.68 - 9.8
	Rural	1.5	1.8	3.4 (3.3)		na	na
o-Xylene	Freeway	1.85	6.12	6.77 (6.47)	4.3 - 8.1	3.34	3.03 - 4.0
	Rural	0.8	0.9	1.5 (0.0)		na	na
Formaldehyde ($\mu g/m^3$	Freeway	na	na	9.5	4.3 - 11.0	na	na
	Rural	na	na	9.6		na	na
PM_{10} ($\mu g/m^3$)	Freeway	43.0	na	63.5	33 - 84	65.8	54[illegible]78.
	Rural	28.0	na	18.0		na	na
$PM_{2.5}$ ($\mu g/m^3$)	Freeway	50.8	45.2 (49.0)	35.2 (44.6)	16 - 64	31.5	24.8 - 38.
	Rural	31.0	13.0 (26.0)	24.0 (22.0)		na	na
Carbon ($\mu g/m^3$)	Freeway	na	5.96	7.08		na	na
	Rural	na	na	1.3		na	na
CO (ppm)	Freeway	0.1, 0.1[4]	2.7, 2.4	2.2, 1.7		0.4, 0.4	0.2 - 0.9, 0.2 -
	Rural	0, 0	0, 0	0, 0		na	na
NO_2 (ppb)[c]	Freeway	42.2, 38.0	61.2, 41.0	78.3, 63.5		25.3, 33.5	25.3 - 86. 17.5 - 5
	Rural	9.0, 5.0	1.0, 1.0	0.0, 29.0		na	na

See table notes following Table 2-1C

[1] values in parenthesis are duplicate analyses; [2] na: not available; [3] 0.0 indicates below MDL; [4] Hour 1, Hour 2

Table 2-1B. Summary Table of Measurements Comparing Six Freeway Commutes (Mean) with One Rural Commute (cont'd)

	Commute	Ambient	Out-Car Mean	In-Car Mean	In-Car Range	Roadside Mean	Roadside Range
PAH's (ng/m3)							
Benzo[b]fluoranthene	Freeway	0.2	0.5	0.2	na	0.5	na
	Rural	0.1	0.3	0.0	na	na	na
Benzo[k]fluoranthene	Freeway	0.1	0.1	0.1	na	0.1	na
	Rural	0.1	0.2	0.0	na	na	na
Benzo[e]pyrene	Freeway	0.1	0.3	0.2	na	0.3	na
	Rural	0.0	0.0	0.0	na	na	na
Benzo[a]pyrene	Freeway	0.1	0.3	0.3	na	0.2	na
	Rural	0.1	0.1	0.1	na	na	na
Indeno[1,2,3-	Freeway	0.2	0.4	0.5	na	0.3	na
	Rural	0.0	0.2	0.1	na	na	na
Benzo[ghi]perylene	Freeway	0.2	0.8	1.0	na	0.6	na
	Rural	0.0	0.2	0.0	na	na	na
$PM_{2.5}$ Metals (ng/m3)							
Cadmium (Cd)	Freeway	0.16	0.23	0.09 (0.12)	0.0 - 0.12	0.24	0.0 - 0.46
	Rural	0.0	na	na	na		
Chromium (Cr)	Freeway	103.7	108.0	76 (122)	2.7 - 109	104	76.5 - 114
	Rural	0.0	na	na	na		
Manganese (Mn)	Freeway	14.6	5.6	6.4 (6.1)	.25 - 6.8	2.1	0.2 - 4.0
	Rural	0.0	na	na	na		
Nickel (Ni)	Freeway	0.0	0.0	25 (0.0)	na	10.3	0.0 - 29.0
	Rural	0.0	na	na	na		
Lead (Pb)	Freeway	9.2	7.6	15.7 (7.8)	11 - 24	5.3	3.1 - 9.0
	Rural	0.0	na	na	na		
Sulfur (S)	Freeway	293.3	356.0	342 (274)	231 - 575	299	166 - 392
	Rural	93.0	na	na	na	na	na

See footnotes following Table 2-1A and additional notes following Table 2-1C

Table 2-1C. Summary of Measurements Comparing Six Freeway Commutes with One Rural Commute (cont'd)

	Commute	Ambient	Out-Car Mean	In-Car Mean	In-Car Range	Roadside Mean	Roadside Range
PM_{10} Metals (ng/m3)							
	Freeway	0.17	na	0.62 (0.26)	0.37 - 0.86	0.28	0.0 - 0.75
	Rural	na	na	na	na	na	na
Chromium (Cr)	Freeway	262.0	na	161 (251)	9.5 - 239	176	67.7 - 239
	Rural	na	na	na	na	na	na
Manganese (Mn)	Freeway	24.2	na	18.8 (21)	9.3 - 25	24.3	2.5 - 46
	Rural	na	na	na	na	na	na
Nickel (Ni)	Freeway	13.3	na	28 (11)	na	0.0	na
	Rural	na	na	na	na	na	na
Lead (Pb)	Freeway	12.8	na	12.5 (8.3)	11 - 14	9.6	1.1 - 16.8
	Rural	na	na	na	na	na	na
Sulfur (S)	Freeway	466.2	na	478 (660)	265 - 639	398	256 - 507
	Rural	na	na	na	na	na	na
In-Traffic Data							
Commute speed, mph.	Freeway	na	na	35.0	na	na	na
	Rural	na	na	47.6	na	na	na
Total miles	Freeway	na	na	75.1	na	na	na
	Rural	na	na	107	na	na	na
Trailing Distance, ft	Freeway	na	na	94.8	na	na	na
	Rural	na	na	193.1	na	na	na
Level of Congestion	Freeway	na	na	3.6	na	na	na
	Rural	na	na	1.0	na	na	na

Content Notes for Tables 2-1A, B, and C:

- All data below the MDL were considered as and entered as 0.0 [see Table 5-1 for starred values that are below the detection limits]
- Means were computed even if the individual input data were below the MQL's
- Data are not necessarily paired, and inter-comparisons should be done with caution
- Some freeway means represent significantly fewer than 6 input values, especially for the metals
- No range is possible for rural data; many rural concentrations were below the MQL
- "Ambient" refers to study monitor data collected at ARB 13th and T St. monitoring site
- Carbon and carbon monoxide data are commute averages of 1.0 minute data
- Benzene data were not available from canister analyses; tabular results shown are from multisorb tubes
- No In-Car PAH analyses were above the MQL (no range reported)
- PAH samples were collected at only 1 roadside site (no range available)
- Only selected samples were analyzed for $PM_{2.5}$ and PM_{10} metals; see Table 5-2 to identify selected samples; means reported represent up to 4 samples for In-Car, but no more than 2 for Roadside
- Data separated by a comma (,) are individual Hour 1 and Hour 2 values
- Data in parentheses () are duplicate analyses
- The $PM_{2.5}$ data are uncertain due to a random leak (see Section 3)
- An "na" means that no data are available

- The limited sensitivities of the integrated $PM_{2.5}$ PM_{10} and CO methodologies did not permit a realistic determination of the utility of Roadside and Ambient monitoring stations to be used as surrogates to predict in-vehicle concentrations. This may also be true for the Main Study. Where the MQL's were sufficient, the VOC Inside and Outside vehicle concentrations were higher than Roadway, which were higher than those at the Ambient site.

  [MS Recommendation(s): Although Roadside measurement gave better indications of the in-vehicle concentrations than did the Ambient station data, the cost-effectiveness of Roadside sampling is still under discussion.]

- If the 1991 Caprice air exchange measurements from the Pilot Study are representative of those determined during the Main Study for the other sedan the Sport Utility Vehicle, and the school bus, the number of commutes using both Low and High exchange rates should be reconsidered. The limited range of influences of air exchange rate from settings Vent 1 to Vent 3 on inside and outside pollutant concentration ratios appears to be insufficient to warrant expending additional resources to impose equal emphasis on both High and Low exchange rate.

  [MS Recommendation(s): Emphasizing the High air exchange scenarios, while collecting only limited data for the Low AER, should provide adequate information to characterize the range of exposures..]

- The unexpectedly high particle counts and CO levels detected when following selected vehicles (e.g. most heavy duty diesels (but not all), poorly tuned vehicles, and a diesel school bus) suggests that closely following these vehicles may significantly contribute to in-vehicle concentrations. Although specific vehicle type identification is not part of this effort, subsequent review of video records, compared against continuous monitor data may provide valuable information in assessing exposure mitigation strategies.

  [MS Recommendation(s): Continue the driving protocols developed for the Pilot Study, focusing on heavy duty diesels and smoking vehicles.]

- The limited range of influences of air exchange rate from Low to High on inside and outside pollutant concentration ratios appears to be insufficient to warrant expending additional resources to impose equal emphasis on both High and Low exchange rate. Emphasizing the High air exchange, while collecting only limited data for the Low AER, should provide adequate information to characterize the range of exposures. If the 1991 Caprice air exchange measurements from the Pilot Study are generally representative of those determined during the Main Study for the other vehicles, the number of commutes using both Low and High exchange rates should be reconsidered.

2.2.2 Specific by Pollutant Category

At this point in the overall program, the Pilot Study data have been analyzed primarily to validate the methodologies for the Main Study. Only limited observations are presented here as to levels and inter-comparability of the data.

2.2.2.1 VOC's

In general, the freeway levels were substantially higher than the rural commute for all pollutants. The In-Vehicle and Outside-Vehicle concentrations were also substantially higher than the Roadside data, which was in turn higher than the Ambient sites. There was essentially no difference between Inside and Outside the car. .

2.2.2.2 Formaldehyde

The freeway level was substantially higher than the rural commute

2.2.2.3 PM_{10} & $PM_{2.5}$

In general, the freeway levels were slightly higher than the rural commute. The higher In-Vehicle levels than the Outside-Vehicle levels for $PM_{2.5}$ are uncertain because of the sampling problems with the $PM_{2.5}$ inlets. PM_{10} was generally higher than $PM_{2.5}$, but not always. The Roadside data provided similar levels to the In-vehicle for both PM_{10} and $PM_{2.5}$.

2.2.2.4 Carbon Black

The freeway mean was significantly higher than the rural, while the In-Vehicle level was slightly higher than the Outside Vehicle concentration.

2.2.2.5 CO

The freeway levels were significantly higher than the (essentially non-detected) rural concentrations. The Outside-Vehicle levels were not significantly different from those Inside. The Inside and Outside levels were substantially higher than either the Ambient or Roadside sites.

2.2.2.6 PAH's

The PAH levels were all very low and below the detection limits, making it difficult to draw any conclusions between scenarios.

2.2.2.7 Elements

Freeway levels were significantly higher than rural levels. PM_{10} levels were, in general higher than $PM_{2.5}$ levels (but not always). In-Vehicle and Outside-Vehicle levels (for $PM_{2.5}$) were in most cases significantly higher than either the Roadside or the Ambient data.

2.2.2.8 In-Traffic Data

Rural commute speed was significantly higher than the freeway, making the total miles driven in the 2-hour commutes also higher. Trailing distance, due to higher traffic congestion, was substantially smaller for the freeways as compared to the rural commute.

3.0 FIELD MONITORING

This section provides more detailed descriptions of the field monitoring design and the supporting monitoring activities used during the Pilot Study.

3.1 Methods and Approach

Field activities for the Pilot Study were conducted from February 22 to March 6, 1997 in Sacramento, California. Actual sample collections occurred from February 26 thru March 3. RTI, Sierra Research, Aerosol Dynamics, and ARB personnel who participated in the field effort and their responsibilities are shown in Table 3-1. All study activities including sample preparation, scheduling, instrument calibration, filter weighing, and record keeping focused around a work room set up in a local motel near one end of the planned commuting route. Preparation of the vehicle for sampling and data collections before and after each commute were accomplished in the parking area near the work room. A detailed schedule of planned daily events is given in Appendix C.

The overall design for the Pilot Study is described by the sampling design in Table 3-2, which shows the routes, the time of day, the ventilation settings, the commute lengths and the number of trips for each driving scenario. A gasoline-powered, California-registered, 1991 Chevrolet Caprice provided by Sierra Research was used as the sample and data collection platform for all test drives. In order to assure that the test vehicle was not contaminating the interior through leaks from the exhaust system and the engine compartment, the Caprice vehicle was inspected by Sierra Research prior to the start of the field activities (inspection results are included as Appendix D). In addition, a canister air sample was collected with the vehicle at rest to measure concentrations of VOC's in the car interior. Measured concentrations for all target VOC's, except toluene (1.0 $\mu g/m^3$ was detected), were below the quantitation limit.

During this Pilot Study, two routes were selected and driven - a freeway and a rural commute, both in the Sacramento area. These routes were selected in consultation with the ARB project officer. One route was intended to represent commuting in heavy freeway traffic in the Sacramento area. This was on an approximately 30-mile stretch on Interstate 5, Business 80, and Interstate 80, extending from the I Street ramp of I-5 to the Madison Avenue Exit of I-80. During rush hour, both the inbound and outbound portion of this route took approximately 40 minutes to drive. Drives on this route took place either during the morning (7 to 9 am) or afternoon (4 to 6 pm) rush hours. The second route was intended to represent rural conditions with little traffic and a correspondingly low pollutant levels. This route was north of Davis, CA and used State Road E6 and County Roads 95, 27, and 99. The route was approximately 16 miles. The rural route was driven during midday (12 to 2 pm) on Saturday, 3/1. Table 3-3 summarizes information and driving times, driving distances, and average speed during each trip. Maps that show these two routes are included in Appendix E.

TABLE 3-1. Personnel and Responsibilities for the Pilot Study

Personnel	Responsibility
RTI Principal Investigator	• Oversee all field operations
RTI Field Chemist 1	• Prepare paperwork/labels for monitoring • Prepare, set-up VOC, CO, PAH and NO_2 equipment, filters • Tend Roadway 3 and 4 sites • Prepare rack in car • Perform CO decay tests for air exchange rate measurements • Prepare car for test runs • Set-up workroom • Maintain equipment
RTI Field Chemist 2	• Weigh filters •Prepare, set-up particle samplers and filters • Tend Roadway 1 and 2 sites • Download/backup data files • Prepare car for test runs • Set-up workroom • Maintain equipment
Sierra Team Leader	• Schedule drivers • Drive/navigate test vehicle • Operate Aethalometer/LASX
Sierra Technicians 1 and 2	• Drive/navigate test vehicle
AD Field Scientists	• Install Aethalometer/LASX • Instruct RTI/Sierra personnel on operation of instruments
ARB Personnel	• Assist in operating the Ambient site

TABLE 3-2. Design of the Pilot Study

Trip	Date	Roadway Type	Ventilation Setting	Time	Roadway Monitoring
1	2/27	Freeway rush	mid	AM	no
2	2/26	Freeway rush	mid	PM	no
3	2/27	Freeway rush	high	AM	yes
4	2/27	Freeway rush	high	PM	yes
5	2/28	Freeway rush	low	PM	yes
6	3/1	Rural[a]	low	mid-day	no
7	3/3	Freeway	high	PM	yes

[a] A second rural trip was not conducted based on consultation and approval of ARB personnel in the field.

TABLE 3-3. Distances for Vehicle Drives

Commute	Location	Total Minutes	Total Miles	Average Speed (mph)
2/26 am	Freeway	135	56.7	25.2
2/26 pm	Freeway	138	85.6	37.2
2/27 am	Freeway	118	84.2	42.8
2/27 pm	Freeway	171	56.4	19.8
2/28 pm	Freeway	120	78.7	39.3
3/1 am	Rural	135	107	47.6
3/3 am	Freeway	116	88.7	45.9
Means:		133.3	79.6	36.8

Driving protocols were developed by Sierra Research and approved by ARB prior to the Pilot Study. The protocol for "freeway-congested-heavy duty influence" was as follows:

1) follow the pre-selected route and position behind a target vehicle whenever possible; the target vehicle was defined as a heavy duty vehicle with diesel exhaust or other obvious emissions;
2) drive the right hand lane, except when changing lanes to follow or acquire a target vehicle;
3) break off target vehicle pursuit if target vehicle turns off route, can't be followed, drives erratically or unsafely, or appears to modify behavior due to following;
4) change target vehicle if a vehicle with higher exhaust emissions becomes available;
5) drive with normal following distances (like other nearby cars) but not further than about 100 feet behind target vehicle.

The protocol for "rural" driving was to drive at the posted speed limit and simply note any target vehicles that were on the road. No attempt was made to either acquire or avoid target vehicles.

During vehicle runs, monitoring data were collected from inside the passenger compartment of the vehicle, from the exterior of the vehicle, along the roadways traveled, and at an ambient monitoring station close to the route traveled. Information on the pollutants monitored and the sampling and analysis methods used is summarized in Table 3-4. Information on supplemental data collection is given in Table 3-5. The number and location of samples collected for each drive is given in Table 3-6. Summaries of the total integrated and continuous data collections were given previously in Tables 1-3 and 1-4. A schematic that shows the vehicle and fixed-site monitoring is given in Figure 3-1.

In-vehicle samples were collected at a location representative of the driver and passenger's breathing zone. This was accomplished by mounting the sampling lines/cartridges in a specially constructed rack positioned in the rear seat. The interior sampling lines/cartridges were positioned at shoulder height just behind the passenger seat near the center of the car. Exterior car samples were collected from a glass manifold connected to tubing which extended through an aluminum plate at the car's rear passenger window and extended to the front grill of the car. The inlet of the tubing was secured to the hood ornament of the car. Exterior air was pulled through the tubing and into the glass manifold by an air pump mounted in the car's trunk and by the internal pumps supplying air to the individual monitors. The sampling lines and cartridges for the exterior samples were mounted directly to the glass manifold using appropriate stainless or Teflon fittings.

Most of the sampling systems operated simultaneously, collecting from both the inside and outside manifold. The high flowrate in the sampling line and manifold provided transport times from the front of the vehicle that were less than a few seconds. Since only single LAS-X and Aethalometer units were available, electronic 3-way valving units operating on a one minute cycle were used to allow sequential inside and outside sampling. This was reasonable for all scenarios except those with durations less than 1 minute (e.g. following behind a target vehicle for only 50 seconds). In these cases, an equilibrium inside reading might be obtained with an associated outside reading that was much lower (did not reach equilibrium - or vice versa).

TABLE 3-4. Pollutant Sample Collection and Analysis Method Summaries

Pollutant	Sample Collection	Sample Analysis
PM_{10} Particles (integrated)	MSP 200 2.0 LPM PM_{10} inlets, particle on 37 mm, 3.0 Tm Gelman Teflo filters	Gravimetric, on a modified Mettler AT20 microbalance, with computer control
$PM_{2.5}$ Particles (integrated)	MSP 200 4.0 LPM $PM_{2.5}$ inlets, particle on 37 mm, 3.0 Tm Gelman Teflo filters	Gravimetric, on a modified Mettler AT20 microbalance, with computer control
Particle Size Distribution	Particle Measurement Systems (PMS) Model LASX multi-channel analyzer	Computer data collection and size distribution analyses
Black Carbon	McGee Scientific Aethalometer	5 LPM on quartz fiber tape readings by optical absorption
VOCs	SUMMA passivated 6 liter evacuated canisters, sample rate of 25 cc/min; Multisorbent tubes	GC/MS with SIM enhancement
Formaldehyde	DNPH cartridges	Electron with acetonitrile, HPLC analysis Thermal desorption GC/MS, full scan
CO	Draeger Model 190, diffusion sensing (not pumped)	electro-chemical
NO_2	OSHA Model ID-109, sampling rate of 100 cc/min through molec. sieve tubes	Extraction with TEA, analysis by polarography
Metals in PM_{10} /$PM_{2.5}$ particles	PM_{10} /$PM_{2.5}$ Teflon filters	X-Ray Fluorescence (XRF), energy dispersive, or Ion-Coupled Plasma Mass Spectrometry (ICP/MS)
PAH	Particle phase (only) on 37 mm, 3.0 Tm Gelman Teflo filters at 8.0 LPM	Gas Chromatography/Mass Spectrometry

TABLE 3-5. Supplemental Measurement Method Summaries

Measurement	Sensor	Data Collection/Media
Sedan 1 Traffic speed	Digital speedometer, mph	Computer, real time, trip averaged
Sedan 1 Level of Congestion (traffic density)	Navigator categorical judgment, manual input	Computer storage of binary data
Sedan 1 Additional Switchbox Categories: Air Exchange Rate Category, Roadway Type, Apparent Vehicle Influence, Target Type	Navigator categorical judgment, manual input	Computer storage of binary data
Sedan 1 Lead car spacing	Laser distance meter in grill	Computer, real time, trip averaged
Air Exchange Rate	Draeger CO monitor (method of Ott & Willits, 1981)	Internal logger/computer
Meteorology - wind speed, wind direction, relative humidity, and temperature	Obtained from nearest weather station	Computer file, hourly
Commute Routes, characterization	Trip narrative prepared by navigator to supplement video	video; computer file
Unusual Events	Trip narrative prepared by navigator	video; computer file

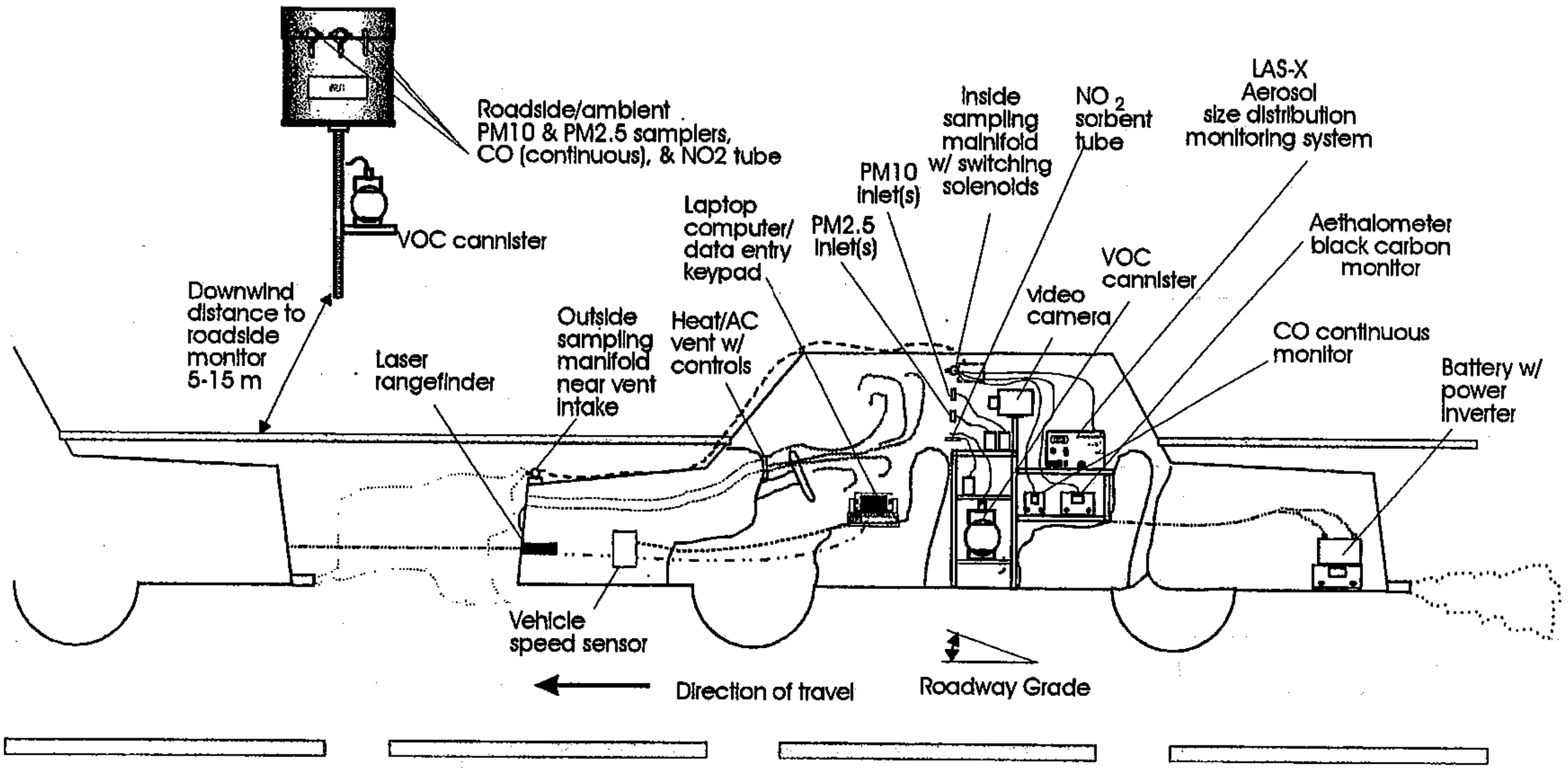
TABLE 3-6. Sample Collection Schedule for Each Drive

Sample Type	Inside Car	Outside Car	Ambient	Roadside 1[a]	Roadside 2	Roadside 3	Roadside 4	Total
VOCs (multisorb)	1							1
VOCs (canister)	1	1	1	1	1	1	1	7
Aldehydes (DNPH)	1							1
PAHs (quartz filter)	1	1	1			1		4
CO (Draeger)[b]	1	1	1	1	1	1	1	7
NO_2 mol. sieve)	2	2	2	2	2	2	2	14
Particles ($PM_{2.5}$)	1	1	1	1	1	1	1	7
Particles (PM_{10})	1		1	1	1	1	1	6
Particles (LAS-X)	1	1						2
Carbon Black[b]	1	1						2
Temp/% Rh[b]	1							1

[a] Roadside sample collection schedule for four test drives.
[b] Continuous measurements.

Figure 3-1

Schematic Diagram of In-Vehicle and Roadside Sampling Components for ARB Pilot Study



C. Rodes, RTI, 6/97

For four of the vehicle runs, monitoring was conducted at four roadway sites. These sites were selected in consultation and with final approval by the ARB. Encroachment permits were obtained from the California Department of Transportation. Roadway sites are described in Appendix F. Also provided is the CalTrans encroachment permit information to conduct the Roadside sampling. Criteria for selecting these sites included a proximal location to the roadside with no more than a 5-foot elevation difference with the roadway surface, easy access from the freeway, a secure location, and a minimum of obstructions, including walls and trees. Monitoring equipment at each site was located 15 to 30 feet from the roadway. Sampling during freeway commutes was also conducted at one ambient monitoring station located at the ARB ambient monitoring station at 13th and T Streets in Sacramento.

In conjunction with the chemical monitoring data, the ancillary data shown in Table 3-5 was also collected. Information was collected on meteorological conditions, vehicle speed, and traffic conditions. Topographical or environmental conditions that might effect roadway pollutant concentrations were recorded via the switchbox. Drives were video taped. In addition, air exchange rates were measured during separate rural drives for the test vehicle under the three operating conditions.

All vehicle runs were nominally two hours. Either one or two runs were made per day. Vehicle runs were made on 2/26, 2/27, 2/28, 3/1, and 3/3. A detailed schedule of activities for all field monitoring activities is given in Appendix C.

After samples for formaldehyde, NO_2, PAHs, and VOCs (multisorbent tubes) were collected, they were stored sealed in clean steel cans at 40 °C. VOC canisters were stored in a cool, clean area. All samples were shipped within seven days of collection to RTI via overnight carrier. Particulate filters were equilibrated at temperatures in the work room. An air conditioner in the room was the only source of temperature and humidity control. Filters were pre-weighed before samples were collected and then again within 24 hours after collection. Exposed, weighed filters were placed in labeled Gelman Analyslide petri dishes. All filter samples were hand-carried within seven days of collection to RTI on the return flight from California to Research Triangle Park.

For VOC and formaldehyde monitoring, several types of quality control samples were used throughout the study. Sampling media (cartridges or canister) equivalent to approximately 5% (or minimum of two) of the field samples were set aside as field blanks and were used to assess contamination and/or interferences of field samples. These samples traveled to the field site, returned to the laboratory and analyzed along with the field samples. Field controls were used to assess analyte recovery. Cartridges/canisters equivalent to approximately 5% of the field samples were spiked with known amounts of target analytes. As with the field blanks, these samples were shipped to the field, returned, and analyzed along with the field samples. Five percent of the samples were collected and analyzed in duplicate to evaluate precision.

For particles, metals, PAHs and NO_2, field blanks each equivalent to 5% of the samples were deployed to assess background contamination. Field duplicates equivalent to 5% of the samples were collected to evaluate precision, respectively.

Since CO was measured using real-time monitoring methods, different QC procedures were used. In the field, an initial calibration was prepared on each monitor upon arrival in California using 0, 2, 10 and 22 ppm standards to assure proper operation prior to use. Analytical accuracy was checked by analyzing zero and span (22 ppm CO) gas standards at the beginning and end of each vehicle run. Precision was evaluated by deploying duplicate monitors.

Table 3-7 presents information on the number of samples scheduled, collected, and analyzed. These data are provided for both the field and the QC samples.

TABLE 3-7. Total Numbers of Field and Quality Control Samples

Pollutant	Field Samples[b]	Duplicates	Field Blanks	Field Controls
VOCs (multisorbent)	8/7/7	2/2/1	2/2/2	2/3/3
VOCs (canister)	41/38/38	2/2/2	2/2/2	2/2/2
Formaldehyde	8/7/7	2/2/2	2/2/2	2/2/2
PAHs	12/15/15	2/0/0	2/2/1	[c]
CO	40/37/36	2/2/2	-	-
NO_2	80/74/74	4/4/4	4/4/4	-
$PM_{2.5}$ Particles[d]	40/37/37	2/2/2	2/2/2	-
PM_{10} Particles[d]	32/30/32	2/2/2	2/2/2	-
Particles (LAS-X)	16/14/-	-	-	-
Carbon Black	16/14/-	-	-	-

[a] Originally 8 test runs were scheduled; however, only 7 test runs were conducted. One rural test run was canceled.
[b] Scheduled/collected/analyzed.
[c] Not applicable to method.
[d] Approximately one-half of the collected filter samples were analyzed for metals.

Strict sample custody procedures were followed throughout the collection and analysis activities. Each sample was given a unique code to link that sample to the study participant and household, sample type, and collection regime, etc. As part of our quality control procedures, sampling protocol/chain-of-custody forms were prepared for each sample collected. This form was used to track each sample from the time it is prepared until the data have been reduced and reported. Back-up diskettes of all real time data files were prepared to lessen chances of losing electronic data.

3.2 GENERAL FIELD MONITORING EVALUATION

Overall, the field monitoring methodologies employed in the Pilot Study were successful, but several very significant and time consuming problems occurred that required resolution. All of these problems have currently been addressed and corrective actions taken to prepare for the Main Study. Several problems were experienced with the monitoring methods proposed only for the Pilot Study. These included the performance of the in-vehicle power system's ability to operate the real-time monitors for particles and carbon black, and the integrated monitoring pumps for PAH's. A complete evaluation (accomplishments and problem areas) for the Pilot Study is provided in Appendix G. The following is a summary of the most important aspects of the study.

- The technical skills of research field personnel from RTI, Sierra Research, and Aerosol Dynamics were suitable to meet the routine and unexpected demands of the field sampling.

- The number of personnel assigned to this field monitoring effort for the Pilot Study were adequate to complete the planned field monitoring, given the extended hours each day required to resolve technical problems. This includes the (gratefully acknowledged) assistance of ARB personnel to assist in servicing the Ambient site. Careful planning and preparations will be required to eliminate large, time-consuming problems during the Main Study.

- Several unplanned events related to pollutant monitoring that were unique to the Pilot Study methods substantially taxed the field monitoring staff. These included (a) the initial failures of the on-board vehicle system to provide power to the continuous monitors and the PAH pumps, (b) the decision to assign separate individuals to set out the four Roadway and Ambient sites.

- The route selection process met the study objectives, providing (a) a freeway commute route that highlighted heavy traffic densities in the Sacramento area for the AM and PM commutes, (b) a rural commute that substantially taxed the minimum detection limits of the methods resulting from the very low pollutant levels.

- Monitoring at roadway sites was difficult and had a substantial impact on the burden and cost of the field monitoring effort. Obtaining CalTrans permits required more time and was, therefore, more costly than anticipated. Access to roadway sites was difficult during freeway rush hour. The use of four roadway sites placed a heavy burden on equipment requirements which impacted acquisition, testing, shipping, calibration, and set up costs. Finally, there was some initial concern for the security of the expensive monitoring equipment at the Roadway sites. This concern appeared to be unfounded with reasonable care (security cables).

- The 1991 Caprice sampling platform with a driver and navigator worked as planned to collect vehicle spacing data, traffic density, periodic driving diaries, and video records of each commute.

- The initially-installed, on-board power system in the car proved inadequate to handle the power requirements of the sampling equipment and provide sufficiently filtered power to operate the optical particle counter. These problems were corrected prior to the start of the 2/28 commute in a temporary manner that permitted completion of the Pilot Study continuous monitoring. The excessive power drain of this corrective "fix" drained the batteries rapidly and would be unsuitable for the Main Study. A new power system has been ordered by Sierra Research for the test sedan.

- An insurance liability issue concerning the overnight parking location and the personnel authorized to drive the Caprice complicated the logistics of preparing the vehicle for sampling. A coverage arrangement between RTI and Sierra Research is currently being developed.

3.3 SPECIFIC FIELD MONITORING RECOMMENDATIONS

- The number and skills of field personnel proposed for the Main Study will be sufficient for conduction both AM and PM vehicles runs if: (a) there are no on-board power or logistical problems with the 1991 Caprice or the other test vehicles, (b) Roadside monitoring is limited to no more than 1 site per commute and at an easily accessibly location, and (c) NO_2 tube sampling is deleted. Actions are currently in progress to address all items (a) thru (c).

- All field operations should be streamlined to be as efficient as possible and to distribute the work load evenly between all of the field staff members. Careful consideration must be given to the logistical problems of monitoring in both Sacramento and Los Angeles during the Main Study.

- For the Main Study, several local field technicians/drivers will be hired. Adequate time must be allowed to train these field staff member prior to the start of sampling.

- The same routes should be used in the Sacramento area. Routes in Los Angeles should be chosen using similar criteria. Routes should be selected that allow easy access to the work room and minimize the amount of travel time for setting up/taking down equipment.

- The data/information collected in Sedan 1 (Sierra Caprice) during each commute for the Main Study should be revised. Switchbox data other than Level of Congestion should be deleted. Data to be collected in the Main Study in Sedan 1 should be only (a) vehicle speed, (b) vehicle spacing, (c) Level of Congestion, (d) video recording, and (e) a commute diary.

- If continuous particle monitoring is included as an addition to the Main Study, a more robust power system with a highly filtered 120 VAC output must be obtained.

- An agreement between parties covering the liability insurance concerns for the 1991 Caprice is currently being arranged. All test vehicles must remain at the work room sites overnight.

4.0 MONITORING METHODS

This section provides more detailed discussion of the integrated sample and continuous monitoring methods used in the Pilot Study. Specific recommendations for applying the methods in the Main Study are also provided.

4.1 Integrated Measurement

4.1.1 Particles ($PM_{2.5}$ and PM_{10})

Method Description - The filter collection and weighing methods for gravimetrically-based PM_{10} and $PM_{2.5}$ particles measurements are based on methods that have been used previously at RTI. The methods have been validated during the past three years on two large-scale exposure studies conducted for the U.S. EPA and a commercial client.

A summary of the specifications for the RTI PM_{10} and $PM_{2.5}$ particle exposure monitoring systems is shown in Table 4-1. The MSP model 200 Personal Exposure Monitor (PEM) inlets for PM_{10} and $PM_{2.5}$ are based on standard impactor theory, and demonstrate excellent cut point sharpness. Although $PM_{2.5}$ cut point impactors can exhibit substrate overloading during extended use, the combination of an additional "scalping" stage, and the short duration of sampling proposed in this study eliminated this concern. The MSP inlets are relatively wind speed insensitive, but the turbulence outside a moving vehicle is undoubtedly too harsh an environment for accurate coarse particle sampling. Thus, the inlets were not used external to a moving vehicle. Outside PM_{10} measurements were not made. $PM_{2.5}$ inlets collected particles off of the manifold after air was drawn in from the outside.

As shown in Figure 4-1 the inlets incorporate a 5-jet inlet cover (10 holes for a 4 LPM version) that directs the inlet flow toward an oil-coated, sintered metal impactor ring. After impaction to achieve the design cut point, the remaining particles are drawn to the membrane filter substrate located in the inlet base. The oiled surface is clean and replenished prior to each sampling event. The inlets are placed in Ziplok bags after preparation to prevent stray particles from entering through the jet holes.

During monitoring, an electronically flow-controlled battery operated pump (modified BGI model AFC123) was used to sample air through the portable impactors. The impactor contained a 37-mm diameter Teflon filter having a 3-µm pore size. For the PM_{10} impactor, a constant flow rate of 2.0 L/min was used. For the $PM_{2.5}$ impactor, a constant flow rate of 4.0 L/min was used.

Flow rate checks were performed with a specially-designed orifice that seals over the MSP inlet. The pressure drop across the orifice is monitored with a Magnehelic gauge. The pressure drop versus flow rate calibration for the orifice is established against a NIST-traceable Gilibrator bubble flow meter.

Filters were weighed both before and after sample collection using a Mettler AT20 balance with a ± 2 µg weighing precision in a single measurement. The balance was connected to a microcomputer with weighing software developed for gravimetric analysis of filters. All weighings were conducted in the field in the work room. Filters were equilibrated in the work room for at least 12 hours before weighing. Once tared, all filters were inspected for holes or other imperfections prior to use and were kept in a barcode-labeled Petri dish.

A set of ten filters was weighed as follows.

TABLE 4-1. RTI PM_{10} and $PM_{2.5}$ Particle Monitoring System Performance

Parameter	Specification
Inlet	
Inlet type	MSP, Corp. model 200
Aerodynamic Cutpoints (D_{50})	PM_{10} & $PM_{2.5}$
Cutpoint accuracy	+/- 0.2 Tm
Impactor coatings	Silicone oil or stopcock grease
Filter	
Filter type	Gelman 37 mm, 3.0 Tm porosity Teflon
Pump	
Source	modified BGI model AFC123 with integral feedback flow control
Flowrate	PM_{10} - 2.0 liters/min; $PM_{2.5}$ - 4.0 liters/min
Flowrate stability	+/- 5% up to 25 inches of H_2O
Batteries	
Type	4 alkaline AA
Battery life, continuous	~30 hrs at 70□F

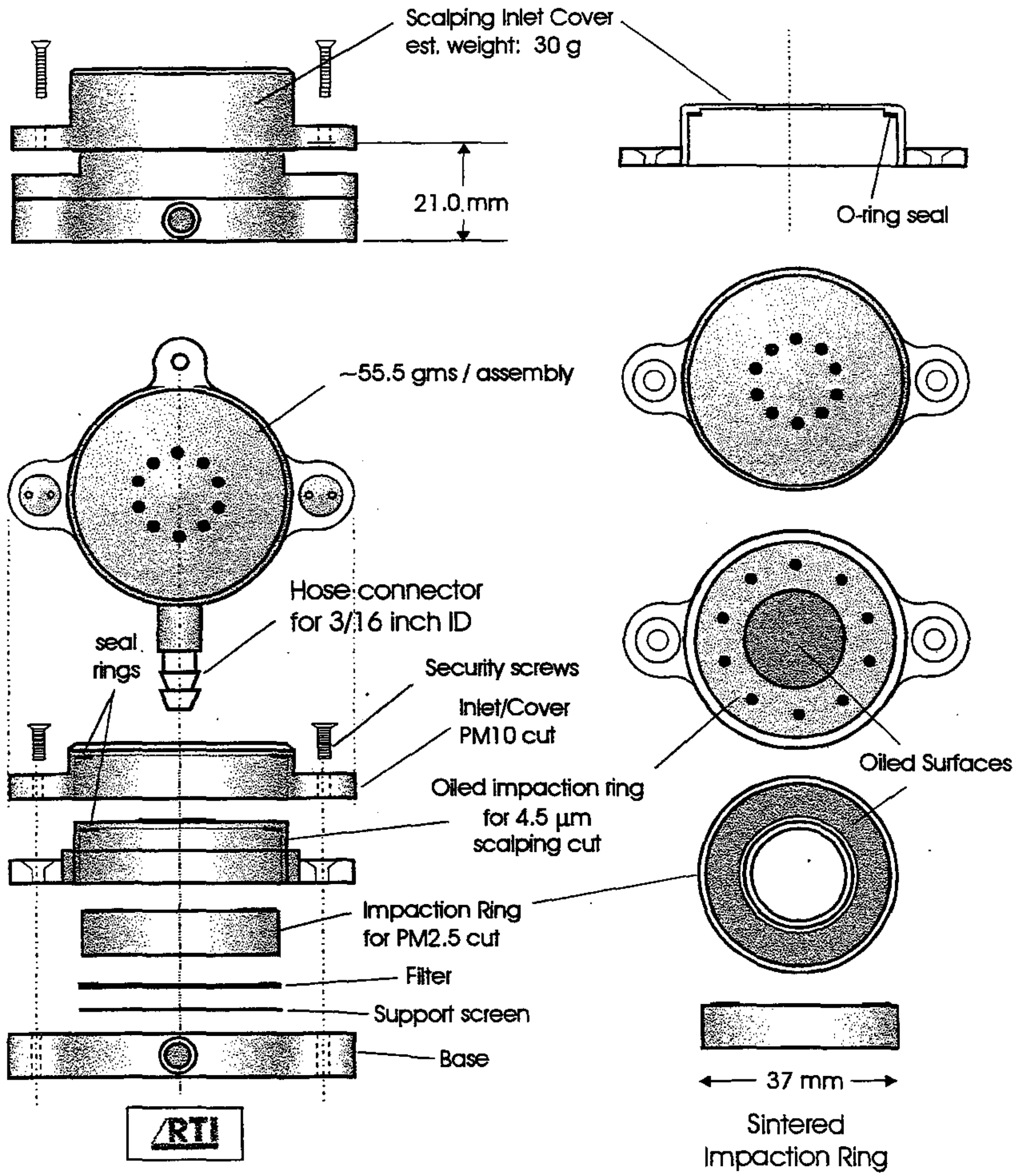
Samples were collected over the nominal 2-hour driving period.

1. The balance was zeroed and the calibration checked using a NIST-traceable weight (200 mg). If the zero check was within ±0.004 mg and the 200 mg weight within ±0.002 mg then the balance was "in control" and filters were weighed. If these specifications were not met the balance was recalibrated.
2. Each filter was weighed and the weight recorded once the computer recognized a stable reading (1-2 min).
3. After each set of 10 filters was weighed, the zero was checked to within ±0.004 mg and a 200 mg weight to within ±0.002 mg. If either the zero or the 200 mg weighing failed their test, then the zero/calibration was repeated and the previous set of filters was reweighed.

QC checks included multiple weighing tests with a dedicated filter, and spot checks (reweighing 1 in 20) of filter weights.

Figure 4-1

$PM_{2.5}$ and PM_{10} Aerosol Sampling Inlets (MSP Model 200) Used in ARB In-Vehicle Pilot Study



Method Evaluation - Performance of the method for particle mass is summarized in Table 4-2. Overall, the method performed adequately. Key element to method performance may be highlighted as follows:

TABLE 4-2. Summary of Method Performance Data for Particle Mass Samples (PM_{10} and $PM_{2.5}$

% of samples collected within flowrate specifications (external flow into inlets)	PM_{10} - 100.0% $PM_{2.5}$ - 94.1%
% of samples collected under acceptable conditions	PM_{10} - 100.0% $PM_{2.5}$ - 94.1%
% of sample weighed with "in control" calibration	100%
Precision of check samples - Standard filter - Reweighing of field sample filters	s = 2.0 μg = 2.5 μg, s = 3.4 μg
% RSD of duplicate field samples above MQL	PM_{10} - 34.4% $PM_{2.5}$ - 20.7%
Mass on field blanks	Mean Loss: 3.0 μg[a]
Estimated Method Quantitation Limits (MQL's)[b] in μg/m³	PM_{10} - 49.8 $PM_{2.5}$ - 24.9
% of samples with concentrations greater than MQL	PM_{10} - 66.7% $PM_{2.5}$ 63.9%

[a] 2/25/97 TO 3/3/97 [see text]
[b] 3 times MDL

- The flow control systems used for 2 and 4 LPM integrated sampling met specifications.

- Defective internal sealing rings in several of the $PM_{2.5}$ inlet impactors produced random leaks that were not identified properly with the existing leak tests. The number that were leaking is uncertain, but was assumed to be the four concentrations below 10 μg/m³ (see summary table in Appendix H). The hardware problems (manufacturing QC and design) with the MSP inlets were identified and corrected by the manufacturer after Pilot Study sampling had been conducted. The current leak test procedure was inadequate to detect this problem and is being revised (by RTI). The corrected $PM_{2.5}$ inlets will be operated (by RTI) briefly in side-by-side testing with ambient $PM_{2.5}$ monitors to validate the corrections. Since identification of particle concentration levels is a critical component of this research, every reasonable attempt to optimize the $PM_{2.5}$ and PM_{10} measurements for the Main Study will be made. The modified $PM_{2.5}$ MSP inlets are expected to be fully satisfactory for the Main Study]

- Weighing the Teflon filters in an air conditioned (but otherwise uncontrolled for temperature and relative humidity) space in the motel work room generally proved adequate to meet the expected detection limit of 2.0 µg, based primarily on the precision of successive weighings of the same filter. This limit inexplicably increased, however, to 3.4 µg during the post-weighing period, significantly increasing the MQL for both $PM_{2.5}$ and PM_{10} samples over a 2-hour commute. A summary of the particle concentration data exceeding the MQL's is given in Appendix H. This small increase proved significant, since the low ambient concentrations and small particle mass collections during the 2-hour commutes in the Pilot Study severely taxed the limits of the gravimetric analyses. The median mass collections per filter for all samples in the Pilot Study was only 11 µg for $PM_{2.5}$, and 18 µg for PM_{10}. In order to reduce the MQL as much as possible for the Main Study, every effort must be made to optimize the balance performance. A pre- and post-weighing location with a more temperature controlled and less draft-prone balance environment will be sought for both Sacramento and Los Angeles.

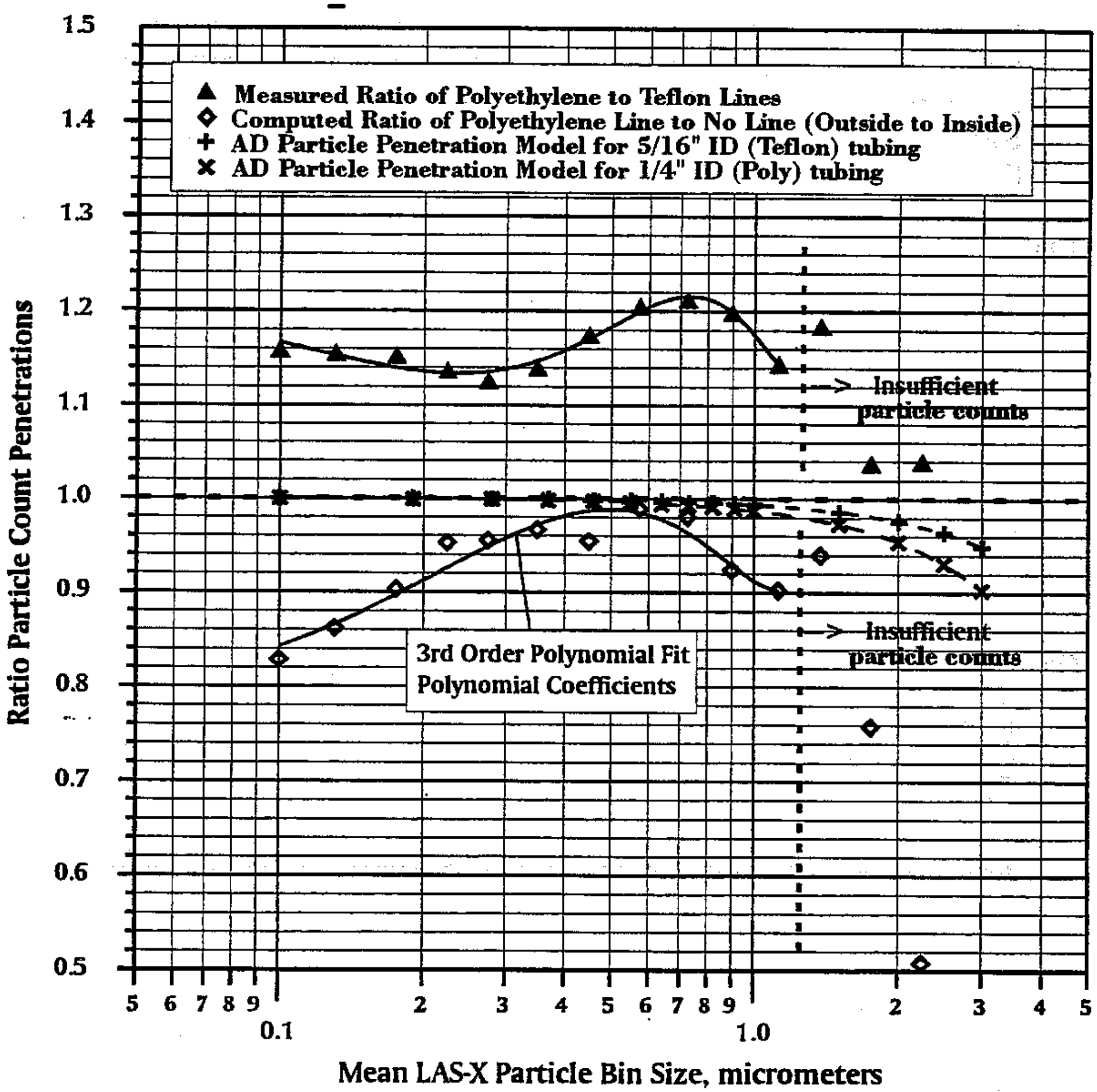
- The PM_{10} MSP sampling inlets functioned acceptably to collect integrated particle samples, except that the flowrate (2.0 LPM) was too low to provide an adequate sample volume and a reasonable MQL in a 2-hour commute. The low PM_{10} concentrations during the Pilot Study were generally at or below the method detection limits. Higher flowrate (4.0 LPM) inlets will be provided (by RTI) to double the collected volume and halve the MQL for PM_{10} in the Main Study. Increasing the inside sampling flowrates above 2 LPM had been avoided for the Pilot Study, since the air exchange rates in the test car were assumed to be significantly lower than was measured. Note that although $PM_{2.5}$ is a subset of PM_{10}, the significantly higher MQL for the PM_{10} increased the probability that a $PM_{2.5}$ value would occasionally be higher than a paired PM_{10}. This was also complicated by random internal leaks in the $PM_{2.5}$ inlets.

- Outside the vehicle samples were collected through a sampling line run to the front of the car that operated at a flowrate of approximately 24 LPM. The line was originally PTFE Teflon, but was switched to polyethylene prior to the start of the Pilot Study. Testing with the LAS-X to evaluate ambient particle losses as a function of particle size showed that polyethylene material had significantly fewer losses. This was attributed to the larger static charging capacity of Teflon. The LAS-X testing showed that the size-specific LAS-X count measurements should be corrected when comparing inside and outside measurements using the sampling line (see Figure 4-2). Particle loss calculations using a theoretical model supplied by Aerosol Dynamics had not suggested particle sizes less than 2.5 µm to be significantly affected by the sampling line. This model is not really appropriate, since it provides no compensation for particle diffusive losses. Mass losses based on these counts were estimated to be less than 5% for integrated $PM_{2.5}$ samples. Note that the subsequently reported LAS-X outside data in this report are loss-corrected, while the integrated $PM_{2.5}$ data are not. The experimental nature of the count-to-mass computation using the LAS-X is experimental, and currently not proven enough to warrant correcting gravimetric data. A table of estimated mass loss corrections will be provided in the Main Study report

Figure 4-2

Ratio of Teflon to Polyethylene Sampling Line Particle Penetration and Ratio of Polyethylene Sampling Line (Outside Car) Penetration to No Line Inside Car) Compared to AD Penetration Model for Two Different Inside Tubing Diameters

Teflon and Polyethylene Line lengths: 16 feet
OD's: 3/8"
ID's: Teflon: 5/16", Polyethylene: 1/4"
Flowrate: 6.5 lpm
Integration Period: 60 seconds



that will permit a semi-quantitative assessment of the potential gravimetric losses. Also, it was observed that the location of the outside line inlet at the center of the grill, did not always represent the air that was entering the vehicle through the open car windows during the high air exchange rate commutes. Moving the intake to the base of the windshield for the Main Study will significantly reduce the sampling line length, and more importantly, place the intake adjacent to the car vent system intake.

- The Gelman Teflo® filters lab blanks all lost a small, but measurable, 3 μg (mean of 4 filters) in weight from the pre-weighing until the post-weighing. The reason for this loss is not clear, but may be a plasticizer vaporization loss from the plastic support rings. All reported gravimetric data were corrected for this 3 μg loss. This potential for tare weight change will also be monitored in the Main Study.

Recommendations- The particle mass measurements should be performed in the Main Study using the same general procedures as for the Pilot Study with the following recommendations. The PM_{10} inlet caps should be replaced with 4 LPM versions to double the total collected sample volume and thus reduce the MQL by a factor of 2.

- The faulty $PM_{2.5}$ inlets will be returned to the manufacturer for replacement of the sealing rings (already completed). The modified units will be evaluated prior to the Main Study.

- A revised leak test procedure will be developed and evaluated for the particle inlets that will identify internal leaks.

- Filter weighing should be conducted in a more closely temperature-controlled environment, if at all possible. This should improve the precision of the resulting measurements.

- The outside vehicle sampling line loss testing should be repeated immediately prior to the start of sampling in the Main Study.

4.1.2 Metals (Elements)

Method Description - The 37 mm Teflon membrane filter samples for the analysis of elements and ionic species were digested using a modification of U.S. EPA SW 846 Method 3052. Metals were analyzed by graphite furnace atomic absorption (GFAA), inductively coupled plasma emission mass spectrometry (ICP/MS) and ion chromatography (IC).

Filter samples were first extracted with 0.1 M $HClO_4$ in an ultraclean cuvette and an exact volume (2 or 3 mL) removed for the IC measurement. The remaining extract was freeze-dried and digested with 50% nitric acid (1 mL) and a few drops of hydrofluoric acid until the digestate began to boil. The digest was cooled then diluted to the desired volume and analyzed. After samples were digested/extracted, they were transferred to the measurement laboratory in a sealed clean container to minimize contamination from room dust. Prior to ICP/MS analysis, samples were placed in an autosampler that was covered by a class 100 hood glove box enclosure to further avoid room dust contamination during measurement. ICP/MS measurement of the digestates/extract solutions were performed using U.S. EPA SW 846 Method 6020. Similar "clean" techniques were employed for GFAA determinations.

For the pilot study analysis, QC materials such as filter SRM's were not available. Instead, replicate reagent controls (blank spikes) were carried through the entire procedure. Recoveries for these spikes for Cd, Cr, Cu, Fe, Mn, Ni, Pb, Sr, and Zn exceeded 80% without correcting for sample acid matrix suppression on the analytical signal, thereby validating the digestion technique. All preparation operations were carried out in Class 100 clean room conditions. Reagent blank contamination levels were within a factor of 2 of the instrument detection limits.

For the pilot study, several key elements were analyzed using GFAA due to some temporary problems with the ICP/MS which have since been resolved. These elements included lead, cadmium, manganese, and nickel. The remaining metals were determined later by ICP/MS. Sulfate, phosphate, and chloride were analyzed by IC.

Method Evaluation - Table 4-3, provides information on instrumental method detection limits (MDL's) and instrumental method quantitation limits (MQL's) for digests of both PM_{10} and $PM_{2.5}$ filter samples. These are instrumental MDL's based on 3 times the standard deviation of blank samples; MQL's are 3 times the MDL's. The percentage of sample digests that had metal levels above the MQL's are also shown in the table. For some elements, levels on the field blank filters were as high as levels on the samples filters. In these cases, background corrected sample concentrations were reported as not detected even though levels in the digests were measurable.

Results of method controls and method blanks suggested that the proposed method could be used to analyze for elements on filter samples. However, instrumental sensitivity of the method was not sufficiently low to give high percent measurables for many of the elements including lead, cadmium, nickel, phosphorus, potassium, iron, and bromine. For other elements, the field blank samples showed significant and variable background levels which further decreased the percent measurable values for field samples. This was the case for calcium, chlorine, copper, potassium, phosphorus, silicon, strontium, titanium, and zinc. The magnitude of the variable-background problem is currently unclear, and will be addressed by more extensive blank evaluation testing prior to the Main Study.

Recommendations - Analyses for the Main Study will focus on the target elements (Pb, S, Cd, Cr, Mn, and Ni) and the additional metals originally proposed, using XRF as the analysis method. Although not as sensitive as ICP/MS, XRF will provide a greater range of elements at a significantly reduced cost/analysis. Additional work should also be performed to minimize contamination for the field blanks. The secondary elements should not be included in the main study since none of these elements gave high percent measurable values during the pilot study. For the main study, additional QC samples including filter SRM's should be included. A rigorous evaluation of method detection limits should also be conducted.

TABLE 4-3. Method Performance Data for Elemental Analyses

Analyte	Method	PM_{10}			$PM_{2.5}$			Field Blanks (ng/ sample)
		MDL ($\mu g/m^3$)	MQL ($\mu g/m^3$)	%>MQL	MDL ($\mu g/m^3$)	MQL ($\mu g/m^3$)	%>MQL	
Primary Elements								
Pb	GFAA	10	30	8.3	5.0	15	22	2.1, 2.1
Cd	GFAA	1.2	3.6	0	0.60	1.8	5.6	0.32, 0.59
Cr	ICP/MS	4.0	12	100	2.0	6.0	100	3.1, 4.8
Mn	GFAA	3.6	11	92	1.8	5.4	89	2.1, 2.1
Ni	GFAA	46	140	0	23	69	5.6	9.5, 9.5
S	IC	520	1600	100	260	780	94	120, 123
Secondary Elements								
P	IC	1000	3000	0	520	1600	0	105, 698
Si	ICP/MS	5000	15000	100 (0)[a]	2500	7500	100 (0)[a]	21000,21900
K	ICP/MS	1300	3900	0	630	1900	0	653, 2620
Ca	ICP/MS	2800	8400	100 (5)	1400	4200	78 (5)	2470, 5490
Ti	ICP/MS	13	39	100 (0)	6.3	19	100 (0)	7, 26
Fe	ICP/MS	1300	3900	0	630	1900	0	na
Zn	ICP/MS	260	780	100 (0)	130	390	100 (0)	131,524
Cu	ICP/MS	13	39	83 (10)	6.3	19	94 (15)	12, 26
Sr	ICP/MS	2.6	7.8	100 (0)	1.3	3.9	94 (0)	3.0, 5.0
Br	ICP/MS	1600	4800	0	800	2400	0	26, 105
Cl	IC	320	960	42 (25)	160	480	56 (15)	250, 250

[a] For background corrected samples.

4.1.3 VOC's

4.1.3.1 Canister VOC Collection

Method Description - Air samples for monitoring the target VOCs (see Table 4-4) were collected in 6 L SUMMA passivated stainless steel canisters. Restrictive orifices were used to control air flow into the canisters at ~25 mL/min during the 2-hour sampling period. Canister samples were returned to the laboratory. Canister samples were analyzed within 8 weeks of collection.

Prior to use, canisters were cleaned by heating to 130 °C in an oven for 4 hours while connected to a vacuum manifold. Canisters were then evacuated to 0.05 mm Hg vacuum. Restrictive orifices constructed and calibrated at RTI were attached to each canister in the field. During sample collection, a rotameter was used to measure air flow rates.

VOCs in canister samples were cryofocused then analyzed by gas chromatography/ mass spectrometry (GC/MS). Selected ion monitoring (SIM) was used to enhance method sensitivity. Analytical conditions are shown in Table 4-4. During analysis, a portion (200 mL) of the sample plus a known concentration of the external quantitation standard were cryogenically trapped then injected into the GC column for separation and analysis.

VOC identifications were based on chromatographic retention times relative to the external quantitation standard and relative abundance's of the selected ion fragments shown in Table 4-5. Ion fragments were selected based on previous project work with the target chemicals. Quantitation was performed using chromatographic peak areas derived from the selected ion profiles. Specifically, relative response factors (RRF's), or first order linear regression, for each target compound were generated from injections of canister standards prepared at 5 different concentrations (~0.5 to 50 ng/L). For each injection, the RRFs was calculated as:

$$RF_T = \frac{A_T C_{QS}\ (ng/L)}{A_{QA} C_T\ (ng/L)} \qquad (1)$$

where A_T is the peak area of the quantitation ion for the target compound and A_{QA} the peak area for the quantitation ion of the external quantitation standard. C_T is the concentration of the target compound in the standard canister and C_{QS} is the concentration of the external standard canister.

Mean values and standard deviations of the RRFs were calculated for each target VOC. The calibration curve was considered acceptable if the standard deviation for each relative response factor was less than 25%. During each day of analysis, an additional medium level calibration standard was analyzed. If the RRF values for this standard was within ±25% of the average RRF, the GC/MS system was considered "in control" and the mean RRFs was used to calculate the concentration of the target VOCs in a sample (C_{TS}):

$$C_{TS}\ (ng/L \text{ or } \mu g/m^3) = \frac{A_T C_{QS}\ (ng/L)}{A_{QA} RF_T} \qquad (2)$$

TABLE 4-4. GC/MS Operating Conditions for Analyses of VOC's

Parameter	Setting
THERMAL DESORPTION[a]	
Trap Type	1 = Glass beads, 2 = Tenax TA, 3 = Open
CARTRIDGE DESORPTION[a]	
Temperature	2400C
Carrier Gas Flow Rate	25 mL/min
Time	8 min
TRAP 1[b]	
Initial Temperature	~1500C
Desorption Temperature	200C
Desorption Carrier Gas Flow Rate	10 mL/min
Desorption Time	4 min
TRAP 2	
Initial Temperature	~100C
Desorption Temperature	1800C
Desorption Carrier Gas Flow Rate	10 mL/min
Desorption Time	35 min
TRAP 3	
Initial Temperature	~1500C
Desorption Temperature	1000C
Inject Time	5 min
GAS CHROMATOGRAPH	
Instrument	Hewlett-Packard 5890
Column	DB-624 widebore fused silica capillary column
Temperature Program	350C (5 min) to 2000C (1 min) at 50C/min
Carrier Gas Flow Rate	1.8 mL/min
MASS SPECTROMETER	
Instrument	Hewlett Packard, Model 5988A
Ionization Mode	Electron Ionization Scan 35-350 m/z
Emission Current	0.3 mA
Source Temperature	2000C
Electron Multiplier	2000 volts[c]

[a] For multi-sorb tube analysis, [b] For canister sample, air sample metered into trap 1.
[c] Typical value.

TABLE 4-5. Target VOCs

Target VOCs	Ion Fragments for GC/MS Analysis
Methyl *t*-butyl ether	73, 57
Ethyl *t*-butyl ether	57, 87
Benzene	78, 77
Toluene	91, 92
m,p-Xylene	91, 106
o-Xylene	91, 106
1,3-Butadiene	54, 53, 39

During this pilot study, the following quality control (QC) samples were prepared and analyzed to demonstrate method performance.

- Field controls (FC) are used to evaluate method recovery. These are canisters spiked with target VOCs at known concentrations. These samples are shipped to the field and handled exactly as field samples except that the valves are not opened.

- Field blanks (FB) are used to evaluate background contamination. These are unspiked canisters that are prepared by filling clean evacuated canisters with a volume of approximately 4.5 liters of VOC-free humidified nitrogen. These canisters are shipped to the field and handled exactly as field samples except that the valves are not opened.

- Field duplicates are field samples collected side-by-side to assess sampling precision.

Method quantitation limits have been set to the concentration of the lowest calibration standard.

Method Evaluation - Table 4-6 summarizes results for performance evaluation samples analyzed as part of the field monitoring effort on this Pilot Study. Although spiked into method controls and calibration standards, benzene was inadvertently left out off the list of target analytes. Since the analyses were conducted by GC/MS, the benzene results could not be retrieved from the sample analysis data. Overall, the method showed good performance for the target VOC's. Recoveries for 1,3 butadiene and methyl *t*-butyl ether (MTBE) were slightly low which may have been due to prolonged storage of the samples prior to analysis. Method quantitation limits were sufficiently low to provide high percent measurables for all targets except ethyl *t*-butyl ether (ETBE). Presumably, ETBE was not in use as a gasoline additive at the time of field monitoring and was, therefore, not present in air samples.

Recommendations - It is recommended that the canister method for VOC analysis be used in the Main Study without modification. Benzene will be a target analyte for the Main Study. During the Main Study, rapid turnaround will be required for the canister samples in order to send the canister back to the field for additional collections. Under these conditions, it is anticipated that storage times will be less than 7 days for all samples, and losses of VOC's due to storage will be minimized. Additional target VOCs may be added to the list of analytes; this list of analytes should be finalized by the ARB.

TABLE 4-6. Method Performance Data for VOC Canister Samples

Analyte	Method Quantitation Limit ($\mu g/m^3$)	Field Blank Concentration ($\mu g/m^3$) (n=2)	Field Control % Recovery (n = 2)	% RSD Duplicate Samples
1,3-Butadiene	0.22	0.1	76	0
MTBE	0.65	0.2	78	0
ETBE	0.65	0.0	83	ND[a]
Toluene	0.75	2.0	90	8.6
o-Xylene	0.77	0.3	91	2.0
m,p-Xylene	0.74	0.7	83	1.8
Benzene	NA[b]	NA[b]	NA[b]	NA[b]

[a] Not detected in duplicate samples. [b] Not analyzed

4.1.3.2 Multisorbent Tube VOC Collection

Method Description - VOCs in in-vehicle air samples were also collected and analyzed using a multisorbent cartridge technique. Multisorbent cartridge samples were collected for two reasons. First, it was felt that the cartridge techniques were more practical for field operations. Second, the exposed cartridges were analyzed by GC/MS in the full scan mode which allowed additional VOC's that were present in the automobile air samples to be identified (see Appendix I).

For this method, VOCs were collected by passing air though multisorbent cartridges containing Tenax TA and Carbonex 1000 (Supelco, Inc., Pittsburgh, PA). Air samples were collected at a flow rate of approximately 50 mL/min over a 2-hour period to give a nominal sampling volume of 6 L. Exposed cartridges were sealed in stainless steel cans at 4 °C in the field. Samples were shipped via overnight carrier to RTI within 7 days of collection. At RTI samples were stored at -20 °C until analysis. All samples were analyzed within 6 weeks of collection.

VOCs on exposed cartridges were thermally desorbed, focused, then analyzed by GC/MS using the conditions shown in Table 4-5. For quantitative analysis, VOC identifications were based on chromatographic retention times relative to the external quantitation standard and relative abundance's of the selected ion fragments shown in Table 4-4. Quantitation was performed using chromatographic peak areas derived from the selected ion profiles. Specifically, relative response factors (RRFs), or first order linear regression, for each target compound were generated from injections of standard cartridges prepared at 5 different levels (~10 to 500 ng/cartridge). For each injection, the RRFs was calculated as:

$$RF_T = \frac{A_T C_{QS}\ (ng/L)}{A_{QA} C_T\ (ng/L)} \qquad (3)$$

where A_T is the peak area of the quantitation ion for the target compound and A_{QA} the peak area for the quantitation ion of the external quantitation standard. C_T is the amount of the target compound on the standard cartridge and C_{QS} is the amount of the external standard canister.

Mean values and standard deviations of the Rfs were calculated for each target VOC. The calibration curve was considered acceptable if the standard deviation for each relative response factor was less than 25%. During each day of analysis, an additional medium level calibration standard will be analyzed. If the RRF values for this standard was within ±25% of the average RRF, the GC/MS system was considered "in control" and the mean RRFs was used to calculate the amount of the target VOCs in a sample (M_{TS}):

$$C_{TS}\ (ng/L \text{ or } mg/m^3) = \frac{A_T C_{QS}\ (ng/L)}{A_{QA} RF_T} \qquad (4)$$

Sample concentrations were calculated by dividing the sample amount by the collected volume.

Identification of non-target VOCs was performed using an electronic search of the NIH/EPA/MSDC Mass Spectral Data Base (NBS library) and the Registry of Mass Spectral Library (Wiley library).

Method Evaluation - Quality control samples included field blanks, field controls, and duplicate samples. Method quantitation limits were set equal to sample concentration that would be equal to one-half of the lowest calibration level.

Results for these analyses are given in Table 4-7. Data indicate that recoveries of 1,3-Butadiene from field controls was low. Additional work with the multisorbent tubes showed that during sample collection, MTBE was concentrated on the Carbonex 1000 trap but was not desorbed efficiently. Side-by-side comparisons of the results for multisorbent and canister samples (Table 6-1) showed a negative bias for the multisorbent method for 1,3-Butadiene and MTBE. Comparative data for the other target compounds showed good agreement between the two methods.

Recommendation - Based on the results for the pilot study, the multisorbent method is not recommended for the Main Study.

TABLE 4-7. Method Performance for VOCs and Multisorbent Samples

Analyte	Method Quantitation Limit ($\mu g/m^3$)	Field Blank Concentration ($\mu g/m^3$)	Field Control % Recovery	% RSD Duplicate Samples
1,3-Butadiene	0.22	ND	31 ± 7.3	ND[a]
MTBE	0.75	ND	101 ± 24	3.0
ETBE	0.75	ND	108 ± 9.8	ND
Toluene	0.75	ND	106 ± 3.5	9.7
o-Xylene	0.75	ND	103 ± 5.0	7.1
m,p-Xylene	0.75	ND	104 ± 4.5	9.0
Benzene	0.75	ND	100 ± 3.1	4.5

[a] Not detected in duplicate pairs.

4.1.4 Nitrogen Dioxide (NO_2)

Method Description --

Nitrogen Dioxide in air samples was monitored using OSHA Method ID-109. Using this method, air samples were passed through SKC sorbent cartridges containing molecular sieve impregnated with triethanolamine (TEA). NO_2 in the air sample reacts with the TEA and is collected on the cartridge material. Samples were collected over 1-hour period at a flow rate of approximately 0.1 L/min for a nominal sample volume of approximately 6 L. Flow rates at the cartridge inlet were measured before and after sample collection using calibrated rotameters with a fixed-orifice bypass tube.

The nitrogen dioxide trapped on the sorbent tube was extracted with an aqueous TEA solution. An aliquot of the extract was treated with a solution containing diphenylamine, thiocyanate, and hydrochloric acid. The resulting nitrite ion was measured polarographically. Quantitation was accomplished using by the external standard method using calibration standards prepared in the range of 0.01 to 10 ppm nitrite solution.

Method Evaluation - Method performance data generated during the Pilot Study are given in Table 4-8. Results indicate that the method was not sufficiently sensitive to reliably measure nitrogen dioxide in air samples at the low levels found in the ambient air and in automobile samples.

Recommendations - Due to its limited sensitivity it is recommended that NO_2 monitoring not be conducted during the Main Study. Alternatively, work should be conducted to improve method sensitivity. Sensitivity could potentially be improved by increasing the sample volume. If this approach were taken, then a study of acceptable breakthrough volume would be required prior to field monitoring for the Main Study.

TABLE 4-8. Method Performance Results for NO_2 Samples

Method Quantitation Limit -- based on lowest calibration standard	25 ppm	
Method Detection Limit -- based on 3X standard deviation of field blanks	47 ppm	
% of Samples above MDL	46%	
Field Blanks	0 ± 15.7 ppm	
Duplicate Sample Pairs	Concentration (ppm)	%RSD
1	55, 46	13
2	57, 79	23
3	31, 0	--[a]
4	75,15	94

[a] Not calculated; both samples below the MDL.

4.1.5 PAH's

Method Description - Particle-bound PAHs were measured on a limited set of particle filters. The 5-, 6-, and 7-ringed PAHs targeted for monitoring are given in Table 4-9. This group of PAHs include benzo[a]pyrene (BaP) which is a known human carcinogen; BaP is also within the group of chemicals known as polycyclic organic matter and was identified along with other federal hazardous air pollutants as a toxic air contaminant. PAHs were monitored using a method developed at RTI and applied to more than 1000 air samples as part of ARB funded studies to investigate PAH levels in indoor air.

TABLE 4-9. PAH's For Analysis

Structure	Compounds
5 rings	benzo{a}pyrene, benzofluoranthenes, benzo[e]pyrene
6 rings	indeno[1, 2, 3-cd]pyrene, benzo[ghi]perylene
7 rings	coronene

Particle-bound PAHs were collected by passing air through a sampling cartridge containing a 21 mm quartz fiber filter using an AC medium-volume constant flow pump (Esoteric, Model Sp-2511). For samples collected inside and outside of the car, the pumps were operated off the power inverter in the car. A gel cell battery was used to power the pumps at the roadway and ambient sites. Samples were collected during the 2-hour driving period at a flow rate of 8 L/min to provide a nominal sample volume of approximately 1 m^3. Flow rates at the cartridge inlet were measured before and after sample collection using calibrated rotameters with a fixed-orifice bypass tube.

PAHs were recovered from the filter by sonication extraction with methylene chloride for a 30-minute period, soaking overnight, then sonic extraction for an additional 30 minutes. The solvent extract was separated from the cartridge material by filtering through silanized glass wool. The filtered extract was solvent exchanged into toluene and concentrated to 0.2 mL.

Deuterated surrogate standards were added to samples immediately prior to extraction to monitor overall method performance. External quantitation standards were added to sample extracts immediately prior to final concentration and analysis. Chrysene-d_{12}, and benzo[e]pyrene-d_{12} were used as surrogate standards. 1,2,3,4-Tetrachloronaphthylene and perylene-d_{12} were used as external quantitation standards.

Sample extracts were analyzed by direct liquid injection capillary GC/MS. A 1 uL aliquot of the sample extract was injected using a split/splitless injection technique. Analytes separated on the GC column were introduced to a quadrupole mass spectrometer operating with electron ionization in the selected ion monitoring (SIM) mode. Sample constituents are characterized and quantitated by measuring ions characteristic of the target chemicals. Instrumental operating parameters are described in Table 4-10. Prior to analysis, the GC/MS system was calibrated by analyzing five calibration standards ranging in concentration from 5 to 500 ng/mL. For PAHs with no other chemical substituents, the M+ ion is used as the primary quantitation ion because it is usually the ion with the greatest relative abundance for PAHs. The M+1 ion is included to verify compound identification.

TABLE 4-10. GC/MS Operating Parameters for Analysis of PAHs

Column Type:	30 m, DB-5, 0.25 mm i.d., 0.1 m film
Run Type:	Electron ionization; selected ion monitoring
Injection Type:	Splitless/Split (0.5 min)
Injection Temperature:	3000C
Interface Temperature:	3000C
Source Temperature:	2000C
GC Program:	Initial temperature = 1000C
	Initial program rate = 30C/min
	Final temperature = 3000C
	Final hold time = 20 minutes
Instrument:	Hewlett Packard 5988A
Multiplier Voltage:	2000[a]
Emission Current:	300 mA[a]
Dwell Time:	75-250 msec

[a]A typical value.

Results of individual calibration analysis are used to generate relative response factors (RRF) using the following equation:

$$RRF_t = \frac{A_t / C_{std}}{A_{std} / C_t} \qquad (5)$$

where:

At	=	system response (integrated peak area)
C	=	concentration in calibration standard (ng/mL)
t	=	analyte
std	=	external quantitation standard.

Average RRFs are then calculated using results from each calibration standard. Instrumental calibration is considered acceptable if the percent relative standard deviation of the average RRF value was less than 25 for each of the target PAHs.

During sample analysis, two performance checks are made on the analytical system at the start of each day. First, the tune compound, perfluorotributylamine, is introduced into the mass spectrometer ionization source. All characteristic fragment ions were required to be present in the correct relative abundance before proceeding with any further analyses. Second, a mid-level calibration standard is analyzed and RRF values calculated for each target PAH. The calibration is considered "in control" if the RRF values calculated for the primary ions or the target PAHs are within ±25% of the mean RRFs. Analyte amounts in sample extracts (T) are calculated as:

$$T\,(ng) = \frac{A_t \; C_{std} \; V_e}{A_{std} \; RRF_t} \qquad (6)$$

where V_e is the final extract volume (mL). The concentration of PAHs in air samples is calculated by dividing the sample amounts by the sample volume.

Performance of the monitoring method has been thoroughly evaluated in several ARB-sponsored field monitoring studies. For this study, method performance was evaluated using method blanks, method controls, filters spiked with NIST dust, duplicate samples, and the recovery of surrogate standards from field samples. The method quantitation limits are calculated based on the sample concentration that would give an extract concentration at one-half the level of the lowest calibration standard.

Method Evaluation - Method performance data are summarized in Table 4-11. Recoveries of target PAHs from method controls and NIST SRMs were good. In addition, recoveries of surrogate standard in all filter samples was acceptable. Levels of PAHs in the single field blank were either very low or not detectable. Unfortunately, PAHs were not measured in any of the samples at concentrations higher than the MQL. Method sensitivity could be increased by a factor of two by increasing the flow rates for the sampling pumps. Alternatively, RTI is acquiring a new GC/MS system that will have much lower detection limits (~0.1 pg/µL) compared to the systems currently in use (5 pg/µL). The feasibility of using this system for analyzing PAH samples could be evaluated. It should be noted however, that the MQLs report for this pilot study (1.0 ng/m^3) are similar to the 0.9 ng/m^3 level that the California Office of Environmental Health Hazard Assessment suggests is required to cause 10^{-6} excess cancer risk over a 70-year exposure period.

TABLE 4-11. Method Performance for PAH Samples

Estimated Method Quantitation Limit	1.0 ng/m^3 for all PAHs
% of Samples with PAH levels > MQL	0%
% Recovery of Surrogate Standards (n=14)	Chrysene-D12 – 97 ± 9.4% Benzo[e]pyrene-D12 -- 93 ± 13%
% Recovery from NIST SRM (n=3)	Benzo[a]anthracene --73 ± 19% Benzo[a]pyrene -- 83 ± 12% Indeno[1,2,3-cd]pyrene -- 95 ± 4% Benzo[ghi]perylene -- 79 ± 8%
Recovery from Method Controls (n=6)	Benzo[b]fluoranthene -- 96 ± 7% Benzp[k]fluoranthene -- 100 ± 5% Benzo[a]pyrene – 91 ± 11% Indeno[1,2,3-cd]pyrene -- 82 ± 18% Benzo[ghi]perylene -- 78 ± 16%
Amount on Field Blank	All not detected except Benzo[b]fluoranthene -- 0.08 µg/m^3 Benzp[ghi]perylene -- 0.06 µg/m^3
% RSD of Duplicate samples	No duplicates collected

Recommendations -m Currently, PAH monitoring is <u>not</u> proposed for the Main Study. If additional monitoring is requested by the ARB then both the need for and the feasibility of improving method quantitation limits should be investigated.

4.1.6 Formaldehyde

Method Description - Formaldehyde was monitored inside the car during each test drive. Formaldehyde in air samples were collected by passing air through DNPH-coated Sep-Pak cartridges (Water Associates, Milford, MA). Samples were collected at a flow rate of approximately 300 mL/min using a battery-powered low volume pump. Samples were collected for a 2-hour period to give a nominal volume of 36 L. Flow rates at the cartridge inlet were measured before and after sample collection using calibrated rotameters with a fixed-orifice bypass tube.

DNPH/formaldehyde derivatives on sample cartridges were extracted by eluting each cartridge with 5 mL of HPLC grade acetonitrile into a 5 mL volumetric flask. The final volume is adjusted to 5.0 mL and the sample aliquoted for analysis.

DNPH/formaldehyde derivative in sample extracts were analyzed by HPLC with UV detection. Certified solutions of the DNPH/formaldehyde derivative were used to prepare the calibration solutions. DNPH/formaldehyde derivatives in sample extracts were identified by comparison of their chromatographic retention times with those of the purified standards. Quantitation was accomplished by the external standard method using calibration standards prepared in the range of 0.02 to 15 ng/µl of the derivative. Standards were analyzed singly for the formaldehyde/DNPH derivative and a calibration curve calculated by linear regression of the concentration and chromatographic response data. To be acceptable the calibration curve needed to give an R^2 greater than 0.998.

To demonstrate on-going analytical performance, a calibration standard was analyzed each day prior to the analysis of any sample and after every 10 samples. The calibration was considered "in control" if the measured concentration of the formaldehyde derivative in the standard was 85 to 115% of the prepared concentration.

Method Evaluation - Method performance was evaluated using field blanks, field controls, and duplicate samples. The method quantitation limit was calculated based on the sample concentration that would give an extract concentration at the level of the lowest calibration standard.

Method performance data are summarized in Table 4-12. Results indicated that the method should provide sufficient accuracy, precision, and sensitivity to measure formaldehyde in automobile air samples.

Recommendations - It is recommended that the method be used without modification in the Main Study.

TABLE 4-12. Method Performance for Formaldehyde Samples

Estimated Method Quantitation Limit	1.4 µg/m³
% of Samples with formaldehyde levels > MQL	0%
% Recovery from Field Controls (n=2)	99 ± 0%
Amount on Field Blanks (n=2)	36 ng/samples, 1.5 µg/m³ for a 24 L sample
% RSD of Duplicate samples (n=2)	2.5%, 5.5%

4.2 Continuous Measurements

4.2.1 Carbon Monoxide (CO)

Method Description - Carbon monoxide was measured inside of the vehicles, outside of the vehicles, and at the roadside sites using Draeger Model 190 carbon monoxide monitors/data loggers with extended memory. The monitors are pocket size, sensing and logging devices with accuracy reported by the manufacturer as ±2 ppm CO. The monitors are powered by a single 9 V alkaline battery. The monitors utilizes a three-electrode electrochemical sensor for continuous measurement of CO. A scrubber containing charcoal and Purafil is used on the monitor inlet to reduce interferences. An integral data logger records sensor measurements 120 times per minute. These values are averaged by the monitor and 1 minute average values are stored by the monitor data logger. Stored values are downloaded at the end of the monitoring period via an RS-232 interface to a portable computer using software supplied by National Draeger, Inc.. Results will be reported as one hour average and peak CO concentrations.

Two CO monitors were used for each vehicle to monitor inside and outside CO concentrations; Teflon sampling lines were used to draw air sequentially, first near the driver's breathing zone, and then from the vehicle exterior via a sampling manifold. A computer controller electronic timer was used to switch solenoid positions between the interior and exterior sample line every 5 minutes. Fixed site CO monitors were placed in "weather tight", insulated sampling boxes to minimize effects due to ambient outdoor temperatures and moisture.

Prior to initial use in the field, each CO monitors was calibrated using certified carbon monoxide gas standards at concentrations of 0, 2, 10 and 21.5 ppm. In addition to the weekly checks, a zero and span (21.5 ppm) check was performed at the start and the end of each test drive. At the start of the test drive, the zero and span of the monitor was adjusted to give readings of zero and 21.5, respectively. At the end of the test drive, no adjustments were made for the zero and span, rather reading were recorded on log sheets prepared for this purpose.

Method Evaluation - Performance of the CO monitors was evaluated based of the calibration checks and the deployment of duplicate monitors. For each test drive, performance of the CO monitor was considered "in control" if there was less than a 2 ppm drift in either the zero or the span reading. This criterion was meet for all monitors with one exception. On day one, the zero reading for one monitor drifted to 3 ppm. Method quantitation limits were set at 2 ppm based on information from the instrument manufacturer. Results for duplicate monitors showed agreement in 1-hour average readings within the 2 ppm specifications.

Recommendations - The CO monitors worked well throughout the study. Although many of the readings especially at the ambient and roadway sites were at or below the MQL, the monitors are acceptable for measuring CO levels that are below the California ambient air monitoring standard of 9 ppm. It is recommended that the method for monitoring CO be used without modification during the Main Study.

4.2.2 Particle Size and Mass Distributions

Method Description- The size distribution and volume of fine particles both inside and outside of the vehicle were measured continuously in the size range from 0.1 to 3 μm. Measurements were made using the LAS-X optical particle counter (Particle Measuring Systems, Boulder, Colorado). Prior to the study, the instrument was calibrated in the laboratory at Aerosol Dynamics Inc. The individual optical channel calibrations were performed using a differential mobility optical particle size spectrometer (DMOPSS) system, which was developed and deployed for two atmospheric visibility studies to provide *in-situ* calibration of optical counters for precise size distribution measurement (Stolzenburg et al., 1995) with ambient Berkeley, CA aerosols and with dioctyl sebacate aerosols. Calibrations were conducted using both dioctyl sebacate, an aerosol with a refractive index of 1.45, with size-classified ambient Berkeley aerosols, and size-classified California vehicular aerosols from a local Berkeley tunnel study. The details of these calibrations were provided to the ARB project officer as part of the final subcontract report prepared by Aerosol Dynamics.

During the study, fine particle measurements were made by sampling with a single LAS-X optical counter both inside and outside the vehicle. Data were collected with 15 s time resolution, then combined into 1 min averages. The data were reduced using both calibrations, to yield the volume of aerosol as a function of particle diameter inside and outside of the vehicle. Size distribution data was averaged over longer periods to obtain the mean ratio of inside to outside particle volume as a function of particle diameter. Size distributions were also integrated to give fine particle volumes inside and outside the vehicle as a function of time. The instrument was operated off of the power inverter that was located in the trunk of the test vehicle. Mass distributions were computed by applying density calibrations from "real" California ambient and vehicular aerosols and integrated to produce $PM_{2.5}$ concentrations. In order to apply the densities of vehicular and ambient aerosol, a composite estimate must be made of the fractional contribution of each source to the aerosol measured during commuting. This was accomplished by first developing a composite density that included a fractional contribution term from each source. The $PM_{2.5}$ inside and outside concentrations for all commutes were then computed from the LAS-X data, over a range of these fractional contributions. By minimizing the differences between the measured (the concentration <10 $\mu g/m^3$ for the 3/3 AM commute was not used) and computed values, it was determined that the best agreement occurred when the fraction of vehicular aerosol was 24 % (i.e. the ambient fraction was 76 %). A graph of the influence of fractional source contribution of the mean differences between computed and measured $PM_{2.5}$ concentrations is shown in Figure 4-3. The relationship of the measured and computed $PM_{2.5}$ concentrations for all commutes using the 24 % vehicular contribution factor is shown in Figure 4-4.

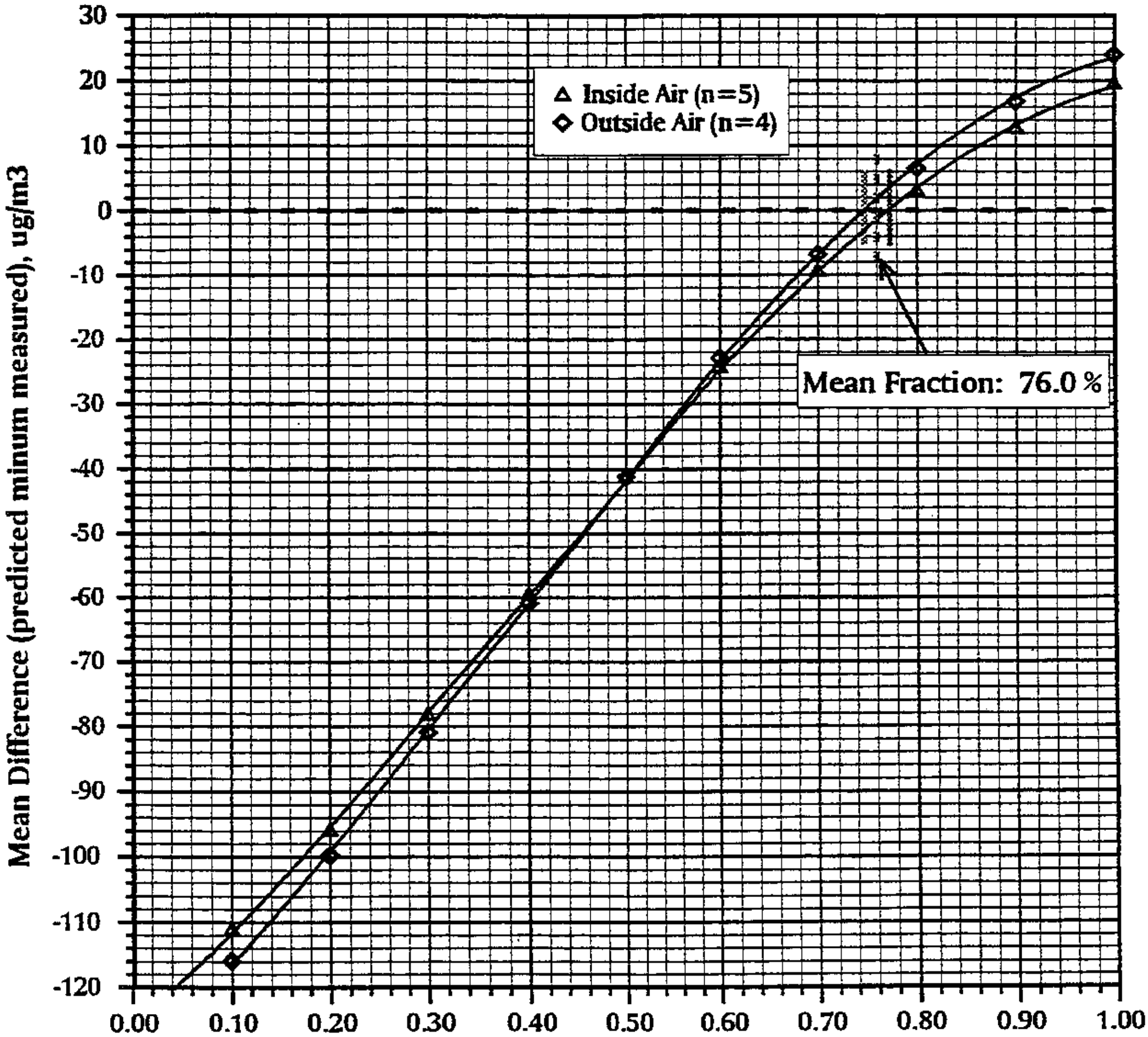
Method Evaluation- Overall the LAS-X particle counter worked well and provided valuable information on real-time particle counts and concentrations. Method performance is highlighted as follows:

- When the on-board power system was functioning properly in the car, the LAS-X operated smoothly, requiring little attention during sampling and no unplanned maintenance.
- The prior calibration of the LAS-X with real California ambient and vehicular aerosols substantially improved the ability to correlate the $PM_{2.5}$ concentrations computed from optical measurements with the integrated gravimetric data.
- The LAS-X 1 minute particle count averages correlated strongly with the Aethalometer black carbon analyzer (see example Figure 4-5) when the car was following a vehicle (gasoline or diesel) with a smoking exhaust.
- The LAS-X 1 minute computed $PM_{2.5}$ mass concentrations provided greater detail during the commute of the actual exposure levels, as compared to the total commute gravimetric, integrated average (see example Figure 4-5).

Figure 4-3

Composite Mean Difference Between Measured and Computed LAS-X PM2.5 Concentrations as a Function of the Fraction of Ambient Air Input Into the Particle Size and Particle Density Computations

(Blank-Corrected Gravimetric Data)

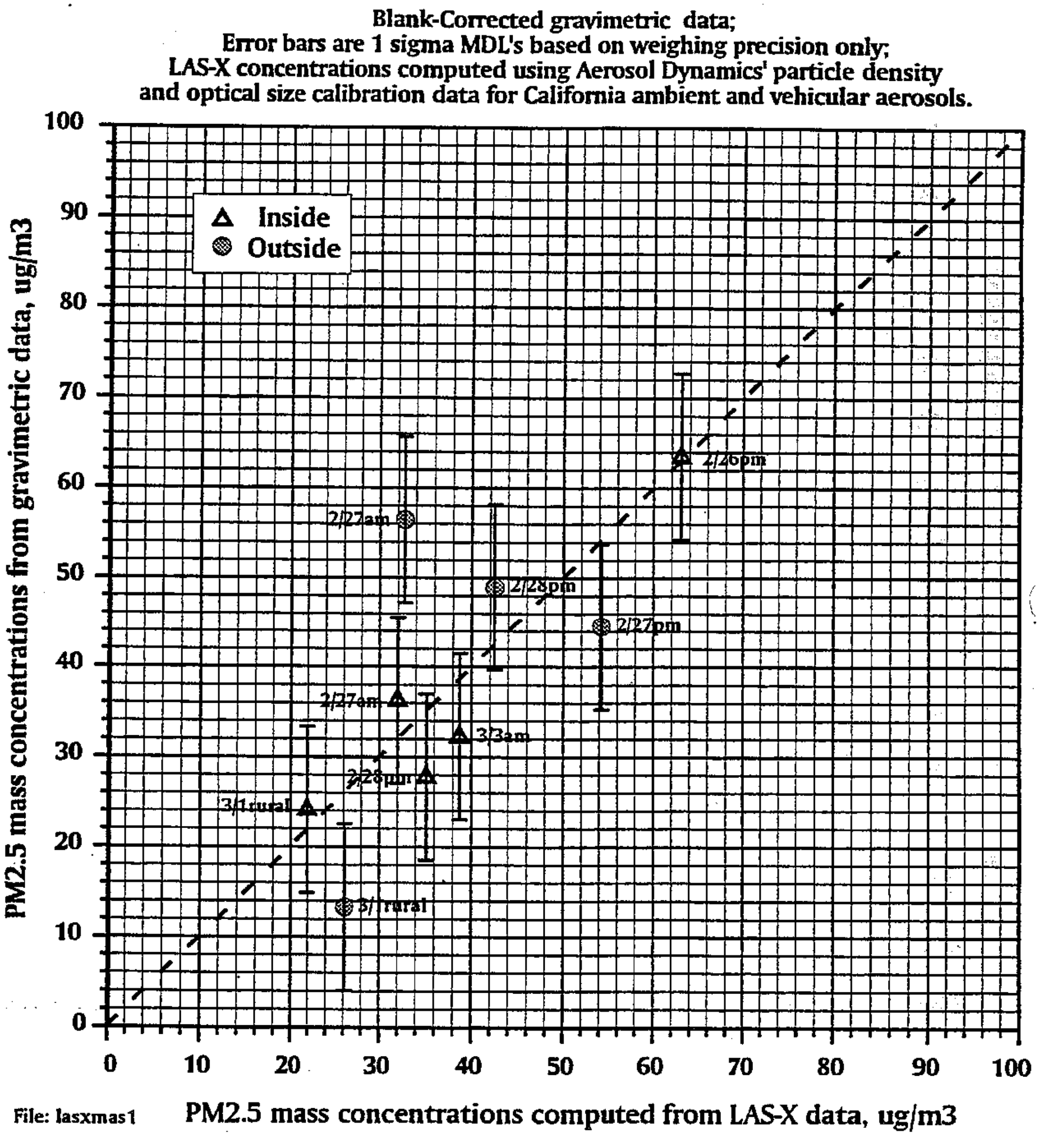


File: optima2

Ambient Air Fraction of Total (Total = Ambient + Vehicular)

Figure 4-4

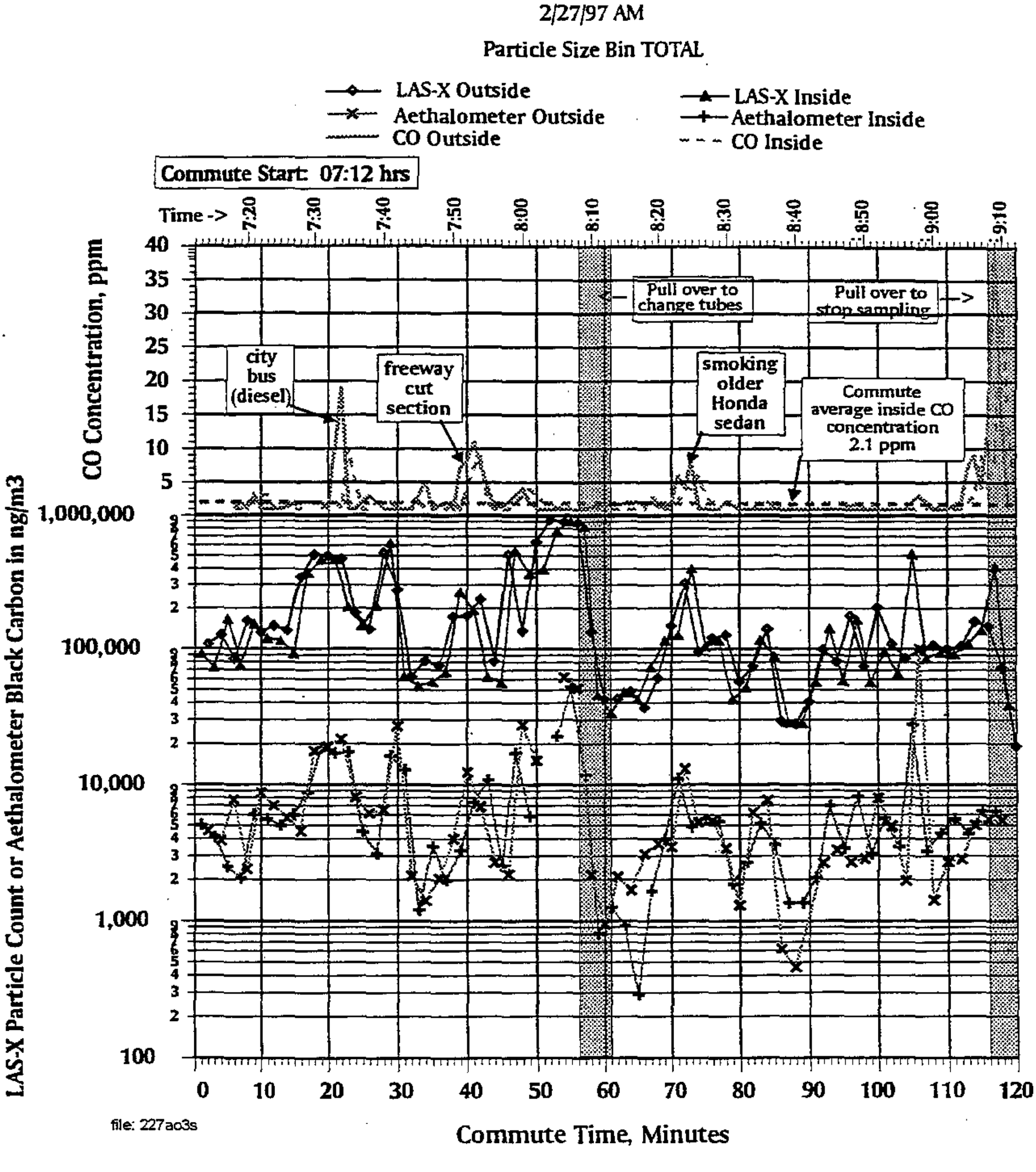
PM2.5 Gravimetric Mass Concentrations as Predicted by Computed Concentrations from LAS-X Data



File: lasxmas1

Figure 4-5

LAS-X Particle Counts, Aethalometer Black Carbon and Carbon Monoxide (CO) Outside and Inside Test Car



Recommendations- It is recommended that the LAS-X particle counter be used during the Main Study to collect real-time particle data. This can be done with a minimum of cost and effort with the equipment that is currently available. The calibration that was generated during the Pilot Study would still be applied. These data would be archived and provided to the ARB for future analysis.

4.3.3 Black (Elemental) Carbon

The concentration of elemental, or "black" carbon was measured semi-continuously using an Aethalometer (Magee Scientific, Berkeley, CA). This is a commercial instrument that examines the blackness of a filter as the sample is collected. A prototype developed at Lawrence Berkeley Laboratories was used in the 1986 ARB-sponsored Carbon Species Method Comparison Study, and was able to resolve single diesel trucks in the parking lot next to the sampling site. The instrument was operated using the manufacturer's calibration. Measurements were taken with a 1 min time resolution. Measurements were made inside and outside of the vehicle to give the inside/outside ratios as a function of time and vehicle driving conditions. Outside air was drawn through the sampling manifold. The instrument was operated off of the power inverter that was located in the trunk of the test vehicle.

Method Evaluation- Method performance for the Aethalometer black carbon measurements may be highlighted as follows:

- When the on-board power system was functioning properly in the car, the Aethalometer operated smoothly, requiring little attention during sampling and no unplanned maintenance.

- The expected correlation of the LAS-X and Aethalometer was observed when 1 min averages were compared, but the expected correlation with PAH integrated levels could not be determined because of the low PAH concentrations.

- The Aethalometer readily indicated the presence of smoking gasoline and diesel exhausts (as did the LAS-X), when the Caprice was behind these vehicles.

Recommendations- Although the Aethalometer potentially can provide useful information relative to identifying diesel vehicle influence on vehicular exposure levels, the additional cost of the monthly lease (unplanned) does not appear to be a warranted expense for the Main Study.

4.3 Air Exchange Rate (AER)

Air exchange rates for the test car under the three ventilation settings were measured using a modification of the CO decay method of Ott and Willits (1981). The procedure was implemented as follows:

- travel to an isolated location with minimal traffic ;
- set the selected ventilation setting in the test car and begin to drive the car at the desired speed (0 to 45 mph);
- release CO into the cabin of the automobile to a concentration of approximately 100 ppm;
- maintain the desired speed of the car (0 or 45 mph);
- monitor CO concentrations in the cabin of the car with the Draeger CO monitor; and
- compute the AER [air changes / hour], as

$$AER = (1/t)\ \ln (C_i / C_f) \qquad (7)$$

where t = decay time (h), ,
C_i , C_f is the initial, final concentration of CO in ppm.

Method Evaluation - Air exchange rates for the test vehicle were made on the rural route. Measurements of the three air exchange rate took approximately 2 hours. There were no logistical problems with implementing this procedure. There was, however, no way to assess the accuracy of the method, other than to cite the expected accuracy of the Draeger CO monitor (see Section 4.2.1). The main drawback to this method is that only a representative air exchange rate is obtained for the ventilation settings. Measurements of AER are not made during the test runs thus the AER during the test run could be substantially different that that was measured.

Recommendations - Despite this limitation, the method is recommended for the Main Study. Tests should be performed at the outset of the Main Study to characterize Sedan 1, Sedan 2, the sport/utility vehicle, and the school bus. If Sedan 2 and the SUV have the same range of air exchange rates as Sedan 1, the emphasis for the Main Study should be the high AER ventilation settings, which tend to maximize inside concentrations. If the additional vehicle AER data are significantly lower than Sedan 1, the emphasis should be balanced.

4.4 TRAFFIC DATA

4.4.1 In-Vehicle Data

Method Description--

Vehicle speed was recorded using a digital sender mounted on the drive-shaft for Sedan 1 and custom signal-conditioning circuitry. The signal from the OEM speed sender was also recorded as a backup. A grill-mounted laser range finder made to custom order for Sierra Research by Laser Atlanta, measured following distance from the car ahead. Accuracy of the measurement is approximately two feet. Lateral and longitudinal accelerometers were used to record total acceleration. All data were recorded once per second.

During on-road data collection, the test vehicle was driven by a two-member team that is familiar with the on-board equipment and drive protocols. The principal responsibility of the driver was, of course, to drive safely. The second technician served as a navigator and "observer," and uses a data entry switch box to log information of the selected parameters. These parameters were selected in consultation and final approval by the ARB. When necessary, the navigator kept a manual record of unusual events during each test drive. All drives were videotaped for later examination of any unusual events or to ascertain additional information about the test drive. Available data were obtained from CalTrans on roadway traffic counts relative to the selected commute route.

Method Evaluation- The collection of data for Level of Congestion and the Additional Parameter given in Table 3-5 using the-vehicle switch box was cumbersome and time consuming for the navigator. The utility of the Addition Parameter data was also not apparent during data analysis. The videotape of the drives provide excellent information on roadway conditions and target vehicles. CalTrans data are not always available for test runs and although it can provide good information for route selection, it does not appear to be useful for data analysis. For the freeway drives following distances were uniform throughout and therefore would not be a useful variable for data analysis.

Recommendations- The data/information collected during each commute for the Main Study should be revised to be (a) vehicle speed, (b) vehicle spacing, (c) Level of Congestion (traffic density), (d) video recording, and (e) a commute diary. This revisions will minimize the burden placed on the driver and navigator in collecting the data. It will also reduce the effort associated with reducing these data and relating it to measurement parameters.

5.0 DATA TABULATIONS

5.1 Data Tables

A compilation of the individual pollutant monitoring data for VOCs, formaldehyde, particle mass, black carbon, PAHs, carbon monoxide, and nitrogen dioxide is given in Tables 5-1A thru 5-1D by monitoring trip. These data represent 6 freeway commutes and 1 rural commute, all in the Sacramento area. Starred (*) data are below the method MQL. A similar compilation for the primary elements (metals) is given in Tables 5-2A thru 5-2E. The commute-average data are based on the commute times (minutes) given in Table 3-3. The CO and NO_2 hourly data are nominally: (a) Hour 1 - first 60 minutes, and (b) Hour 2 - next 60 minutes [truncated if the commute was less than 120 minutes]. A table summarizing the $PM_{2.5}$ and PM_{10} data separately is provided in Appendix H.

It should be noted that the Pilot Study data represent only a limited six-day monitoring period in Sacramento from February 26 to March 3, 1997. The meteorological conditions during that period resulted in a relatively "clean" ambient air setting compared to what might normally be expected in the winter in Sacramento or in the Summer/Fall (proposed time period for the Main Study) in either Los Angeles or Sacramento. The limited scope of the data suggests that only limited conclusions can be drawn, especially considering the low concentrations and the associated limits of detection for the respective methods.

We have based our conclusions on these monitoring data. However, it should be understood that some of the conclusion from the Pilot Study may not be directly applicable to a more polluted setting such as that anticipated for the Main Study later this year in Sacramento and Los Angeles. This becomes a very important consideration when evaluating the sensitivity of various monitoring methods. Methods that appear to be marginally suitable based on sensitivity may, in fact, be acceptable if the Main Study is conducted under more highly polluted conditions.

5.2 Data Interpretations

The data collected during the Pilot Study have been evaluated to answer several questions that address basic study design elements of the Main Study. These include:

1. **Are the measurement methods sufficiently sensitive to measure pollutant air concentrations during 2-hour driving periods?**

Results in Tables 5-1 and 5-2 provide information on air concentrations regardless of whether they are below the reported MQL. Data that are below the estimated MDL of MQLs are highlighted in the tables. The percentage of sample measurements that are above the reporting level are summarized in Table 5-3. In general, methods for VOCs, formaldehyde, continuous measures of $PM_{2.5}$, continuous measures of carbon black, and peak measures for CO provided higher percent measurable values. Methods for $PM_{2.5}$ mass, PM_{10} mass, NO_2, and 1-h average CO provided measurement data that were in the range of the MQL or MDL values. Methods for the metals were typically near the MQL, but the results were dependent upon the specific metal measured. PAHs gave concentrations well below the MQL values.

It should be reiterated that although several methods appear to provide only marginal sensitivity for this Pilot Study. They may, in fact, provide acceptable sensitivity if the Main Study is conducted under more highly polluted conditions.

TABLE 5-1A. IN-TRAFFIC DATA

Analyte	Concentration						
	Ambient	Out-Car	In-Car[a]	Road-1	Road-2	Road-3	Road-4
Day 1 (2/26), AM, Freeway Rush – Vent 2; medium air exchange rate:(98 hr^{-1} @ 55 mph)							
VOCs ($\mu g/m^3$)							
1,3-Butadiene	0.5	1.9	2.7 (ND)[b]	--[c]	--	--	--
MTBE	5.7	10	12 (7.2)	--	--	--	--
ETBE	ND[d]*	ND*	ND*	--	--	--	--
Benzene	--	--	(1.7)	--	--	--	--
Toluene	20	27	37 (34)	--	--	--	--
m,p-Xylene	5.3	12	21 (21)	--	--	--	--
o-Xylene	2.1	4.8	8.1 (7.2)	--	--	--	--
Formaldehyde ($\mu g/m^3$)	--	--	11	--	--	--	--
PM_{10} ($\mu g/m^3$)	46*	--	63	--	--	--	--
$PM_{2.5}$ ($\mu g/m^3$)	58	53 (--)	35 (--)	--	--	--	--
Carbon Black ($\mu g/m^3$)	--	--	--	--	--	--	--
CO average (ppm)	0, 0[e]	1.3, 1.1	--	--	--	--	--
CO peak value (ppm)	1, 0	10	--				
NO_2 (ppb)[e]	48, 37	36, 67	45, 48	--	--	--	--
Day 1 (2/26), PM, Freeway Rush – Vent 2; medium air exchange rate:(98 hr^{-1} @ 55 mph)							
VOCs ($\mu g/m^3$)							
1,3-Butadiene	0.6	2.9	3.1 (.75)	--	--	--	--
MTBE	4.5	17	19 (12)	--	--	--	--
ETBE	ND*	ND*	ND*	--	--	--	--
Benzene	--	--	(1.8)	--	--	--	--
Toluene	12	30	32 (31)	--	--	--	--
m,p-Xylene	4.6	17	19 (19)	--	--	--	--
o-Xylene	2.0	7.0	7.7 (6.7)	--	--	--	--
Formaldehyde	--	--	--	--	--	--	--
PAHs (ng/m^3)							
Benzo[b]fluoranthene	0.2*	0.6*	0.3*	--	--	0.4*	--
Benzo[k]fluoranthene	0.1*	0.2*	0.2*	--	--	0.1*	--
Benzo[e]pyrene	ND*	0.4*	0.2*	--	--	0.2*	--
Benzo[a]pyrene	ND*	0.4*	0.2*	--	--	0.1*	--
Indeno[1,2,3-cd]pyrene	0.2*	0.6*	0.3*	--	--	0.3*	--
Benzo[ghi]perylene	0.2*	1.1*	0.4*	--	--	0.5*	--
PM_{10} ($\mu g/m^3$)	238	--	76	--	--	--	--
$PM_{2.5}$ ($\mu g/m^3$)	34*	24* (70)	64 (63)	--	--	--	--
Carbon Black ($\mu g/m^3$)	--	7.2	6.6	--	--	--	--
CO average (ppm)	0,0	3.6, 3.9	--	--	--	--	--
CO peak value (ppm)	0,0	33	--	--	--	--	--
NO_2 (ppb)	22*, 42*	59, 22	144, 108	--	--	--	--

[a] For VOC in-car number in parentheses is multisorbent tube date.
[b] Starred (*) values are below the reported limit.
[c] No sample. [d] Not detected. [e] For CO and NO_2, two one-hour average values are reported.

TABLE 5-1B. IN-TRAFFIC DATA (continued)

Analyte	Concentration						
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
Day 2 (2/27), AM, Freeway Rush -- Vent 3; high air exchange rate: (160 hr^{-1} @ 55 mph)							
VOCs ($\mu g/m^3$)							
1,3-Butadiene	0.3	3.7	3.0 (ND*)	0.9	1.9	1.4	1.5
MTBE	3.5	18	17 (9.8)	4.7	9.1	8.0	7.7
ETBE	ND*	ND*	ND*	ND*	ND*	ND*	ND*
Benzene	--	--	(1.8)	--	--	--	--
Toluene	6.1	26	27 (32)	13	26	19	18
m,p-Xylene	2.9	18	18 (21)	4.3	11	8.6	9.2
o-Xylene	1.3	7.2	7.1 (7.3)	2.0	4.3	3.5	3.7
Formaldehyde	--	--	6.2	--	--	--	--
PM_{10} ($\mu g/m^3$)	75	NS	71	53	62	71	78
$PM_{2.5}$ ($\mu g/m^3$)	6.0*	56 (38)	36 (32)	15	15	44	35
Carbon Black ($\mu g/m^3$)	--	9.7	7.2	--	--	--	--
CO average (ppm)	0*, 0*	1.6*, 2.3	1.9*, 2.3	0*, 0*	--, --	1.5*, 0.7	0.1*, 0.1*
CO peak value (ppm)	ND	40	31	1.0	--	3.0	2.0
NO_2 (ppb)	61, 38	64, 9	65, 59	9.0*, 17*	69, 60	50, 43	108, 24
Day 2 (2/27), PM, Freeway Rush --Vent 3; high air exchange rate: (160 hr^{-1} @ 55 mph)							
VOCs ($\mu g/m^3$)							
1,3-butadiene	0.4	1.5	1.4 (ND*)	1.4	1.7	1.1	2.0
MTBE	ND*	ND*	8.9 (3.8)	9.1	10	7.9	10
ETBE	ND*	ND*	ND*	ND*	ND*	ND*	ND*
Benzene	--	--	(4.6)	--	--	--	--
Toluene	5.9	15	15 (12)	14	22	13	19
m,p-Xylene	3.2	10	10 (7.8)	8.6	12	7.5	12
o-Xylene	1.2	4.0	4.3(2.7)	3.5	4.9	3.0	4.8
Formaldehyde	--	--	4.3	--	--	--	--
PAHs (ng/m3)							
Benzo[b]fluoranthene	0.2*	0.1*	ND*	--	--	0.3*	--
Benzo[k]fluoranthene	0.1*	0.03*	ND*	--	--	0.1*	--
Benzo[e]pyrene	0.1*	0.02*	ND*	--	--	0.2*	--
Benzo[a]pyrene	0.1*	ND*	0.2*	--	--	0.2*	--
Indeno[1,2,3-cd]pyrene	0.1*	0.1*	0.2*	--	--	0.3*	--
Benzo[ghi]perylene	0.2*	0.1*	1.0*	--	--	0.4*	--
PM_{10} ($\mu g/m^3$)	49	--	33*	113	73	21	79
$PM_{2.5}$ ($\mu g/m^3$)	56	44 (50)	16* (54)	15*	15*	44	35
Carbon Black ($\mu g/m^3$)	--	4.9	4.4	--	--	--	--
CO average (ppm)	ND, ND	2.0, 1.0*	1.2*, 0.5*	0.7*, 0.4*	0.2*, 0.1*	1.1*, 1.1	0.6*,0.1*
CO peak value (ppm)	1.0*	5.0	3.0	4.0	2.0	3.0	2.0
NO_2 (ppb)	37*, 40*	84, 26	42*, 20*	55, 41	50, 57	47, 76	127, 46

[a] For VOC in-car number in parentheses is multisorbent tube date.
[b] Starred (*) values are below the reported limit.
[c] No sample. [d] Not detected. [e] For CO and NO_2, two one-hour average values are reported.

TABLE 5-1C. IN-TRAFFIC DATA (continued)

Analyte	Concentration						
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
Day 3 (2/28), PM, Freeway Rush -- Vent 1; low air exchange rate: (39 hr^{-1} @ 55 mph)							
VOCs ($\mu g/m^3$)							
1,3-Butadiene	0.6	2.8	2.4 (ND*)	1.3	2.2	0.5	1.3
MTBE	1.9	18	13(9.4)	8.4	11	2.5	8.2
ETBE	ND*	ND*	ND*	ND*	ND*	ND*	ND*
Benzene	--	--	(1.9)	--	--	--	--
Toluene	6.0	24	24(29)	13	20	6.1	13
m,p-Xylene	3.3	18	17(20)	8.3	11	0.9	8.2
o-Xylene	1.5	7.0	6.9(7.1)	3.5	4.5	--	3.5
Formaldehyde	--	--	18	--	--	--	--
PAHs (ng/m3)							
Benzo[b]fluoranthene	0.2*	.0.7*	0.4*	--	--	0.7*	--
Benzo[k]fluoranthene	0.1*	0.2*	0.2*	--	--	0.2*	--
Benzo[e]pyrene	0.1*	0.4*	0.4*	--	--	0.4*	--
Benzo[a]pyrene	0.1*	0.4*	0.5*	--	--	0.3*	--
Indeno[1,2,3-cd]pyrene	0.2*	0.6*	0.9*	--	--	0.3*	--
Benzo[ghi]perylene	0.2*	1.2*	1.7*	--	--	0.9*	--
PM_{10} ($\mu g/m^3$)	18*	--	54	101	62	78	61
$PM_{2.5}$ ($\mu g/m^3$)	9.3*	49 (43)	28 (35)	43	40	23	51
Carbon Black ($\mu g/m^3$)	--	--	7.4	--	--	--	--
CO average (ppm)	0.2*, 0.4*	2.8, 4.0	1.9*, 2.3	0. 1*, 0.4	0.4*, 0.6*	0.8*, 1.0	0.6*, 1.2*
CO peak value (ppm)	13	34	5.0	2.0	2.0	2.0	3.0
NO_2 (ppb)	1.0, 44	44, 82	92, 128	48, 50	16, 45	54, 39	61

[a] For VOC in-car number in parentheses is multisorbent tube date.
[b] Starred (*) values are below the reported limit.
[c] No sample. [d] Not detected. [e] For CO and NO_2, two one-hour average values are reported.

TABLE 5-1D. IN-TRAFFIC DATA (continued)

Analyte	Concentration						
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
Day 4 (3/1), AM, Rural – Vent 1; low air exchange rate: (39 hr^{-1} @ 55 mph)							
VOCs (µg/m³)							
1,3-Butadiene	ND*	ND*	ND* (ND*)	--	--	--	--
MTBE	1.0	1.4	1.6 (ND*)	--	--	--	--
ETBE	ND*	ND*	ND*	ND*	ND*	ND*	ND*
Benzene	--	--	(0.3)	--	--	--	--
Toluene	3.2	4.6	5.8 (5.0)	--	--	--	--
m,p-Xylene	1.5	1.8	3.4 (3.3)	--	--	--	--
o-Xylene	0.8	0.9	1.5 (ND*)	--	--	--	--
Formaldehyde	--	--	9.6	--	--	--	--
PAHs (ng/m³)							
Benzo[b]fluoranthene	0.1*	0.3*	ND*	--	--	--	--
Benzo[k]fluoranthene	0.1*	0.2*	ND*	--	--	--	--
Benzo[e]pyrene	ND*	ND*	ND*	--	--	--	--
Benzo[a]pyrene	0.1*	0.1*	0.1*	--	--	--	--
Indeno[1,2,3-cd]pyrene	ND*	0.2*	0.1*	--	--	--	--
Benzo[ghi]perylene	ND*	0.2*	ND*	--	--	--	--
PM_{10} (µg/m³)	28*	--	18	--	--	--	--
$PM_{2.5}$ (µg/m³)	31	13* (26*)	24* (22*)	--	--	--	--
Carbon Black (µg/m³)	--	--	1.3	--	--	--	--
CO average (ppm)	0*, 0*	0*, 0*	0.6*, 1.7*				
CO peak value (ppm)	0*, 0*	0*, 0*	1, 7*				
NO_2 (ppb)	9.0*, 5.0*	1.0*, 1.0*	ND*, 29*	--	--	--	--

[a] For VOC in-car number in parentheses is multisorbent tube date.
[b] Starred (*) values are below the reported limit.
[c] No sample. [d] Not detected. [e] For CO and NO_2, two one-hour average values are reported.

TABLE 5-1E. IN-TRAFFIC DATA (continued)

Analyte	Concentration						
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
Day 6 (3/3), Am, Freeway Rush -- Vent 3; high air exchange rate: (160 hr^{-1} @ 55 mph)							
VOCs ($\mu g/m^3$)							
1,3-Butadiene	0.8	3.0	2.8 (0.9)	0.8	0.7	0.3	0.7
MTBE	8.0	15	14 (12)	5.0	4.2	6.2	3.5
ETBE	ND*	ND*	ND*	ND*	ND*	ND*	ND*
Benzene	--	--	2.5	--	--	--	--
Toluene	11	23	23 (41)	9.8	8.4	8.6	11
m,p-Xylene	7.0	17	16 (23)	5.8	5.3	5.7	4.2
o-Xylene	3.0	6.7	6.5 (7.8)	2.4	2.3	2.6	1.9
Formaldehyde	--	--	7.8	--	--	--	--
PM_{10} ($\mu g/m^3$)	27	--	84	20	20	63	96
$PM_{2.5}$ ($\mu g/m^3$)	55	9.4 (44)	32 (39)	26	35	--	31
Carbon Black ($\mu g/m^3$)	--	8.0	9.8	--	--	--	--
CO average (ppm)	0.5*, ND*	4.7, 2.2	3.8, 1.8	ND*, ND*	ND*, ND*	0.1, 0.1	0.4, ND
CO peak value (ppm)	1.0*	23	20	1.0*	1.0*	1.0*	2.0
NO_2 (ppb)	84, 27	80, 40	83, 68	46*, 35*	9*, 45	ND*,	48, ND

[a] For VOC in-car number in parentheses is multisorbent tube date.
[b] Starred (*) values are below the reported limit.
[c] No sample. [d] Not detected. [e] For CO and NO_2, two one-hour average values are reported.

TABLE 5-2A. IN-TRAFFIC DATA FOR ELEMENTS

Analyte	Concentration						
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
Day 1 (2/26), AM, Freeway Rush Air exchange rate (mid 98 1/h)							
$PM_{2.5}$ (ng/m^3)							
Cadmium	0.01	0.05	0.03	--	--	--	--
Chromium	105	106	87	--	--	--	--
Manganese	2.3	2.5	2.5	--	--	--	--
Nickel	ND	ND	ND	--	--	--	--
Lead	6.6	8.4	12	--	--	--	--
Sulfur	343	269	575	--	--	--	--
PM_{10} (ng/m^3)				--	--	--	--
Cadmium	--	--	0.86	--	--	--	--
Chromium	--	--	9.5	--	--	--	--
Manganese	--	--	ND	--	--	--	--
Nickel	--	--	ND	--	--	--	--
Lead	--	--	11	--	--	--	--
Sulfur	--	--	265	--	--	--	--
Day 1 (2/26), PM, Freeway Rush Air exchange rate (mid 98 1/h)							
$PM_{2.5}$ (ng/m^3)							
Cadmium	0.24	--	0.11	--	--	--	--
Chromium	113	--	107	--	--	--	--
Manganese	1.4	--	6.8	--	--	--	--
Nickel	ND	--	25	--	--	--	--
Lead	6.9	--	11	--	--	--	--
Sulfur	237	--	269	--	--	--	--
PM_{10} (ng/m^3)				ND	ND	ND	ND
Cadmium	0.69	--	0.37	--	--	--	--
Chromium	200	--	192	--	--	--	--
Manganese	6.9	--	9.3	--	--	--	--
Nickel	53	--	28	--	--	--	--
Lead	8.5	--	13	--	--	--	--
Sulfur	345	--	465	--	--	--	--

TABLE 5-2B. IN-TRAFFIC DATA FOR ELEMENTS (continued)

Day 2 (2/27), AM, Freeway Rush Air exchange rate (high 160 1/h)							
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
$PM_{2.5}$ (ng/m^3)							
Cadmium	--	ND	0.12(0.12)	--	--	0.15	0.03
Chromium	--	104	109(122)	--	--	112	115
Manganese	--	4.6	16(6.1)	--	--	0.17	1.3
Nickel	--	ND	ND(ND)	--	--	ND	17
Lead	--	4.6	24(7.8)	--	--	5.7	6.7
Sulfur	--	310	293(274)	--	--	314	183
PM_{10} (ng/m^3)							
Cadmium	ND	--	ND(0.26)	--	--	0.24	ND
Chromium	218	--	239(251)	--	--	2.2	203
Manganese	7.0	--	25(21)	--	--	ND	2.3
Nickel	ND	--	ND(11)	--	--	ND	ND
Lead	7.8	--	14(8.3)	--	--	ND	9.1
Sulfur	547	--	639(660)	--	--	106	407
Day 2 (2/27), PM, Freeway Rush Air exchange rate (high 160 1/h))							
$PM_{2.5}$ (ng/m^3)							
Cadmium	--	0.04	--	--	--	--	--
Chromium	--	73	--	--	--	--	--
Manganese	--	5.4	--	--	--	--	--
Nickel	--	3.5	--	--	--	--	--
Lead	--	3.5	--	--	--	--	--
Sulfur	--	182	--	--	--	--	--
PM_{10} (ng/m^3)							
Cadmium	ND	--	--	--	ND	--	ND
Chromium	221	--	--	--	239	--	197
Manganese	63	--	--	--	46	--	28
Nickel	ND	--	--	--	ND	--	ND
Lead	19	--	--	--	11	--	9.5
Sulfur	453	--	--	--	507	--	326

TABLE 5-2C. IN-TRAFFIC DATA FOR ELEMENTS (continued)

Day 3 (2/28), PM, Freeway Rush Air exchange rate (low 39 1/h)							
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
$PM_{2.5}$ (ng/m^3)							
Cadmium	--	0.40	--	ND	0.46	--	1.1
Chromium	--	110	--	114	114	--	112
Manganese	--	8.6	--	2.7	4.0	--	3.5
Nickel	--	ND	--	5.3	6.9	--	70
Lead	--	6.7	--	3.1	9.0	--	3.7
Sulfur	--	443	--	324	392	--	283
PM_{10} (ng/m^3)							
Cadmium	ND	--	--	--	--	ND	--
Chromium	209	--	--	--	--	201	--
Manganese	20	--	--	--	--	7.5	--
Nickel	ND	--	--	--	--	ND	--
Lead	16	--	--	--	--	1.9	--
Sulfur	520	--	--	--	--	447	--

TABLE 5-2D. IN-TRAFFIC DATA FOR ELEMENTS (continued)

Day 4 (3/1), AM, Rural Air exchange rate (low 39 1/h)							
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
$PM_{2.5}$ (ng/m^3)							
Cadmium	ND	--	--	--	--	--	--
Chromium	ND	--	--	--	--	--	--
Manganese	ND	--	--	--	--	--	--
Nickel	ND	--	--	--	--	--	--
Lead	ND	--	--	--	--	--	--
Sulfur	93	--	--	--	--	--	--
PM_{10} (ng/m^3)							
Cadmium	--	--	--	--	--	--	--
Chromium	--	--	--	--	--	--	--
Manganese	--	--	--	--	--	--	--
Nickel	--	--	--	--	--	--	--
Lead	--	--	--	--	--	--	--
Sulfur	--	--	--	--	--	--	--

TABLE 5-2E. IN-TRAFFIC DATA FOR ELEMENTS (continued)

Day 6 (3/3), Am, Freeway Rush Air exchange rate (high 160 1/h)							
	Ambient	Out-Car	In-Car	Road-1	Road-2	Road-3	Road-4
$PM_{2.5}$ (ng/m^3)							
Cadmium	0.24	--	ND	--	ND	--	ND
Chromium	93	--	2.7	--	102	--	2.6
Manganese	40	--	0.25	--	ND	--	ND
Nickel	ND	--	ND	--	ND	--	ND
Lead	14	--	ND	--	ND	--	ND
Sulfur	300	--	231	--	261	--	32
PM_{10} (ng/m^3)							
Cadmium	--	--	ND	--	--	ND	1.5
Chromium	--	--	203	--	--	ND	243
Manganese	--	--	22	--	--	ND	21
Nickel	--	--	ND	--	--	ND	ND
Lead	--	--	12	--	--	1.5	24
Sulfur	--	--	543	--	--	215	537

TABLE 5-3. Percentage of Samples Above the Reporting Levels

Analyte	% Above Reporting Level	Reporting Level
VOCs -- Canister		MQL estimated from concentration of lowest standard
1,3-Butadiene	92	
MTBE	100	
ETBE	0	
Toluene	100	
Xylenes	100	
Formaldehyde	100	MQL estimated from concentration of lowest standard
PAHs	0	MQL estimated from concentration of lowest standard
PM_{10}	67	MQL based on precision of filter re-weighing
$PM_{2.5}$	64 (100)[a]	MQL based on precision of filter re-weighing
CO 1-h average	20	MQL based on manufacturers specifications
CO peak	95	MQL based on manufacturers specifications
NO_2	46	MDL based on precision of field blanks
Primary Elements		MQL based instrumental measurement precision of reagent water liquids
Pb	PM_{10} - 8.3, $PM_{2.5}$ - 22	
Cd	PM_{10} - 0, $PM_{2.5}$ - 5.6	
Cr	PM_{10} - 100, $PM_{2.5}$ - 100	
Mn	PM_{10} - 92, $PM_{2.5}$ - 89	
Ni	PM_{10} - 0, $PM_{2.5}$ - 5.6	
S	PM_{10} - 100, $PM_{2.5}$ - 94	

2. **<u>What is the effect of Air Exchange Rate on inside and outside-vehicle pollutant concentrations?</u>**

Figure 5-1 shows the relationship between the Inside/Outside concentration ratios and Air Exchange Rate for several selected measurements. Data are shown for CO, $PM_{2.5}$ (computed from the LAS-X), methyl *t*-butyl ether (MTBE), and toluene. Data for CO and $PM_{2.5}$ particles suggest that for the low AER the outside concentrations may be somewhat higher than the inside concentrations (inside/outside concentration ratios less than 1.0). No distinguishable trend is apparent for MTBE or toluene. Overall, the data suggest that as the air exchange rate increases, the ratio approaches unity and the inside and outside concentrations are essentially the same.

The indication that the inside concentrations were lower at the 39 air change per hour rate is perhaps an artifact of a driving protocol that emphasizes closely following smoking diesel and gasoline vehicles when the opportunity existed. The short duration (typically a few minutes or less) of these trailing events highlighted the modest "insulating" affect of a lower air exchange rate. More realistic commutes, however, could be expected to show little difference between inside and outside over the range of air exchange rates encountered.

[a] Integrated measurement.

3. **<u>What was the relationship between outside vehicle, roadside, and ambient site pollution concentrations</u> ?**

Figure 5-2 shows the 1-minute concentrations of real time CO and $PM_{2.5}$ mass (computed from LAS-X data) measured inside and outside the car. Overall results suggest that there are significant relationships for both particle and gas-phase pollutant concentrations inside and outside of the test vehicle. Note, however, that certain vehicles may emit significant quantities of only one of the two pollutants. Figure 5-3 shows the outside CO concentrations compared with the (measurable) data from the ambient site and all four roadway sites during a typical test run. It is apparent that a significant decrease (dilution) in CO concentration is occurring over the limited distance between the vehicles and the roadside. The ambient site and roadway concentration are very low (mostly below the detection limit), precluding development of a relationship between these locations and the outside vehicle monitoring data.

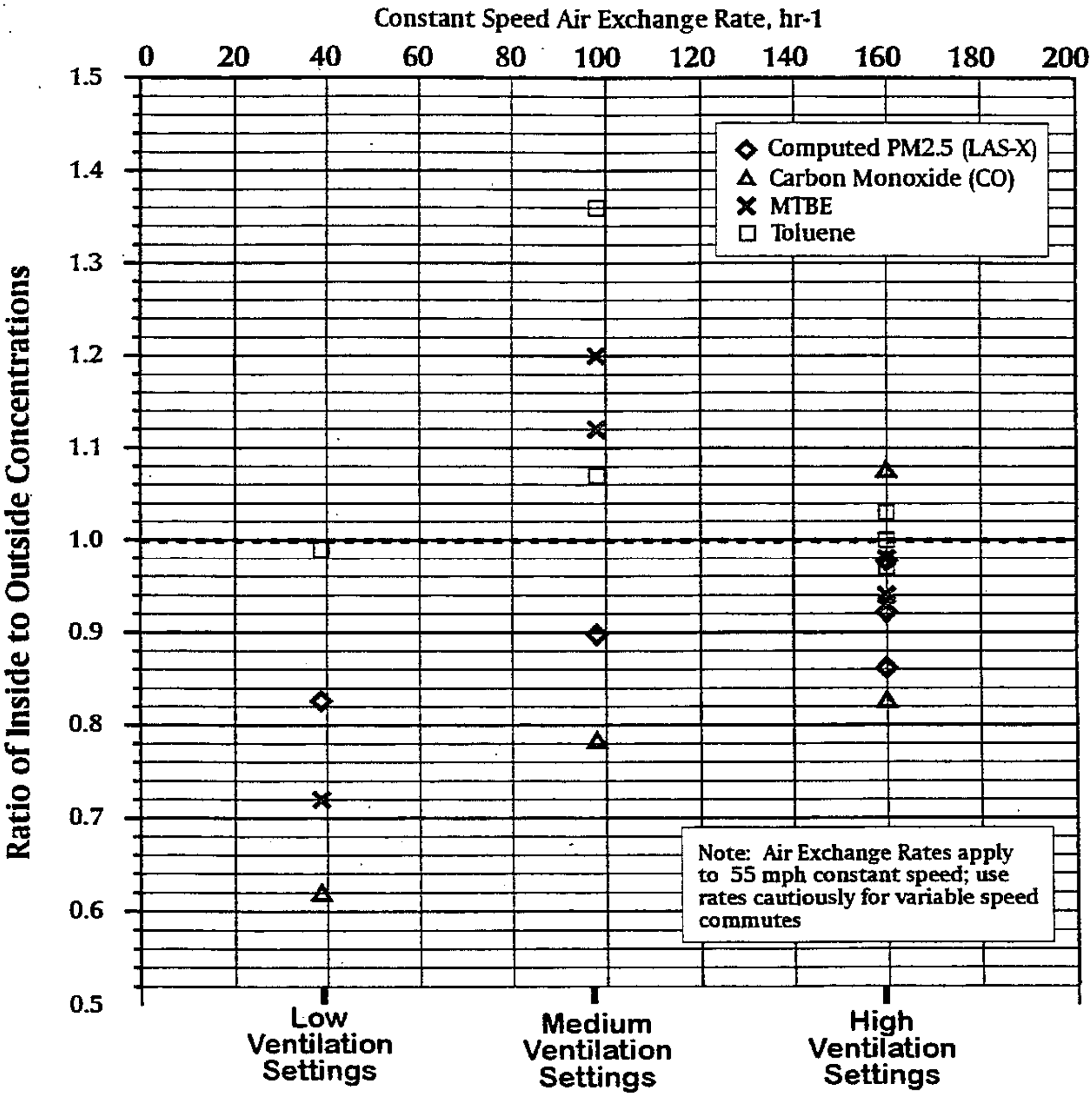
Examination of the integrated sample data in Table 5-4 for VOCs (e.g., methyl *t*-butyl ether and toluene) also demonstrates a lack of clear relationships between the vehicle concentrations and the roadway or ambient monitoring data. In general, the vehicle concentrations (continuous and integrated) are higher than the roadside concentrations, which are higher than the ambient site concentrations.

4. **<u>Can the monitoring data determine differences in roadway sources and conditions?</u>**

Extreme differences in roadway conditions (e.g. between the freeway and rural drives) can be detected by both the integrated and real time monitoring methods for all of the pollutants. Less dramatic differences in roadway conditions (e.g., small changes in hour-to-hour traffic volume, a different mix of target vehicles, proximity to target vehicles to the test car) could not be detected using the integrated monitoring methods. Real time measurements (CO, LAS-X particle count, Aethalometer black carbon) were required to evaluate these effects.

Figure 5-1

Relationships of Constant Speed Air Exchange Rate to the Ratios of Inside to Outside Concentrations During Freeway Commutes for Computed PM2.5 (LAS-X data), Carbon Monoxide (CO), Toluene, and MTBE



file: aerlasx1

See text for vent setting definitions

Figure 5-2

Computed PM2.5 (LAS-X) Outside and Inside vs CO Concentration

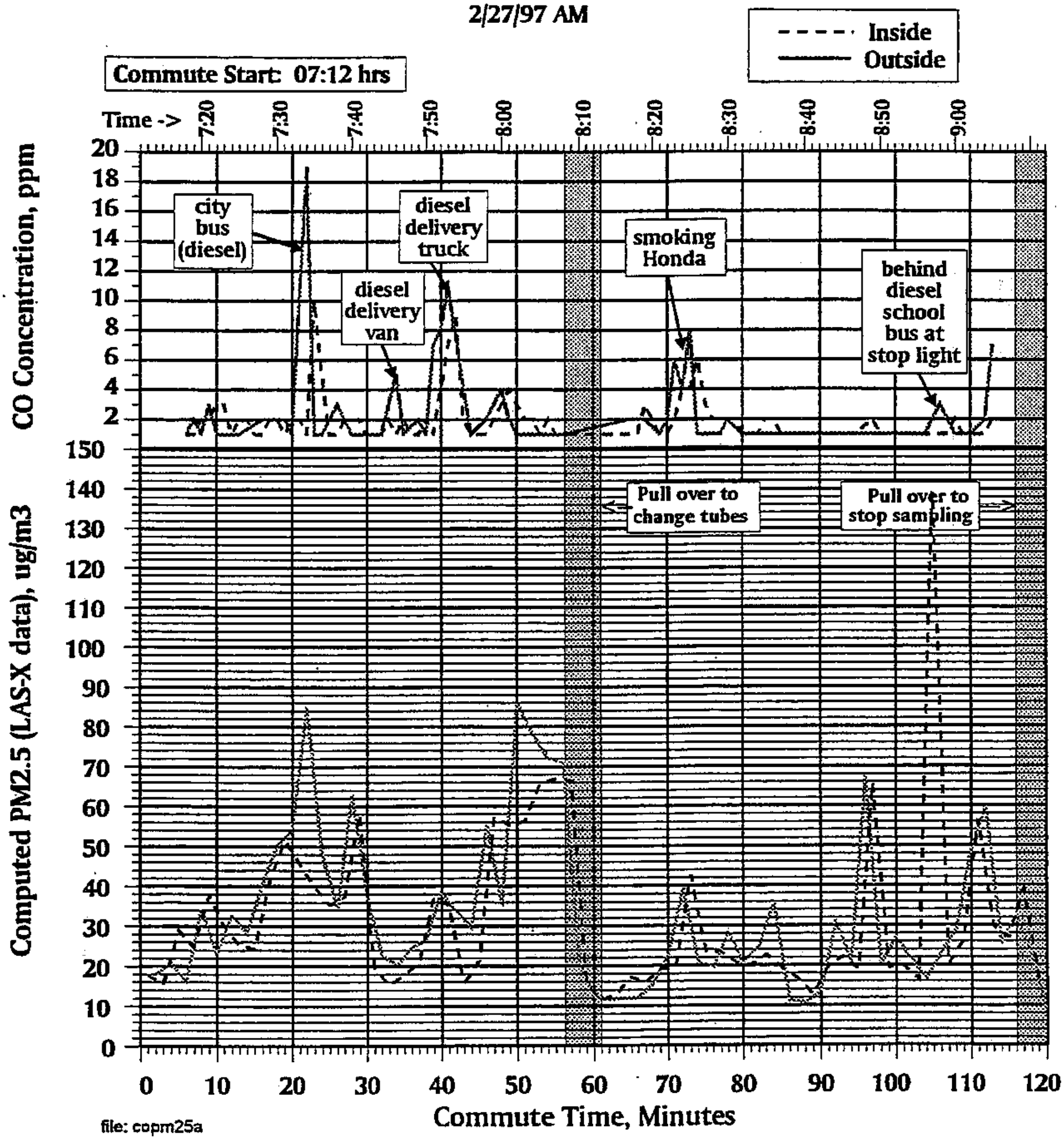
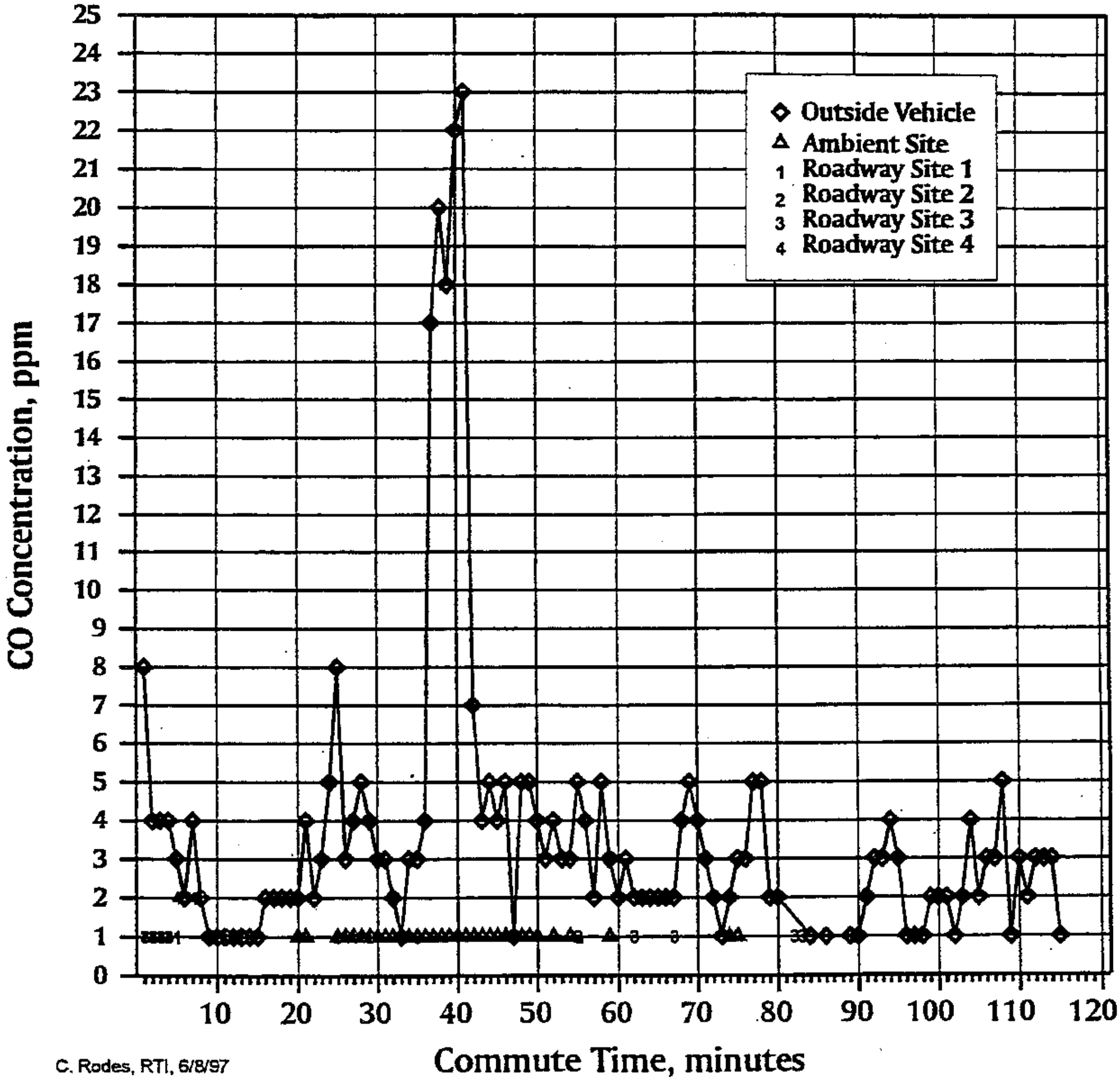


Figure 5-3

Relationship of Carbon Monoxide Outside Vehicle with Ambient Site and Four Roadway Site Concentrations

3/3/97 AM commute



C. Rodes, RTI, 6/8/97

TABLE 5-4. VOC Concentrations at Freeway Sites

Commute		Ambient	Out	In	Road 1	Road 2	Road 3	Road 4	Avg. road	%RSD
1,2/26, am		5.7	10	12						
2, 2/26, pm		4.5	17	19						
3,2/27, am		3.5	18	17	4.7	9.1	8	7.7	7.4	20
4,2/27, pm		2.5	9.1	8.9	9.1	10	7.9	10	9.3	8
5,2/28, pm		1.9	18	13	8.4	11	2.5	8.2	7.5	37
7,3/3, am		8	15	14	5.2	4.2	6.2	3.5	4.8	19
	Avg	4.4	15	14	6.9	8.6	6.2	7.4	6.1	15
	%RSD	47	25	24	28	30	36	32	26	
Toluene										
Trip		Ambient	Out	In	Road 1	Road 2	Road 3	Road 4	Avg road	%RSD
1,2/26, am		20	27	37						
2, 2/26, pm		12	30	32						
3,2/27, am		6.1	26	27	13	26	19	18	19	22
4,2/27, pm		5.9	15	15	14	22	13	19	17	19
5,2/28, pm		6	24	24	13	20	6.1	13	13	34
7,3/3, am		11	23	23	9.8	8.4	8.6	11	9.5	10
	Avg.	10	24	26	12	19	12	15	12	22
	%RSD	50	19	26	13	34	42	22	30	

Several additional observations were made based on the real time CO, LAS-X particle monitoring data, video tapes, and traffic data. These include:

- The particle count data from the LAS-X readily demonstrated the influence of individual, high-emitting particle vehicles immediately in front of the car.

- The short-term particle count size distribution data showed almost no differences between the shapes of the size distributions for several vehicle types (see Figure 5-4). The differences between distributions were mostly in the size of the particle mode below 0.3 μm. This is consistent with internal combustion engine particle emissions that are significantly less than 0.1 μm in diameter.

- The Aethalometer readily detected the particle emissions when following diesel (or visibly smoking gasoline-powered) vehicles, as did the LAS-X. Both measurements tracked correlated closely (see Figure 5-5). A determination as to whether the Aethalometer black carbon levels could be used to predict PAH levels could not be made, due to the below detection level concentrations measured for the PAHs.

- Limited data following poorly tuned vehicles (visible assessment of the exhaust plumes) suggest that closely following these vehicles for periods of more than a few minutes may add significantly to the total commute-average exposures for particles and CO.

- The rapidity of particle and CO concentration changes on the freeway from following individual vehicles, demonstrated the importance of careful time synchronization between all the continuous measurements. This proved to be more difficult than expected with the Aethalometer and video camera because of their time setting sequences.

- Reduction of all continuous measurements to the same integration average (e.g., 1 minute) was very time consuming after the study because of the inconsistent time synchronizations.

- The video camera was extremely informative as to the sources and scenarios that produced elevated exposure levels. Reviewing each tape to record these events, however, is very time consuming.

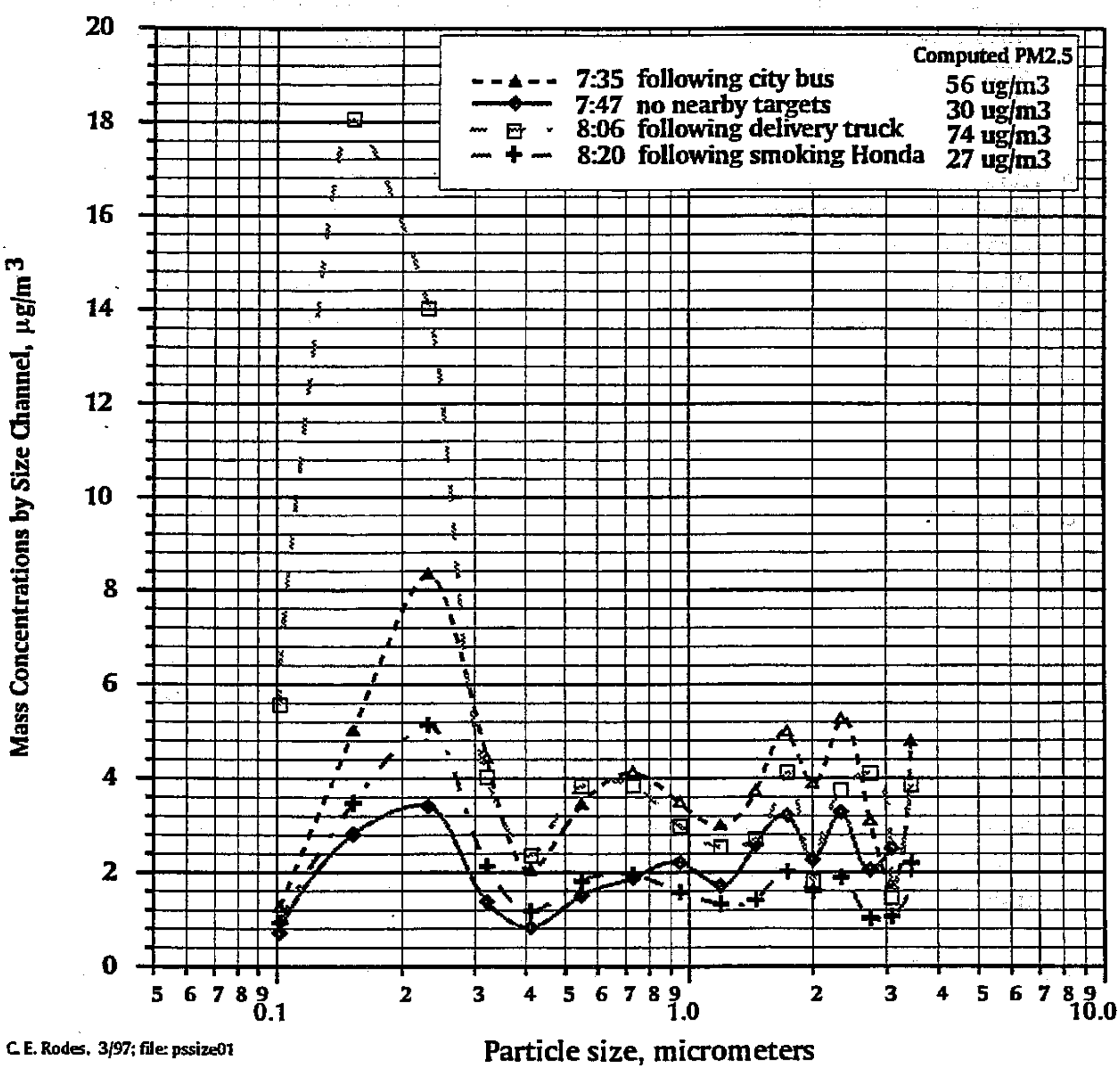
- A more refined time synchronization procedure among real-time measurements must be devised to provide a clearer indication of single events and make it cost-effective to reduce the continuous monitoring data.

- Reduction of the vehicle switchbox data that describe the driving scenarios (including traffic density) were difficult to incorporate into a data analysis, given the low concentrations encountered, suggesting that only traffic density (level of congestion) may be worth retaining for the Main Study.

Figure 5-4

Selected PM2.5 Outside Particle Mass Size Distributions Computed from LAS-X Particle Counts and AD Densities

2/27/97 AM Commute
Composite means of 3 consecutive 1 minute distributions



C. E. Rodes, 3/97; file: pssize01

- Hourly traffic count data were obtained (by Sierra Research) from CalTrans for the locations most relevant to the Sacramento freeway commuting route. Concurrent count data for only a few periods over-lapping the Pilot Study commutes were available. These data were obtained, plotted and are given in Appendix J. They indicated that the selected morning and evening sampling windows for the Pilot Study (7 to 9 AM, and 4 to 6 PM) correctly targeted the periods of highest traffic densities. These same windows will be used in the Main Study.

TABLE OF APPENDICIES

Appendix

APPENDIX A

RTI Milestone Schedule for the ARB In-Vehicle Exposure Study (Post Pilot Study)

C. Rodes, 6/6/97 (revised DRAFT)

Item #	Milestone Category	Item	Start Date	End or Critical Date	Output / Next Step / Result / Comment	Lead/Assisting Org.
1	Field Measurements	Pilot Study	26-Feb	1-Mar	exposure samples & data [Done]	RTI
2	Report	Accomplishments/Problem Area Report	5-Mar	15-Mar	draft report for ARB review [Done]	RTI
3	Chemical Analyses	Pilot Study integrated samples	1-Apr	23-May	data [Done]	RTI
4	Data Analysis	Analyze data / prepare summaries for Pilot Study report	26-May	6-Jun	graphs / tables / summaries	RTI
5	Report	Pilot Study summary	26-May	13-Jun	draft report for ARB review	RTI
6	Agreement Document	Operational agreement between RTI & Sierra concerning test car usage	18-Jun	18-Jun	Clarify RTI insurance provisions relative to SR Caprice	RTI/SR
7	Hardware Modification	Order 4 lpm PM10 caps	na	18-Jun	process requisition	RTI
8	Procurement	Order remainder of substrates/supplies for Main Study	na	18-Jun		RTI
9	Hardware Modification	Send PM2.5 caps to MSP for leak fix	na	18-Jun	replace all gaskets	RTI
10	Study Design Element	Select Main Study Routes	20-Jun	27-Jun	submit to ARB for review	SR
11	*Decision Point*	Inclusion of Aethalometer in Main Study	na	30-Jun	contingent on decision; Arrange for 30 day lease	RTI
12	*Decision Point*	Inclusion of LAS-X in Main Study	na	30-Jun	make sure LAS-X will be available in August; prepare LAS-X for Main Study	RTI
13	*Decision Point*	Increase PM10 flow to 4 lpm	na	30-Jun	prepare additional pumps for tandem operation / order additional 4 lpm inlet caps	RTI
14	*Decision Point*	Proportion of sampling days in Sacramento vs LA	na	30-Jun	Set field schedule	RTI/SR
15	*Decision Point*	Provide temperature-controlled weighing facility in Los Angeles	na	11-Jul	not required, but desirable; find facility and make arrangements with facility owner (e.g. SCAPCD)	RTI

RTI Milestone Schedule for the ARB In-Vehicle Exposure Study (Post Pilot Study)

C. Rodes, 6/6/97 (revised DRAFT)

Item #	Milestone Category	Item	Start Date	End or Critical Date	Output / Next Step / Result / Comment	Lead/Assisting Org.
16	Hardware Modification	Add external switches to particle sampler pumps	na	18-Jul	may require ordering some components	RTI
17	Hardware Modification	Add tandem 2 lpm pump to existing PM10 systems	na	18-Jul	make sure the additional equipment will be available in August	RTI
18	Hardware Modification	Add vibration damping to video and LAS-X platform	na	18-Jul	may require ordering some components; coordinate w/ Sierra	SR/RTI
19	Hardware Modification	Automate NO2 tube switching	na	18-Jul	add solenoids / remote switch / or timer	RTI
20	Hardware Modification	Build 4 lpm flow check orifice	na	18-Jul	may require ordering some	RTI
21	Hardware Preparation	Checkout samplers and prepare/clean substrates	na	18-Jul		RTI
22	Test Procedure	Upgrade inlet leak test procedure	na	18-Jul	Procedure / checklist	RTI
23	Hardware Modification	Upgrade power system in car for continuous monitors - if monitors are used in Main Study	na	18-Jul	Contingent on (a) decision to use continuous monitors, and (b) what power system would cost project	SR
24	Document Modification	Revise Field Operations Manual to reflect changes made during and since Pilot Study	na	18-Jul	send to ARB for review	RTI
25	Personnel Action	Identify additional vehicle drivers (including schoolbus) for Sacramento & LA	na	18-Jul	[List of potential sedan/SUV drivers already identified]	SR
26	Agreement Document	Prepare CalTrans request for encroachment permits for Sacramento & LA	na	18-Jul	Contact CalTrans as soon as roadside sites are identified	RTI/SR
27	Study Design Element	Select Ambient monitoring sites for Sacramento and LA	na	18-Jul	Make requests for permission to access	RTI
28	Study Design Element	Select Roadside monitoring sites for Sacramento and LA	na	18-Jul	Make requests for permission to access	RTI/SR
29	Hardware Modification	Redefine needed switchbox settings based on correlations with pollutant levels from Pilot Study	na	18-Jul	Delete several settings & add navigator observation diary?	RTI/SR
30	Study Design Element	Define driving protocols for the Main Study	na	18-Jul	Review & revise Pilot Study version	SR/RTI

RTI Milestone Schedule for the ARB In-Vehicle Exposure Study (Post Pilot Study)

C. Rodes, 6/6/97 (revised DRAFT)

Item #	Milestone Category	Item	Start Date	End or Critical Date	Output / Next Step / Result / Comment	Lead/Assisting Org.
31	Presentation	Pilot Study summary	8-Jul	29-Jul	meeting in Sacramento	RTI/SR/AD
32	Study Design Element	Select and make arrangements for additional sedan, SUV and schoolbus	18-Jul	1-Aug	Bus by 18-Jul; cars by 1-Aug	SR
33	Analysis Tool Modification	Upgrade GC/MS system to improve PAH detection limits	na	1-Aug	New system to be installed (no cost to contract)	RTI
34	Analysis Tool Modification	Upgrade ICP/MS system to improve metals' detection limits	na	1-Aug	New sample atomizer to be installed (no cost to contract)	RTI
35	Study Design Element	Finalize study design	18-Jul	1-Aug	Major elements by 18-Jul; Conference call with ARB to discuss last minute items on 1-Aug	RTI/SR
36	Shipping Date	Ship all components for Main Study to Sacramento	na	5-Aug	ship out by FedEx; return ship by surface freight	RTI
37	Study Design Element	Field staff training; assignment identifications	9-Aug	10-Aug	On-site meeting with key personnel	RTI/SR
38	Field Measurements	Main Study	11-Aug	29-Aug	exposure samples & data	RTI/SR
39	Chemical Analyses	Main Study integrated samples	5-Sep	3-Oct	data	RTI
40	Data Analysis	Analyze data / prepare summaries for Main Study report	6-Oct	17-Oct	graphs / tables / summaries	RTI/SR
41	Report	Main Study summary	20-Oct	7-Nov	draft report for ARB review	RTI/SR
42	Presentation	Main Study summary	17-Nov	17-Nov	meeting in Sacramento	RTI/SR

APPENDIX B

Caprice Switchbox Settings Used by Sierra Navigator to Characterize Traffic in Pilot Study

Switch 1 [Ventilation Settings]
- 0 - Vent OFF
- 1 - MAX AC (no outside air)
- 2 - NORM AC (allows outside air)
- 3 - Heat
- 4 - Vent open

Switch 2 [not used]

Switch 3 [Roadway Type]
- 0 - Other (parking, etc.)
- 1 - Rural lane
- 2 - Arterial
- 3 - ON or OFF ramp
- 4 - Freeway slow (right) lane
- 5 - Freeway (other lanes except right or carpool)
- 6 - Freeway carpool

Switch 4 [Level of Congestion]
- 0 - Other
- 1 - Level A (free flow)
- 2 - Level B
- 3 - Level C
- 4 - Level D
- 5 - Level E
- 6 - Level F (highly congested)

Switch 5 [not used]

Switch 6 [Target Type]
- 0 - Other
- 1 - Light Duty Vehicle (normal operation)
- 2 - Light Duty Vehicle (obvious exhaust emission, smoking)
- 3 - Heavy Duty (non-diesel)
- 4 - Light Duty Diesel (cars and delivery trucks) [identification sometimes uncertain]
- 5 - Heavy Duty Diesel Buses [and other buses if identification was uncertain]
- 6 - Heavy Duty Diesel truck

APPENDIX C

2/20/97 Final

ARB In-Vehicle Exposure Study Pilot Study Schedule of Activities

Sunday, PM, 2/23/97

* Charles Rodes (hand-carrying study laptop computer), Don Whitaker and Mike Roberds (hand-carrying Mettler AT-20 balance) to arrive in Sacramento (Charles at 5:16 pm, Don and Mike at 9 pm)
* Charles to pick up station wagon rental
* Charles will call Steve Hui at home to confirm arrival.
* Charles will call Frank DiGenova at home to confirm arrival and arrange to pickup air freight shipment of equipment at Sierra
* Charles will call Susanne Hering at home to confirm meeting time on Monday PM for installation of LAS-X and Aethalometer and operator training.
* Don and Mike will pick up cell phones and rental sedan.
* Charles and Mike will set up computer and balance, and temperature/humidity sensor and check balance for proper operation and begin recording temperature and humidity fluctuations.

Monday, AM, 2/24

* Charles and Don will meet Frank at Sierra to install the rack, position the rear window panel and locate the Teflon sampling line to the front of the SR car [the Sierra driver and the Sierra navigator will not be needed on 2/24]
* Mike will begin equipment setup an pump calibrations
* After installation of the rack (should require < 1 hr), Charles, Don, and Frank will take the car to the motel staging area for attachment of the outside switching manifold and the other sampling equipment to the rack.

Monday, PM, 2/24

* LAS-X and Aethalometer will be installed in car by Susan, tested for proper operation, and Susan will train Mike, Don and Frank on their operational settings.
* LAS-X will be attached to the laptop computer by Don and the data output and logging functions checked
* Aethalometer internal data logger (with its own floppy drive) will be checked by Susan
* Paper tape sealing requirements of the Aethalometer will reviewed by Susan along with tape loading and archiving procedures
* All CO monitors will be calibrated by Don and Mike and the internal data loggers checked
* All particle monitoring pumps and associated data loggers will be checked by Mike and Charles and pre-set to the correct flowrate (2.0 lpm), including checking batteries.

** All participants to meet (prior to and at dinner) to discuss responsibilities, logistics and problem areas

Monday, evening, 2/24

* Car will be returned to Sierra garage for overnight parking (every night)
* All filters will be numbered, pre-weighed, and loaded into petri dishes by Mike Roberds - if the temperature and humidity are within 20 ±5 °C and 30 to 70 % Rh (should not be a problem if room HVAC is functional). If outside humidity is extremely high and inside humidity cannot be brought below 70%, a dehumidifier will be obtained and the filters weighed on 2/25 PM.

Tuesday, AM, 2/25

* $PM_{2.5}$ and PM_{10} inlets will be cleaned, oiled (as needed), loaded with a filter, sealed, and leak-tested.
* The in-vehicle continuous monitors - CO, LAS-X, and Aethalometer - will be turned ON each morning (at Sierra garage) and allowed to warm up for 1 hour.
* At the staging area, the CO data logger will be checked, the Aethalometer data logger will be checked, and the RTI laptop connected to the LAS-X and checked.
* The 3 continuous monitors will be put into the data collection modes.
* The computer system in the car will be checked and data collection initiated for laser, switch setting, and speed logging.
* The video camera will be loaded, clock time checked, and camera started.
* The Sierra driver and Sierra navigator will proceed to the start of the rush hour commute route and drive the route for 1-2 hours (time of day irrelevant) to (a) become familiar with the route, and (b) become familiar with the switch panel settings.

Tuesday, PM, 2/25

* Continuous monitors powered up for the duration of the sampling (thru 3/3)
* $PM_{2.5}$ and PM_{10} inlets will be cleaned, oiled (as needed), loaded with a filter, sealed, leak-tested and placed into Ziplok bags.
* Fresh batteries will be installed as needed (batteries will be changed twice - initially and Friday PM) in all particle sampling pumps (4 AA alkalines/pump), NO_2 pumps, VOC multi-sorb pumps, and CO monitors (9V)
* The tripod for the Ambient site and the ground stakes for the 4 Roadside sites should be located and installed for the subsequent sampling days. *CalTrans must be notified so they can inspect.*
* After the car returns the CO, LAS-X, and Aethalometer data will be retrieved for evening review by Charles.
* The car computer data and video will be retrieved by Sierra, reviewed for reasonableness, and given to Charles for subsequent evening review.
* All particle sampling pumps, NO_2 tube pumps, PAH pumps, PAH inverter/battery systems will be checked for functionality.
* The operation of the in-vehicle integrated samplers, the switching manifold, and laptop data logging system will be demonstrated to the Sierra driver and navigator by Don.

Tuesday, evening, 2/25

* All filters will be pre-weighed, if not already weighed on 2/24

* Data forms/spreadsheets will be initiated for each sample collection,
* Rechargeable batteries for the PAH sampling and aldehyde sampling will be placed on charge
* Particle sampler data loggers will be reset to operate unattended (without mid-sampling data review) for the 4 sampling days - unless a final flow is more than 10% different than an initial flow.

Wednesday, AM, 2/26 [Sampling Day 1: Freeway/Low AER/no Roadside Monitoring]

* All monitor and data systems internal clocks will be set and synchronized

* AM General Commute Preparations [5:30 to 6:45 AM]
  + All clocks (samplers, data loggers, video cameral) will be checked for synchronization
  + The car will be fueled and the windows cleaned.
  + A fugitive leak test for CO and NO_2 will be conducted by Sierra under the hood and along the exhaust system under the car, while the (warmed) car is idling.

* In-Vehicle Sample/Data Collection Preparation [5:30 to 6:45 AM]
  + The particle sampling inlets ($PM_{2.5}$ and PM_{10}) will be installed for inside and outside (no PM_{10} outside), the pumps checked and set for initial flowrate, and the data sheets completed with the sampling start time.
  + The NO_2 tubes will be installed (1 for each hourly value), the pumps checked and s' for initial flowrate, and the data sheets completed
  + The aldehyde pump and cartridge will be installed (Inside sampling only) and the data sheet completed.
  + The VOC canisters will be installed and the data sheets completed.
  + The VOC multi-sorb tube (Inside sampling only) will be prepared
  + The CO monitor will be zeroed and span checked, the data logger checked.
  + The LAS-X will be checked, along with the laptop computer data collection system
  + The Aethalometer will be checked, along with its internal data collection system.
  + Video camera to be prepared (1 video tape per day - AM & PM commutes)
  + On-board computer system initiated and laser distance finder checked

* Ambient Sample/Data Collection Preparation [6:00 to 6:30 AM]

  At the motel staging area:
  +. The particle sampling inlets ($PM_{2.5}$ and PM_{10}) will be installed, the pumps checked and set for initial flowrate, and data sheets updated.
  + The NO_2 tubes will be installed (1 for each hourly value), the pumps checked and set for initial flowrate using a dummy tube [the pumps left ON - tubes will be connected at the roadside], and the data sheets updated.
  + The VOC canisters will be prepared and the caps removed.
  + The CO monitor will be zeroed and span checked, and the data logger checked.

* Ambient Site Sampling Initiation [6:40 to 6:45 AM]
  + The route will be driven by Mike and Steve to set out, secure, start the sampler, and note arrival/departure times for the Ambient site station only.
  + After the placement and initiation of the ambient sampler, Mike will make a phone call to the Sierra driver to begin the 2 hour commuting run [may only be required on first sampling day].

* Commute Initiation [6:45 AM]
  + All in-vehicle sampling pumps (particles, NO_2, PAH, VOC, and aldehydes) and data logging (as required) will be started by Sierra navigator after the signal is received upon setup of the last roadside sample
  + The commute drive route (see attached maps) will start at the motel staging area, proceed to the I Street on ramp of I5, proceed South to Rte 99, proceed East to Bus. 80, proceed North past the I80 merge, and turn around at Madison Ave., re-enter South on I80 and re-trace the route continuously for the 120 minute period.
  + The study driving protocol, including data entry via switch panel will be followed.
  + The front windows of the car will be lowered 1/3 open for the first 2 minutes of each commute that are on the freeway (Wed, Thur, and Fri) or rural route (Sat) to provide an initial in-traffic purge and then returned to the required position for the balance of the commute.
  + Sierra navigator to monitor signal light on dash for proper activation of outside manifold solenoid switching - if light flash ceases, LAS-X/solenoid switching laptop computer must be re-initiated.
  + After 120 minutes, the Sierra navigator will suspend all sampling pumps, VOC's, and data logging (as required).

* Mid-Commute [7:40 to 7:45 AM]
  + The route will be driven to switch the NO_2 samplers from Hour 1 tubes to Hour 2 tubes at the Ambient site and each of the four roadside sites
  + The Sierra navigator will switch the in-vehicle NO_2 samplers from Hour 1 tubes to Hour 2 tubes

* Commute Completion [8:45 AM]
  + Car returns to staging area (motel)
  + Mike will conduct final flow checks at the motel on each sampler, complete the data sheets, and secure the collected samples.

* Ambient Site Sampling Completion [8:40 to 8:45 AM]
  + The route will be driven by Steve and Mike to stop the sampling and retrieve the sampling systems for the Ambient site station

* Sample Retrieval/Archival/Data Collection [9:00 to 11:00 AM]
  + All sampling filters, cartridges, tubes, and canisters will be removed and placed in their respective storage/shipping containers

+ The particle inlets will be unloaded, the filters moved to the proper petri dish, and any unusual deposits noted in the filter log book

* Particle Inlet Preparation [12:30 to 1:30 PM]
  + $PM_{2.5}$ and PM_{10} inlets will be cleaned, oiled (as needed), loaded with a tared filter, sealed, leak-tested and placed into Ziplok bags.

Wednesday, PM, 2/26
* In-Vehicle Sample/Data Collection Preparation [3:00 to 4:00 PM]
  + Prepare PAH filter cartridge and pump system
* Ambient Sample/Data Collection Preparation [3:00 to 3:50 PM]
  + Prepare PAH filter cartridge and pump system
* Ambient Site Sampling Initiation [3:50 to 4:00 PM]
* Commute Initiation [4:00 PM]
* Mid-Commute [4:50 to 5:00 PM]
* Commute Completion [6:00 PM]
* Ambient Site Sampling Completion [5:50 to 6:00 PM]
* Sample Retrieval/Archival/Data Collection [6:00 to 8:00 PM]
  + Includes floppy disk backup of data files collected during the day
  + Recharge PAH batteries and Aldehyde sampler pump battery

Wednesday, evening, 2/26
* The inside $PM_{2.5}$ and PM_{10} particle filters will be post-weighed (and repeated each evening until the final post-weighing) to estimate whether volatilization losses may be occurring.
* PAH, VOC multi-sorb, aldehyde and NO_2 samples will be stored in a refrigerator (35-40 °F) after collection until shipment to RTP for analysis. Particle sample filters will not be refrigerated.

Thursday, AM, 2/27 [Sampling Day 2: Freeway/Med. AER/Roadside Monitoring]
* AM General Commute Preparations [5:15 to 6:45 AM]
* In-Vehicle Sample/Data Collection Preparation [6:00 to 6:45 AM]
* Roadside/Ambient Sample/Data Collection Preparation [5:15 to 6:45 AM]
* Roadside/Ambient Site Sampling Initiation [6:40 to 6:50 AM]
  + Steve to place samplers at the ambient site, Mike to place samplers at Roadside sites 1 & 2, Don to place samplers at Roadside sites 3 & 4
* Commute Initiation [6:45 AM]
* Mid-Commute [7:40 to 7:50 AM]
  + Steve to switch NO_2 tubes at the ambient site, Mike to switch NO_2 tubes at Roadside sites 1 & 2, Don to switch NO_2 tubes at Roadside sites 3 & 4
* Commute Completion [8:45 AM]
* Roadside/Ambient Site Sampling Completion [8:35 to 8:55 AM]
  + Steve to stop samplers at the ambient site, Mike to stop samplers at Roadside sites 1 & 2, Don to stop samplers at Roadside sites 3 & 4
* Sample Retrieval/Archival/Data Collection [9:15 to 11:15 AM]

Thursday, PM, 2/27

* In-Vehicle Sample/Data Collection Preparation [2:30 to 4:00 PM]
* Roadside/Ambient Sample/Data Collection Preparation [2:30 to 3:50 PM]
* Roadside/Ambient Site Sampling Initiation [3:50 to 4:10 PM]
* Commute Initiation [4:00 PM]
* Mid-Commute [4:50 to 5:10 PM]
* Commute Completion [6:00 PM]
* Roadside/Ambient Site Sampling Completion [5:50 to 6:10 PM]
* Sample Retrieval/Archival/Data Collection [6:30 to 8:30 PM]
* Charles to leave Sacramento

Friday, AM, 2/28 [Sampling Day 3: Freeway/High AER/Roadside Monitoring]

Repeat Thursday, AM, 2/27, w/ Roadside Monitoring:

+ Change all batteries in particle sampling pumps prior to sampling

Friday, PM, 2/28

Repeat Thursday, PM, 2/27 w/ Roadside Monitoring:

Saturday, AM, 3/1 [Sampling Day 4: Rural Commutes/Low AER/no Roadside Monitoring]]

Repeat Wednesday, AM, 2/26, w/o Roadside Monitoring; start time not critical. A staging area (starting point where car can be parked and samplers serviced) must be identified.

* Add an in-vehicle VOC sample collection with the car standing and OFF to determine in out-gassing from unidentified sources are affecting the inside collections.
* Conduct AER measurements (Low, Medium, and High vent settings) after first commute.
* Set-up ambient station at ARB location identified by Steve.:

Saturday, PM, 3/1

Repeat Wednesday, PM, 2/26 w/o Roadside Monitoring:

* Steve, Charles, Don, Mike and Frank will decide whether sample collections have been "successful" and determine whether an additional AM sampling commute run will be needed on Monday.

Sunday, 3/2

A day of rest

Monday, AM/PM, 3/3 [Special Sampling Day]

* Collect Samples to Replace Lost Samples Days 1 to 4 [6:30 AM to 10:00 AM]

+ Replacement samples (no VOC's will be repeated) will only be collected if more than 50% of samples are lost on a previous commute simultaneously (i.e. the expected data capture rate for integrated samples in the Pilot Study is 7 out of 8 samples - only in a case of catastrophic simultaneous failure will a re-run be made)

* Steve, Charles, Don, Mike, Frank, and Linda by phone (and Susanne if available) will meet to discuss the special sampling scenarios to be examined during the Continuous Monitor driving.
* Collect Continuous Monitor Data [? to 3:30]
  Proposed sampling:
  + Operate only CO, LAS-X, and Aethalometer with Don in backseat to collect data and direct driving scenarios to study typical and max/min exposure situations
  + Driving location 1: Primarily between the truck station at Antelope and the Madison interchange (~4 miles), following Heavy Duty Diesel Truck (HDDT) - investigating concentrations/size distributions for various situations, e.g.:
    Immediately behind HDDT during accel vs speed limit cruise,
    Influence of trailing distance during accel and cruise,
    Influence of 1 or more intervening cars,
    Immediately behind to changing to adjacent lane - both left and right
  + Driving location 2: Moderately congested route with carpool lane:
    Determine levels/size distributions in lane 1 (HDDT influence) vs middle lanes vs carpool lane
* Susanne to conduct final PM check of operating conditions of Aethalometer and LAS-X and retrieve Aethalometer

Monday, evening, 3/3

* All filters will be post-weighed, returned to the petri dishes, and archived for return to RTI for chemical analysis. If the outside humidity is extremely high and inside humidity cannot be brought below 70%, a dehumidifier will be obtained and the filters weighed on 3/4 PM.

Tuesday, AM, 3/4

* All samples (except VOC canisters) to be hand carried, along with Mettler balance and laptop computers by Don and Mike back to NC
* All equipment and supplies to be boxed and prepared for return shipment to NC (including LAS-X)

Tuesday, PM, 3/4

* Project operational debriefing (primarily % data capture; preliminary estimates of data quality by category) for Steve by Don and Mike

Wednesday, AM, 3/5

* Don and Mike to leave Sacramento

APPENDIX D

Inspection of Sedan 1 Prior to the Pilot Study

Sierra Research
February 20, 1997

Summary Description of Sedan 1

The test vehicle for the pilot study, Sedan 1, is a 1991 Chevrolet Caprice that is dedicated by Sierra to service as an instrumented vehicle. The base vehicle is a full-size, six passenger sedan with V8 engine and automatic transmission. The interior has leather bench seats both front and rear, power windows, power door locks and power seats.

Several modifications have been made to the vehicle prior to and as part of the current study. One of the most unique aspects of the vehicle is a front-grille-mounted laser range finder (Laser Atlanta, model Atlas 1000) that is used to measure distance to the vehicle ahead. The vehicle has been equipped with a 110 VAC power system based on an isolated 12 volt DC deep-cycle marine battery and a 1200 watt frequency compensated inverter (Triplite Model 1200FC), all of which is mounted in the trunk. Also mounted in the trunk is a 486/66 computer with ROMdisk (Curtiss, Inc.).

An LCD display and keyboard are mounted in the passenger compartment. A six-switch rotary switch box is provided for operator data entry and an accelerometer package has been installed on the rear deck for longitudinal and lateral acceleration. A video camcorder (Sony model CCD-V701/NTSC) is installed in the center rear part of the passenger compartment to record view out the front window.

Additional equipment, installed by RTI after removal of the rear seat bench for the pilot study, is described elsewhere.

Vehicle Inspection Prior to Pilot Study

The Caprice has been subjected to numerous emissions tests, both as part of California's Smog Check program (it has always passed) and for special mass emissions and fugitive emissions testing programs. However, to ensure that the vehicle did not have undue fugitive emissions either under-hood or in the passenger compartment, three additional tests were performed on February 19, 1997, just prior to the commencement of the pilot program.

First, under-hood emissions were measured at the Sierra Research Vehicle Testing Laboratory. Insofar as there is not yet a standardized test procedure for determining under-hood fugitive emissions, a modified FID-based CVS sampling system* was used together with a custom-made stainless steel dilution funnel to sample under-hood air for fugitive leaks, as described previously.** No dilute concentrations in excess of 20 ppmC were observed, which is considered by EPA to be maximum allowable hydrocarbon concentration in "background" air for IM240, i.e., CVS-type testing.***

Second, to check for potential fugitive hydrocarbon sources in the passenger compartment, a NDIR-type portable exhaust gas analyzer was used as a "sniffer." No measurable concentrations of hydrocarbons above background levels were detected.

Finally, the vehicle was visually checked for fugitive leaks by an automotive engineer and Qualified Environmental Professional from Sierra. No leaks were found.

Conclusion

Based on the observations described above and previous test results, it was concluded that Sedan 1 was unlikely to have significant fugitive hydrocarbon leaks that might unduly influence inside or outside sampling.

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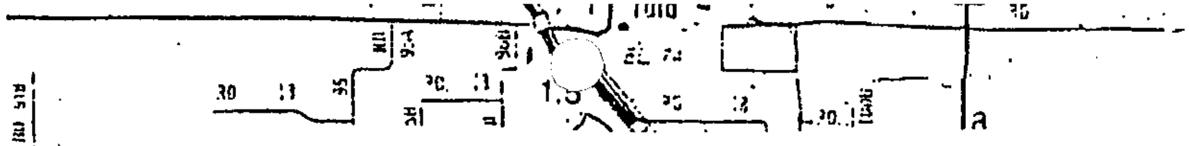
* Di Genova, Frank, et al., "The Potential Significance of Motor Vehicle Crankcase Emissions on the Mobile Source Emissions Inventory," presented at the 6th Coordinating Research Council Emissions Workshop, San Diego, CA, March 18-20, 1996.

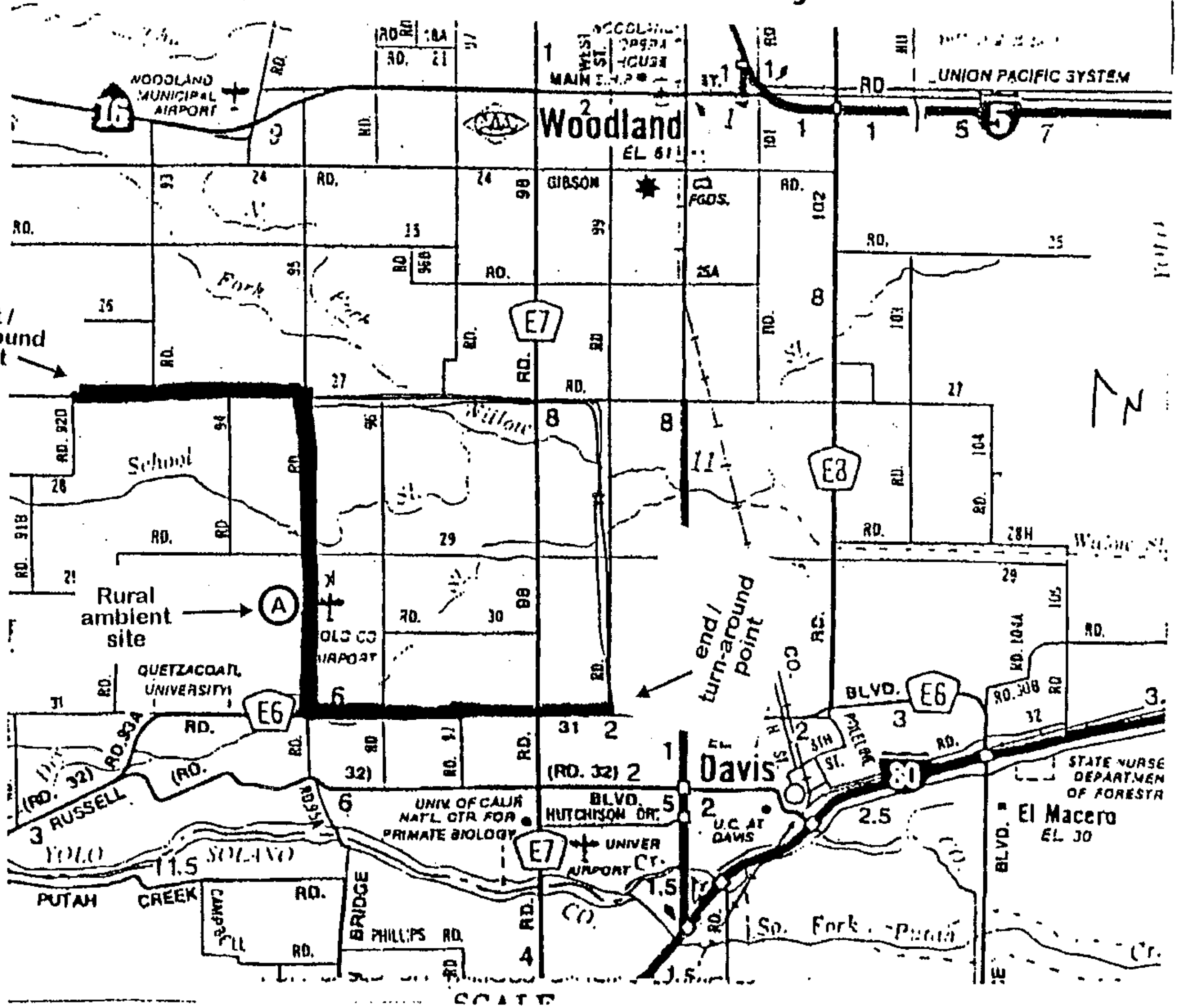
** Di Genova, Frank, et al., "Alternative Techniques for Detecting Excessive Evaporative Emissions During I/M Tests," SAE Paper No. 962093.

*** "High-Tech I/M Test Procedures, Emission Standards, Quality Control Requirements, and Equipment Specifications: IM240 and Functional Evaporative System Tests," Revised Technical Guidance, DRAFT, USEPA-AA-RSPD-IM-96-1, June 1996.

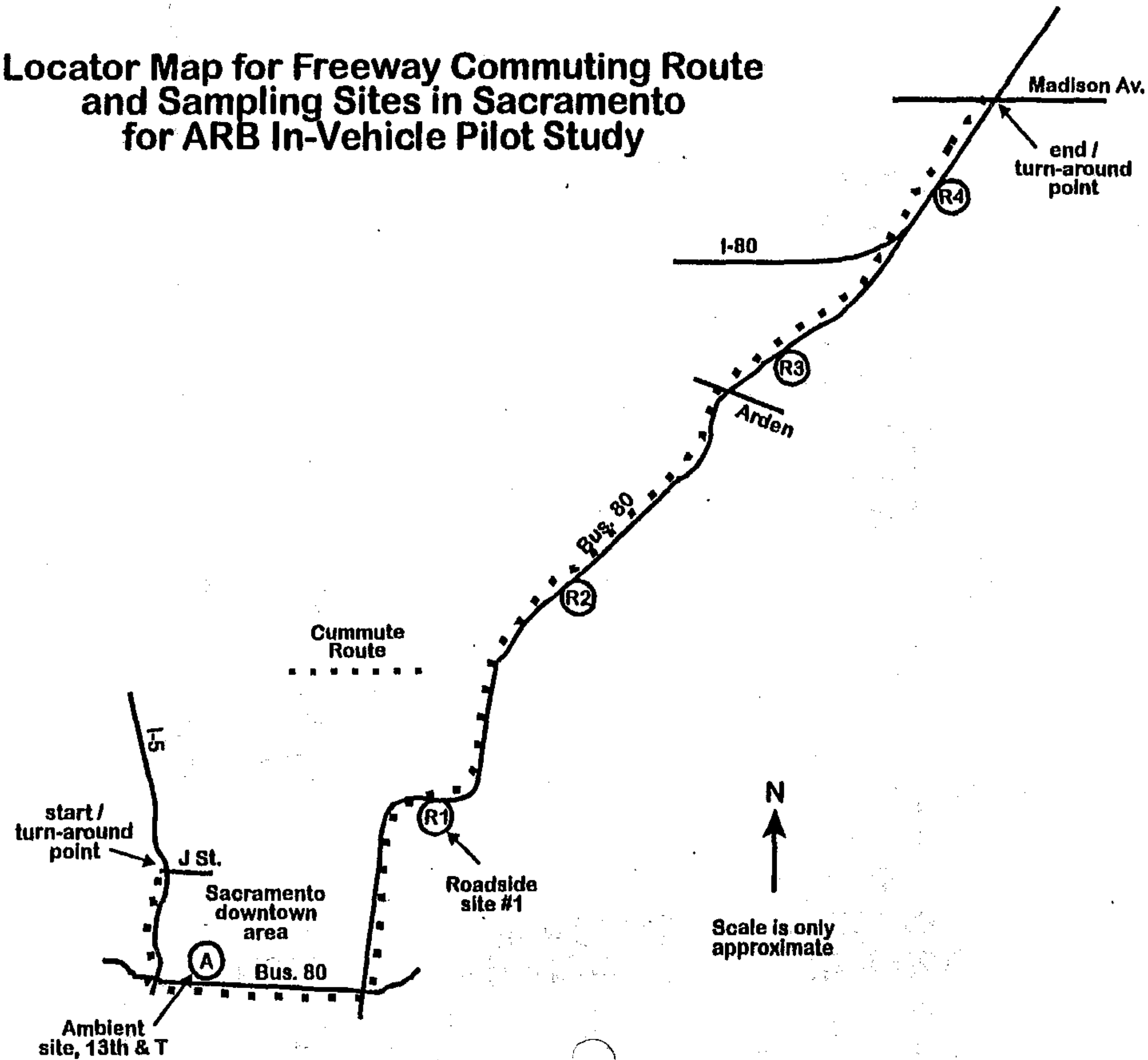
APPENDIX E



Locator Map for Rural Commuting Route and Sampling Site in Sacramento for ARB In-Vehicle Pilot Study



Locator Map for Freeway Commuting Route and Sampling Sites in Sacramento for ARB In-Vehicle Pilot Study



APPENDIX F

sie a
resear
1801 J Street
Sacramento, CA
(916) 444-6666
Fax: (916) 444-8

February 18, 1997

Memo To: Alicia Beyer, Encroachment Permit Engineer
Caltrans District 3 Encroachment Permits

From: Frank Di Genova

Subject: Site Locations for RTI Encroachment Permit Application of 2/6/97

This memorandum provides specific locations for four portable air samplers in support of RTI's February 6, 1997 application for encroachment permits. This air sampling is needed for an inside-vehicle air pollution research study sponsored by the California Air Resources Board.

Three site locations are along Route 51 (Business 80) between the junction with Highway 50 (milepost 0.00) and junction 80 west (milepost 8.86). The fourth location is on Highway 80, just north of the junction with Route 51. All samplers will be located to the right (east) of the shoulder of the northbound lanes, between approximately 15 and 25 feet from the edge of the rightmost lane. Additional details about the samplers are contained in the application filed on February 6, 1997, by RTI.

- Location #1: milepost 2.4, next to the call box (call box number SA-51-22), which is located immediately north of the highway sign indicating 1 mile to the Cal Expo exit. The sampler will be located to the north of the sign and thus will not obstruct view of it.

- Location #2: milepost 4.3, approximately halfway between Arden Way interchange (milepost 4.06) and El Camino Avenue interchange (milepost 4.74), which is approximately adjacent to a large "CINEMA" sign to the east of the right of way.

- Location #3: milepost 5.85, approximately halfway between the Auburn Blvd. connection (milepost 5.78) and the Howe Avenue connection (milepost 5.96). Because of the limited space at the shoulder, it is anticipated that this site will be accessed from Auburn Blvd rather than from Route 51.

- Location #4: milepost 11.4, immediately east of the I-80/highway 51 split but west of the eastbound I-80 onramp from route 244, in the vicinity of call box number SA-80-114.

The approximate locations of the four sampling sites are shown on the attached map. If you have any questions about the sampling locations, please call me. If you have questions about other aspects of the permit application or the project, please call Dr. Rodes at RTI or Mr. Hui at ARB.

cc. Charles Rodes, RTI
Steve Hui, ARB
Tira McCann, Caltrans

ENCROACHMENT PERMIT
TR-0120 (NEW 9/91)

Permit No.	0397-NSV0152
Dist/Co/Rte/PM	03-SAC-51-2.4/5.96 03-SAC-80-R11.55
Date	February 20, 1997
Fee Paid	$ EXEMPT
Deposit	$ N/A
Performance Bond Amount (1)	$ N/A
Payment Bond Amount (2)	$ N/A
Bond Company	
Bond Number (1)	
Bond Number (2)	

In compliance with (check one):

X Your application of February 18, 1997

___ Utility Notice No. _____ of _____

___ Agreement No. _____ of _____

___ R/W Contract No. _____ of _____

TO:

Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709-2194

ATTN: Charles E. Rodes
PHONE: (919) 541-6749

, PERMITTEE

and subject to the following, PERMISSION IS HEREBY GRANTED to:

Install four (4) temporary air monitoring stations, three (3) along State Highway 51 (Bus. 80) and one on State Highway 80. Specific locations described on memo dated February 18, 1997.

MEMO ATTACHED

Permittee shall contact **State Inspector Tara McCann**, telephone (916) 227-7008, **two working day** prior commencing work, to arrange a **pre-job meeting**, in accordance with **Provision 6** of the attached General **Provisions**. The 24 hour notification before restarting work, provided by Provision 6, shall be strictly adhered to. All work shall be conducted and completed to the satisfaction of Caltrans representative below. **Immediately following completion of the work permitted herein, the Permittee shall fill out and mail the Notice of Completion attached to this permit.**

The following attachments are also included as part of this permit. (Check applicable):

Yes	No	
X		General Provisions
	X	Utility Maintenance Provisions
X		Special Provisions TRAFFIC CONTROL
	X	A Cal-OSHA permit required prior to beginning work;
		# PLAN and MEMO ATTACHED

In addition to fee the permittee will be billed actual costs for:

Yes	No	
	X	Review
	X	Inspection
X		Field Work

(If any Caltrans effort expended)

___ Yes X No The information in the environmental documentation has been reviewed and considered prior to approval of this permit.

This permit is void unless the work is completed before May 1, 1997

This permit is to be strictly construed and no other work other than specifically mentioned is hereby authorized.

No project work shall be commenced until all other necessary permits and environmental clearances have been obtained.

Tara McCann, Permits
5900 Folsom Boulevard
Sacramento, CA 95919
(916) 227-7008, Cellular 755-7371

cc Peter Azevedo, Sunrise Region

APPROVED:

Irene J. Itamura, District Director

BY: Richard W. Jones

Richard W. Jones, Chief - Office of Encroachment Permits

Attachment

California Department of Transportation
Standard Encroachment Permit Application

Items 1, 2, 3, 4, 6, 7, and 8
The exact locations of the four encroachment locations on the Highway 51 (I-80 business) freeway from the downtown Sacramento J street intersection to the Auburn Boulevard interchange on I-80 (towards Roseville) have not been determined. They are proposed to be approximately equally spaced over this route. These locations will be used to place portable air pollution monitors temporarily for a study under contract to the California Air Resources Board (see Item 22). The exact locations will be selected by February 12, 1997, and provided to the CalTrans encroachment engineer immediately.

Item 22.
Roadside Air Sampling by the Research Triangle Institute for the California ARB
1. Introduction:

The Research Triangle Institute[1] and its subcontractors, Sierra Research[2], and Aerosol Dynamics[3] have been awarded a contract by the California Air Resources Board (ARB) in Sacramento, California (contract ARB 95-339, project officer: Steve Hui, ph 916-323-1530) to conduct vehicle occupant air pollution exposure studies while commuting on California freeways. The California Health and Safety Code (HSC) Section 39660.5 requires the ARB to assess human exposure to toxic pollutants. The ARB is also required to identify the relative contribution of indoor concentrations to total exposure, taking into account both ambient and indoor air environments. In order to assess a population's actual exposure to a pollutant, it is necessary to account for exposure in all microenvironments where people spend their time. This requires information on how much time people spend in specific microenvironments and the corresponding air concentration of toxic pollutants in those microenvironments. Although the ARB has representative data on Californian's activity patterns (Wiley et al., 1991a, 1991b), very little pollutant concentration data are available for many microenvironments including vehicle passenger compartments.

The purpose of this study is to measure concentrations of a number of pollutants inside vehicles while they are being driven on California roadways. The results of this study will be used by ARB to determine the need for, and feasibility of, additional in-vehicle pollutant measurements in future studies.

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[1] A not-for-profit research organization established in conjunction with North Carolina State University, Duke University, and the University of North Carolina, comprising approximately 1500 employees and conducting research studies in a broad variety of disciplines. mailing address: contact: Charles E. Rodes, PhD, ph. 919-541-6749, FAX 919-541-6749; P. O. Box 12194, Research Triangle Park, NC 27709.

[2] Sacramento, CA, contact: Frank DiGenova, ph. 916-444-6666

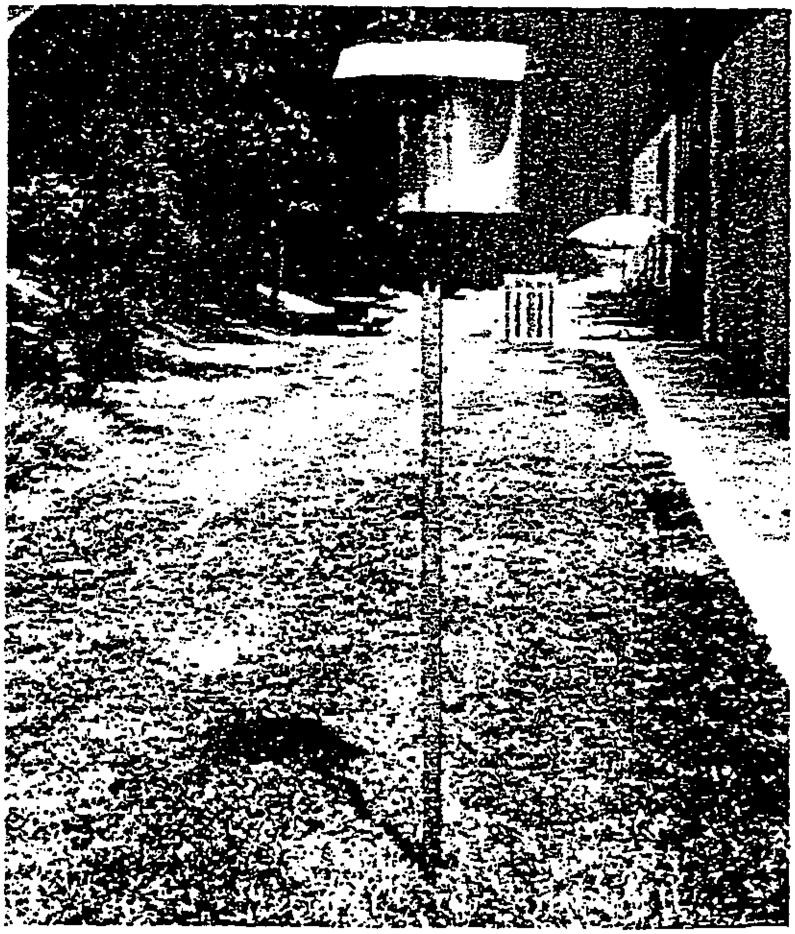
[3] Berkeley, CA, contact Susanne Hering, PhD, ph. 510-649-9360

The results of this project will also be used by the ARB to improve estimates of Californian's current in-vehicle exposures to selected pollutants, and to assess the relative contribution of in-vehicle exposure to total air exposure for these pollutants. In addition, the results may be used to identify actions that driver and passengers may take to reduce their in-vehicle exposures to air pollutants.

2. Experimental Plan

The aspect of this study specifically relevant to this encroachment application is the need to collect roadside measurements simultaneously with the in-vehicle measurements during typical 2 hour commutes. ARB would like to determine if fixed-location roadside measurements can be used as reasonably accurate predictors of in-vehicle exposures, to simplify routine monitoring. The study plan proposes a Pilot Study conducted in the Sacramento area on a selected heavily traveled freeway. A total of 4 commuting trips would be conducted over a 3 day period, consisting of 2 morning and 2 evening rush hour periods. The route would each be approximately 20 miles in length and driven repeatedly by a single heavily instrumented test sedan in both directions for 120 minutes (2 hours) to represent a commute trip. The tentatively selected route begins at the downtown Sacramento J street intersection of Highway 51 and proceeds to the Auburn Boulevard interchange on I-80 near Roseville.

During these 2 hour commuting periods we will need to set out 4 air monitoring stations on the southeast side (most probable downwind side) in the Hwy 51/I-80 right-of-way,



approximately equally spaced along the entire route. The monitor roadside locations need to be within approximately 25 feet of the edge of the outermost traffic lane. The basic aluminum monitoring shelters (see photo) are attached to 1 inch square (Unistrut) steel posts, approximately 8 feet long, that are driven into the ground up to 2 feet for support. This leaves 6 feet of the support post above the ground, to which the shelter is fastened by tightening a single bolt. The aluminum shelters are approximately 16 inches high by 16 inches wide by 8 inches deep and weigh approximately 20 pounds with the monitors. The air pollution monitors inside the shelter require no external power. The proposed pollutants will be particles, nitrogen dioxide, carbon monoxide, and volatile organic compounds. The latter organic compounds will require that a special 12 inch in diameter spherical canister (not shown in photo) be suspended just below one side of each shelter.

The experimental plan would consist of selecting the four roadside sites prior to the actual sampling, and the steel posts located and driven into the ground. Just prior to each 2 hour commuting run by the test vehicle, a technician would travel by car to each roadside location, attach an aluminum shelter with operational samplers to each post, start the samplers manually, and signal by cellular phone to begin the 2 hour commute by the test sedan. The technician is expected to be at each right-of-way location (time required to park, attach the shelter to the post, and start the samplers) less than 10 minutes per location. At the conclusion of each commute, the technician would return to each roadside location to remove the aluminum shelter, leaving the steel post for the next commute. The posts would be removed following the fourth commute.

The physical requirements of the four roadside sites are: (1) locations where Highway 51 and I-80 are proceeding in a northeasterly direction, (2) locations that are relatively unobstructed by nearby trees, (3) locations where the samplers can be within 10 to 25 feet of the roadway, and (4) locations where there is adequate space for the technician to safely pull off and park the service vehicle (rental compact sedan). The exact locations of the four roadside sites are currently being determined. Mr. Frank DiGenova of Sierra Research (916-444-6666) will provide the map copies of the four proposed roadside sampling locations to the CalTrans Encroachment Permit Engineer (Ms. Alicia Beyer; ph. 916-741-4408) to complete this application no later than February 12, 1997.

Minimal damage to the ground cover or other flora should occur as a result of the service vehicle pull off's, driving the posts into the ground, or servicing the samplers during the testing. No modifications to the roadside locations are required and no excavations will be performed.

3. Sampling Schedule

The proposed sampling schedule for the four Hwy 51/I-80 commutes would be on two selected days during the period from February 26, 1997 thru March 4, 1997. The morning 2 hr commutes would occur sometime during the interval of 6:30 to 10 AM, while the evening 2 hr commutes would occur between 3:30 and 7 PM.

Items 25,26,27,28, and 29

Charles E. Rodes, PhD, project engineer
Research Triangle Institute
P. O. Box 12194
Research Triangle Park, NC 27709
ph. 919-541-6749
FAX 919-541-6936

APPENDIX G

Accomplishments and Problem Areas for the Field Sampling Portion of the ARB In-Vehicle Exposure Pilot Study Conducted in Sacramento

Prepared by C. Rodes, D. Whitaker, M. Roberds, and L. Sheldon
Research Triangle Institute
Research Triangle Park, NC 27709
Revised 4/11/97

1. Pre-Trip Preparations (RTP)

a. Lead-Time for Equipment Design/Procedures Documentation

Successes

- All specialized equipment was designed, tested and shipped on schedule.

Problem Area

- ARB would like to see procedures/schedules/assignments prepared in more detail and one to three weeks before field sampling starts so they can review and comment.

Comment: We agree that careful planning improves both the data capture rate and the overall data quality. In some cases, however, it is not cost effective to prepare detailed documentation. Additionally, it is sometimes impossible to prepare documentation one to three weeks ahead of time. We will make every attempt to provide these documents in a timely manner for the Main Study.

b. Manpower Requirements

Successes

- The individuals and skills identified for design and testing were correct.

Problem Area

- Significantly more man-hours were required to prepare than were budgeted to modify and test the sampling hardware to maximize the probability of success.

Comment: This was partly due to (a) the request by ARB for substantial pre-field documentation that had not been budgeted, (b) discarding the originally planned ball valve Inside/Outside switching arrangement for the manifold as too cumbersome and costly, (c) re-designing the glass manifold to minimize losses, (d) the difficulty in finding an available Chevrolet Caprice matching the subcontractor's vehicle for design purposes, and (e) an underestimation of the amount of logistical pre-planning required for a study with this many elements.

2. Shipping/Receiving

Successes

- All equipment arrived intact and on time in Sacramento.
- Very few subsequent FedEx shipments were required to deliver omitted items. This was a substantial accomplishment, considering the total number of items shipped.

Problem Area

- The shipping costs appear to be much greater than was allotted.

Comment: This is attributed to two factors. To maximize the probability of successful data collection during the Pilot Study, we opted to send more spare and support items (e.g. 2 glass manifolds, extra sampling pumps) and items that would minimize down-time (e.g. extra tools). Additionally, the equipment was all 2-day FedEx to Sacramento to assure that everything would arrive on time with minimal damage. Aerosol Dynamics had determined that the fragile equipment (primarily the LAS-X required 2-day FedEx delivery to and from the field in special shipping crates (we purchased from the manufacturer) to minimize rough handling during shipment. The balance of the equipment could possibly have been returned to RTP by (cheaper) conventional freight, but it would have added an additional field day to arrange.

3. General Logistics

a. Field Manpower Requirements

Successes

- In general the allocated manpower was adequate to reach the percent sample capture goal (7 out of 8), although the on-site personnel worked long hours to make the Pilot Study sampling successful.

Problem Areas

- The sampling days were far longer (14 to 16) than the expected hours (12 to 14) on the days with both morning and evening commutes.
- The assistance of ARB personnel (Steve and Peggy) were used to assist in collection of the Ambient site samples.

Comment:. The number of RTI personnel on-site was adequate to cover the study - if very few problems had arisen. The problems encountered with (a) accessing the subcontractor's car for setup, (b) dealing with the inadequate power problems in the car, and (c) requiring very close start and end times for all the roadside sites required substantially more time than had been allotted each day. Although most of the hardware and procedures have now been defined, the ability to do both morning and an evening commutes with such a full schedule of sample and data collection in the Main Study with only 2 full time site operators must be reviewed.

b. Interfacing with Subcontractors

Successes

- In general the on-site personnel (RTI, Sierra and AD) worked well together, with everyone demonstrating the initiative and dedication required to produce a successful field effort.

Problem Areas

• Access to the Sierra car proved problematical since it could not be left on-site (at the motel) in the evening and could not be driven by RTI personnel.

Comment: The access of RTI personnel (driving, if necessary, and overnight access) should have been a requirement. These items must be addressed for the Main Study.

• Sierra personnel who brought over car were sometimes stranded at the motel.

Comment: The utility/training of the Sierra personnel (driver & navigator) during setup and takedown should be reviewed prior to the Main Study to determine how best to use their time.

• Orientation and training of the Sierra personnel to assist in some of the setup/takedown activities was very limited, since the key RTI personnel were diverted to solving unexpected logistical and power problems.

Comment: A sufficient amount of time must be allotted prior to the Main Study for study participant orientations and training.

• Training of the Sierra personnel to assist in some of the setup/takedown activities was complicated because two different teams were used.

Comment: The number of study participants must be defined prior to the Main Study and the training requirements identified.

c. **Schedules/Assignments (Daily and Project)**

Successes

• In general the sampling schedules were comprehensive, such that no samples were lost due to omissions or assignment problems.

Problem Area

• Daily routine (morning and evening rush hour sampling in same day was too time consuming with the complex Pilot Study sampling scheme and total number of samples collected.

Comment: The desire to collect data (e.g. relate roadside sampling) at the same time that the methods were being tested and revised proved to be overwhelming. It would have been preferable to have had a lighter AM commute, followed by an intensive PM commute.

d. **Ambient Site Sampling**

Successes

• After-hours access to the ARB monitoring site was successfully arranged by Steve Hui and Peggy Jenkins.

Problem Area

• The duplicate PAH pumps failed to operate in both attempts. The reasons are still not clear, but appear to be associated with the pump timer.

e. **Roadside Sampling**

Successes

- The team of 2 persons doing setup/takedown of the sampler provide acceptable start- and end-time windows, as compared to the Inside car samplers.

Problem Areas

- The added burden of two persons leaving the starting point early (to meet the ±10 minute set-out window) to set up these sites instead of one, placed an added burden on the setup process.

  Comment: This Roadside monitoring sample collection scheme should be reviewed to determine how it could have been optimized.

- The requirement to return to the Roadside and Ambient sites after 1 hour to switch the NO_2 tubes was very time consuming.

  Comment: A timer and switching valve will be devised for the Main Study to remove the requirement for a mid-sampling return visit.

f. **Inside/Outside Car Sampling**

Successes

- The equipment rack fit well and the outside sampling manifold and computer-controlled switching valves worked well.

Problem Areas

- Testing showed that the Teflon line planned for outside sampling produced significant particle losses as compared to a polyethylene line.

  Comment: The Teflon line was replaced with a polyethylene line prior to the start of sampling to accommodate the particle loss findings. The potential impact on NO_2 losses was not defined.

- The myriad of sampling lines inside the car required careful attention (and slowed the pace) to assure that the correct samples and pumps were connected.

  Comment: Sampling connections should have been modular quick-connects to speed setup and minimize mix-ups.

- The current design of the rack system makes simultaneous access by two operators impossible.

  Comment: If the continuous monitors are to be used in the Main Study (a strong possibility) the rack should be redesigned so that the continuos monitors can be setup simultaneously with the integrated samplers.

- The video camera and some of the sampling inlets vibrated significantly on their rack mounts.

  Comment: Vibration damping must be added to the rack support points prior to the Main Study.

g. **Time Synchronization**

Successes

- The LAS-X data system recording flags of 0 (inside) and 1 (outside) during data collection greatly simplified the identification of sampling modes.

Problem Areas

- The Aethalometer data proved cumbersome to match with the LAS-X data, since its results were recorded on a separate data system.

  Comment: Consideration should have been given to merging the Aethalometer output into the LAS-X data system..

- The synchronization of Roadside and Ambient sampling with the In-Vehicle sampling proved difficult.

  Comment: It is still not clear how closely these sampling time windows should coincide.

- The synchronization of video with the In-Vehicle sampling proved difficult.

  Comment: The video clock and the on-board computer clock should be made to agree within 10 seconds.

h. **Communications**

Successes

- The communications between operators and with the Sierra car (in-transit) worked well with the cellular phones.

Problem Areas

- The planned sit-down all-hands meeting was never held so that major sampling problems could be resolved within the demanding time schedule.

  Comment: This meeting should definitely be scheduled for the Main Study in both locations to make sure that the important elements of logistics and training are understood by all participants.

- The ability to contact the Sierra driver and navigator was problematical when a decision was made late in the evening concerning a revisions of the sampling schedule for the morning commute.

  Comment: Home phone numbers should have been collected.

4. **Work Spaces**

a. **Motel**

Successes

- The location of the motel at the end of the commute run was time efficient.

• The large room used as a set/drylab/storage area worked well for both sampling preparation and filter weighing.

Problem Area

• The added expense of a third room for the entire 10 days (Charles used the room for only 5 days) was not budgeted.

Comment: It order to maximize the probability of the filter weighing providing the desired MDL, we opted to keep the larger room because of its lack of drafts and apparent temperature and humidity control.

• [Potential Problem] If rain had occurred, the In-Vehicle setup would have been very difficult without.

b. **Inside Car**

Problem Areas

• The accessibility of the back-seat rack for setup and takedown for both the ambient and continuous samples and data was inadequate.

Comment: Almost nothing on the rack was accessible from the front seat and the backseat access was very limited.

5. **Filter Weighing**

a. **Temperature/Humidity/Stability**

Successes

• The temperature and humidity control provided by the room HVAC system was completely adequate for the weighing process.

Problem Areas

• The drafts caused by the cold air leaking in through the sliding glass door affected the zero stability of the balance.

Comment: The drafts required that a 3-sided box be built around the balance (from a cardboard box).

b. **Time Requirements**

Successes

• The pre-weighing and post-weighing were accomplished completely on their individual days.

Problem Area

• The addition of the zero recheck in the balance software to assure that the room conditions were adequately dealt with by the balance, significantly extended the total pre- and post-weighing periods.

Comment: At least 1/3 of the weighings had to be repeated. It's isn't clear why the balance worked well the other 2/3's of the time, but the re-weighings undoubtedly improved the overall weighing precision.

6. Particle Inlet Preparation

a. Work Space Requirements

Successes

- The inlet loadings and unloadings were readily accommodated on the small table in the motel room.

Problem Areas

- none

b. Time Requirements

Problem Area

- The PM_{10} inlet clamp that was shipped to Sacramento would not readily accommodate the taller $PM_{2.5}$ inlets.

Comment: A replacement clamp was FedExed overnight from RTP.

c. Leaks

Problem Area

- The leak problems caused by improperly located sealing rings inside the $PM_{2.5}$ caps caused intermittent leak test problems.

Comment:. Typically 2 out of 8 of the $PM_{2.5}$ inlets required reloading after the leak testing. Attempts to re-position the gaskets in the field were only partially successful. The intermittent leaks caused some erratic flow checks (took longer to setup/takedown) and some samples to be seriously under-collected.

d. Filter Numbering System

Problem Area

- The number system adopted to readily identify field blanks and duplicates was too complicated for such an intensive study.

Comment:. Correction of missed-assignments added time to the setup that was unnecessary.

7. Calibrations/Checks

a. Particle Sampler Flows

Successes

- Pumps maintained the flowrate within limits, except for one marginal case that appears to be attributed to a leaking inlet rather than a pump problem.

- In general the samplers and flow controllers worked as expected, with battery consumption being low and requiring to changes during the Pilot Study.

Problem Areas

- The flow adjustment on the pumps proved impossible to access on the units in the car.

Comment: An external adjustment is being considered.

- A 4 lpm orifice should be developed for the $PM_{2.5}$ units.

Comment: The available 2 lpm orifice took twice as long to check the parallel pumps used for $PM_{2.5}$.

b. **NO_2 Tube Flows**

Successes

- Pumps maintained the flowrate within limits.

Problem Area

- Unable to check or switch tubes in the car during a commute.

Comment: Either a timer or a remote solenoid switching system are needed for the car, Roadside and Ambient sites.

c. **PAH Sampler Flows**

Successes

- Pumps maintained the flowrate within limits.

Problem Areas

- The current design makes it impossible to check the flows with the cartridges in place.

Comment: A redesign is being considered.

- The Ambient site duplicate pumps inexplicably did not function in either run.

d. **Multi-sorb tube pumps**

Successes

- Pumps maintained the flowrate within limits.

Problem Areas

- The pumps used were at the lower extreme of their capability.

e. **CO Zeros/Spans**

Successes

- The units calibrated within limits.

Problem Areas

- none

f. In-Car Manifold Loss Testing

Successes

- The losses in the Teflon line were evaluated as compared to a polyethylene line and no line (simulating the Inside sampling).

Problem Area

- This was an unplanned test that was conducted after a group discussion on the potential for excessive static charge losses in the Teflon material.

Comment: The losses for the Aethalometer were inadvertently not determined at the same time. The use of polyethylene may have been somewhat detrimental to NO_2 collection.

8. Battery Charging

a. NO_2 pumps

Successes

- The batteries charged as planned.

Problem Areas

- None

b. PAH pumps

Successes

- The battery inverter/charger system worked well.

Problem Areas

- None

c. Multi-sorb tube pumps

Successes

- The batteries charged as planned.

Problem Areas

- None

d. Aldehyde pumps

Successes

- The batteries charged as planned.

Problem Area

- Only one pump stopped prematurely, when it was discovered that the charger had be set in the wrong (trickle) mode.

8. Data Collections

a. **LAS-X**

Successes

- After the power problems were resolved, the LAS-X appeared to work well.

Problem Area

- The LAS-X requires a much more stable inverter output than was available.

Comment: Several inverters were tested at RTP on a different LAS-X before one was found (and shipped FedEx overnight) that would successfully operate the unit in the car.

- The training time on both the LAS-X and (especially) the Aethalometer were too short, and start-up/shut-down check lists should have been available in writing to streamline the processes (although no data appears to have been lost due to improper operations).

b. **Aethalometer**

Successes

- The Aethalometer appeared to work well and review of a data file sent by Steve Hui to the manufacturer showed no problems.

Problem Areas

- The setup menu to start the sampling was very cumbersome..

Comment: If the Aethalometer is to be used in the Main Study, it would be very helpful if a "quick-start" menu option could be added.

- The collected data file did not have an entry for each minute.

Comment: This made it very difficult to match with the LAS-X. When the tape advances (or for any other non-sampling reason) the data logger should store 9999 or some other code to indicate no data available.

c. **Temperature/Humidity (Car & Weighing)**

Successes

- The loggers worked well.

Problem Areas

- The weighing logger was read by inadvertently not dumped after the initial weighings.

Comment: The operating protocol needs revision.

d. **Air Exchange Rate (AER)**

Successes

- The CO release method worked reasonably well.

Problem Areas

- The higher than expected AER values for the car required using higher than would have been desired initial CO concentrations to stay within the lower limit (1 ppm) of the CO monitor and collect enough points to construct a decay curve.

- The CO release method does not provide integrated AER data representing the composite AER existing for each 120 minute commute.

e. **Manual Data Entry (Forms)**

Successes

- The prepared forms worked well in identifying what was to be collected and when.

Problem Areas

- Some streamlining is needed to clean up the spreadsheets (e.g. no PM_{10} was collected Outside).

- The sheer volume of forms to be completed and checked significantly increased the length of the day (evenings).

f. **Data File Backups**

Successes

- All hard drive data files were backed by floppy drive copies.

Problem Areas

- none

9. Sample Collections

a. PM2.5/PM10 Particles

Successes

- No samples appear to have been lost due to sampling problems.

b. **VOC canisters**

Successes

- No samples appear to have been lost due to sampling problems.

Problem Area

- The inherent flow drop due to reduced vacuum at the end of each sampling period may prove difficult to address.

Comment: An alternative orifice may be needed for the Main Study.

c. **Multi-Sorb Tubes**

Successes

- No samples appear to have been lost due to sampling problems.

Problem Areas

- A special tube holder inside the car is needed to keep them in place during the commutes.

d. **NO_2 Tubes**

Successes

- No samples appear to have been lost due to sampling problems.

Problem Areas

- The procedure for switching tubes after 1 hour must be addressed.

e. **Aldehyde Tubes**

Successes

- No samples appear to have been lost due to sampling problems.

Problem Areas

-

f. **PAH filters**

Successes

- No regular samples appear to have been lost due to sampling problems

Problem Areas

- The two duplicate samples were lost due to pump timer failures.

10. Sample Storage/Transfer

Successes

- All samples were stored according to their protocols (refrigerator/freezers were available in the motel rooms).
- All samples were successfully hand-carried back to RTP following a chain-of-custody procedure.

Problem Areas

- None

11. Samplers/Hardware Maintenance/Repairs

Successes

- Only minor problems occurred and all were resolved immediately.

Problem Areas

- None

APPENDIX H

Inside, Outside, Roadside & Ambient Site Mass Concentrations

PM2.5 (blank corrected)								
Date	Run	R1	R2	R3	R4	A	I	O
2/26	1	na	na	na	na	58.5	35.4	52.5
2/26	2	na	na	na	na	34.1	63.5	23.8
2/27	1	14.6	14.9	44.3	35.2	6.0	36.3	56.4
2/27	2	27.8	23.4	18.6	6.2	56.4	15.9	44.5
2/28	1	42.9	39.5	22.6	51.1	9.3	27.7	48.9
3/1	1	na	na	na	na	30.6	24.1	13.3
3/3	1	25.7	34.6	void	31.1	54.5	32.3	9.4

Shaded cells indicate that an internal leak was suspected

PM10 (blank corrected)								
Date	Run	R1	R2	R3	R4	A	I	O
2/26	1	na	na	na	na	45.6	63.0	na
2/26	2	na	na	na	na	237.7	76.0	na
2/27	1	53.3	61.8	70.6	78.5	75.1	70.7	na
2/27	2	112.7	72.8	20.9	78.8	48.7	32.8	na
2/28	1	101.2	61.5	78.2	61.3	-18.4	53.6	na
3/1	1	na	na	na	na	28.0	18.4	na
3/3	1	19.5	19.8	62.7	96.2	27.4	84.1	na

Testing that PM2.5 is < PM10								
Date	Run	R1	R2	R3	R4	A	I	O
2/26	AM	--	--	--	--	<10 MQL	ok	--
2/26	PM	--	--	--	--	ok	ok	<2.5 MQL
2/27	AM	<2.5 MQL	<2.5 MQL	ok	ok	<2.5 MQL	ok	--
2/27	PM	ok	<2.5 MQL	<2.5 MQL	<2.5 MQL	<10 MQL	<2.5 MQL	--
2/28	AM	ok	ok	<2.5 MQL	ok	<2.5 MQL	ok	--
3/1	midday	--	--	--	--	<10 MQL	<2.5 MQL	<2.5 MQL
3/3	AM	<10 MQL	<10 MQL	>	ok	<10 MQL	ok	<2.5 MQL

Shaded cell indicates PM2.5 is greater than PM10 and both values are above the MQL's

APPENDIX I

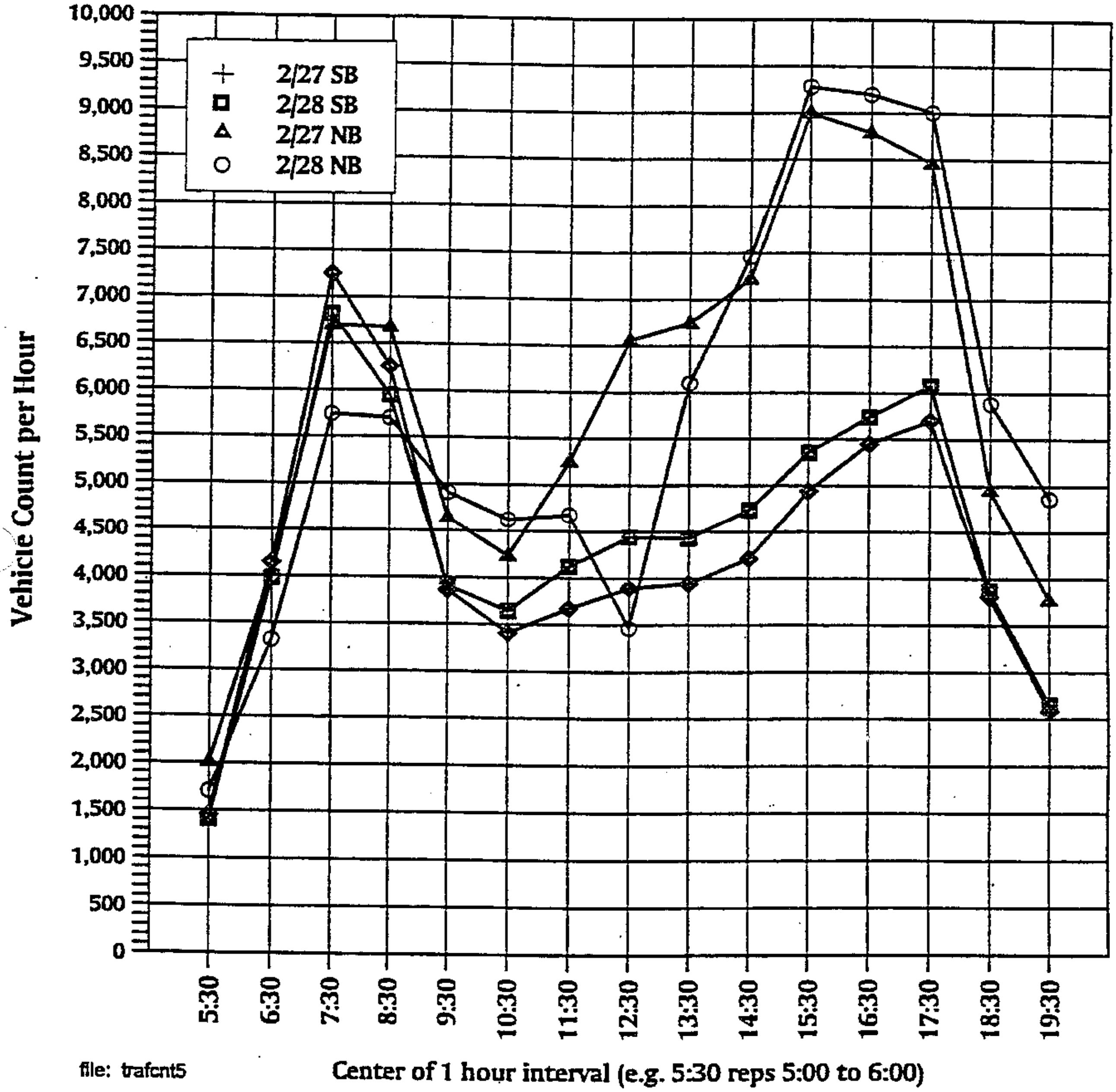
Background VOCs in Sedan 1
"Grab" Sample - Pilot Study - Sacramento

Analyte	Concentration ($\mu g/m^3$)
1,3-Butadiene	BDL[a]
MTBE	BDL
ETBE	BDL
Toluene	4.4
o-Xylene	1.1
m,p-Xylene	2.6
Benzene	NA[b]

[a]BDL = below detection limit
[b] Not Analyzed

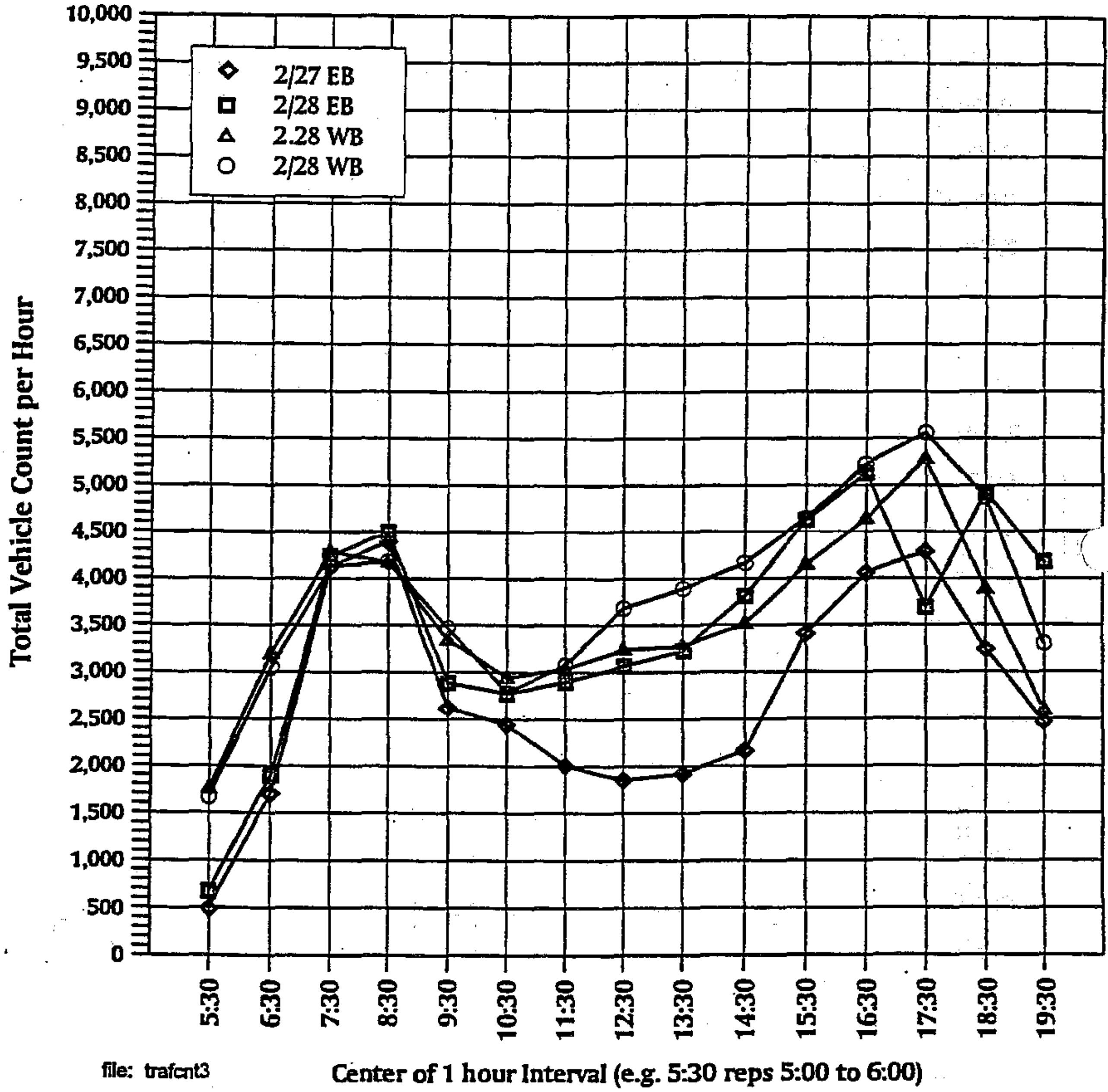
APPENDIX J

I 5 at I-Street
East and Westbound Traffic Count



file: trafcnt5

Bus. 80 at Junction w/ Highway 50
East and Westbound Traffic Count



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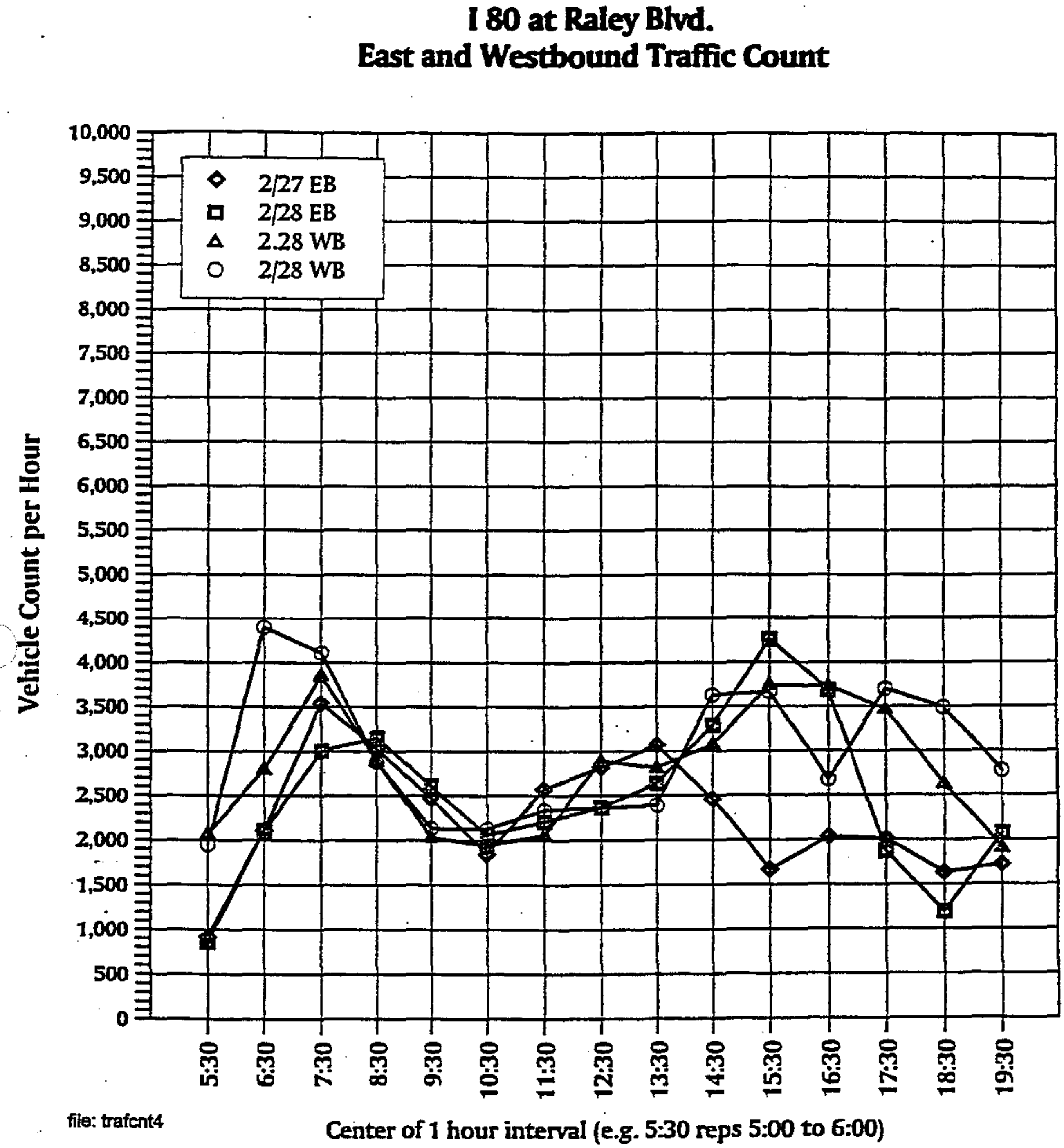
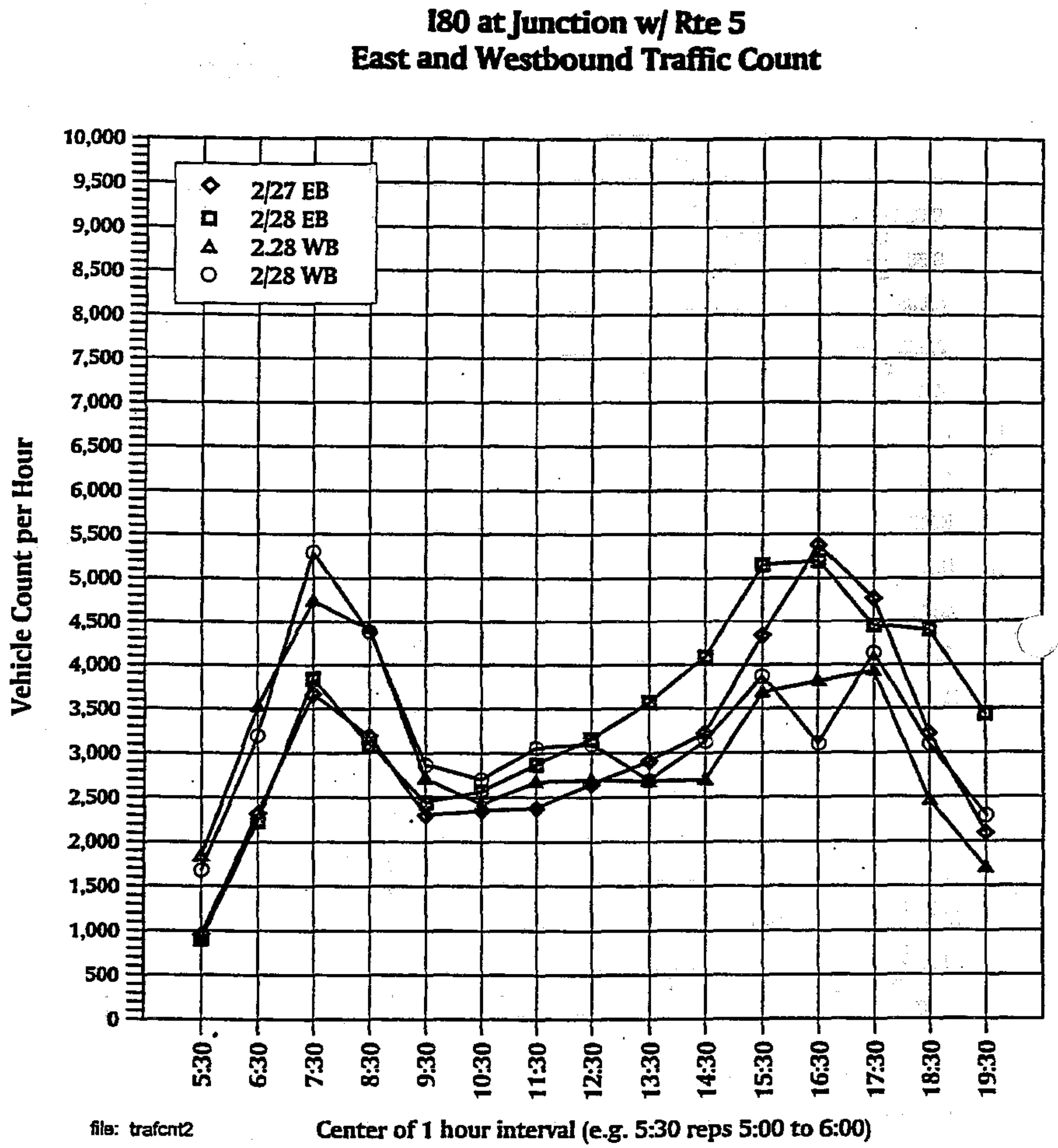


I 80 at Raley Blvd.
East and Westbound Traffic Count
2/27 EB
2/28 EB
2.28 WB
2/28 WB
Vehicle Count per Hour
10,000
9,500
9,000
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
5:30
6:30
7:30
8:30
9:30
10:30
11:30
12:30
13:30
14:30
15:30
16:30
17:30
18:30
19:30
file: trafcnt4
Center of 1 hour interval (e.g. 5:30 reps 5:00 to 6:00)


180 at Junction w/ Rte 5
East and Westbound Traffic Count
Vehicle Count per Hour
10,000
9,500
9,000
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2/27 EB
2/28 EB
2.28 WB
2/28 WB
5:30
6:30
7:30
8:30
9:30
10:30
11:30
12:30
13:30
14:30
15:30
16:30
17:30
18:30
19:30
file: trafcnt2
Center of 1 hour interval (e.g. 5:30 reps 5:00 to 6:00)

Appendix B

ARB Fuel Analysis Results

Appendix B : Fuel Analysis Results

During the main study, field staff collected samples of the gasoline that they used to refuel the test vehicles. The purpose of the sample collection was to find out whether the content of the important oxygenate and aromatics in the gasoline were in normal concentration ranges. The samples were sent to the Air Resources Board for chemical analysis. The analysis was performed for four chemicals: MTBE, benzene, toluene, and *m,p*-xylene. The results of the analysis are listed in the table below. Based on the results, the mass percentage of these fuel chemicals in all the samples were within the normal range. Therefore, the fuel used to power the test vehicles for this study should not have an above-normal impact on the air measurements of these chemicals inside or just outside the vehicles.

Test Vehicle Fuel Content Analysis
(Mass %)

City	Vehicle	Sample date	MTBE	Benzene	Toluene	m,p-Xylene
Sacramento	Caprice	9/8/1997	11.39	0.74	6.51	6.43
	Caprice	9/10/1997	10.18	0.73	7.12	5.10
	Caprice	9/12/1997	10.98	0.78	5.87	5.87
	Caprice	9/13/1997	10.65	0.76	8.46	5.91
	Taurus	9/10/1997	10.14	0.73	7.13	5.09
	Taurus	9/12/1997	10.95	0.77	5.88	5.88
	Taurus	9/13/1997	10.64	0.76	8.48	5.80
Los Angeles	Caprice	9/24/1997	11.51	0.80	6.27	6.06
	Caprice	9/26/1997	11.28	0.67	3.41	4.12
	Caprice	9/28/1997	11.28	0.66	3.45	3.94
	Caprice	9/30/1997	11.35	0.67	3.41	4.24
	Caprice	10/1/1997	11.28	0.68	3.42	4.14
	Explorer	9/26/1997	11.23	0.68	3.41	4.02
	Explorer	9/28/1997	11.30	0.67	3.44	4.19
	Explorer	9/29/1997	11.32	0.67	3.41	4.18
	Explorer	10/1/1997	11.25	0.66	3.31	4.04

Appendix C

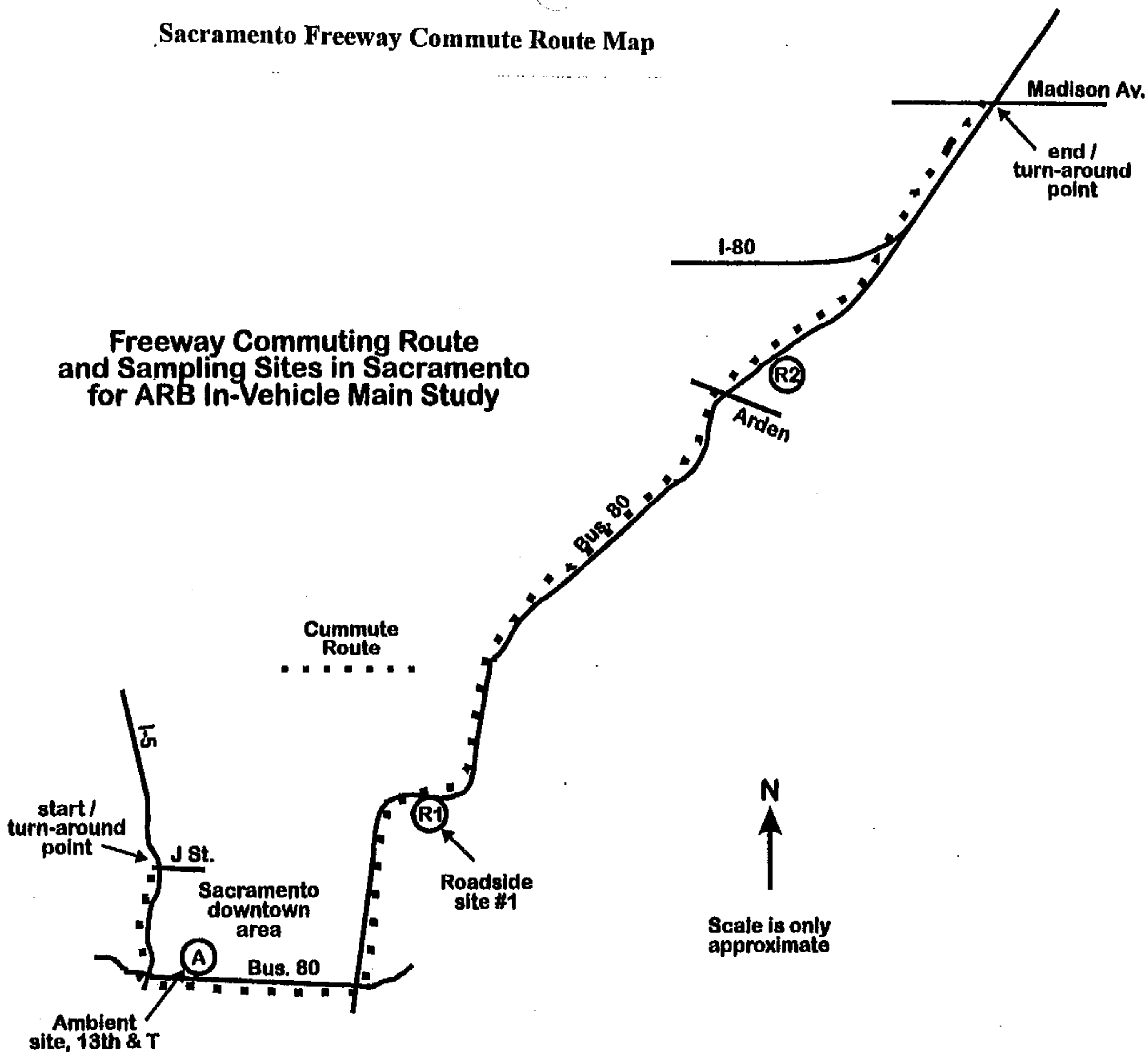
Commute Routes; Roadside and Ambient Site Locations

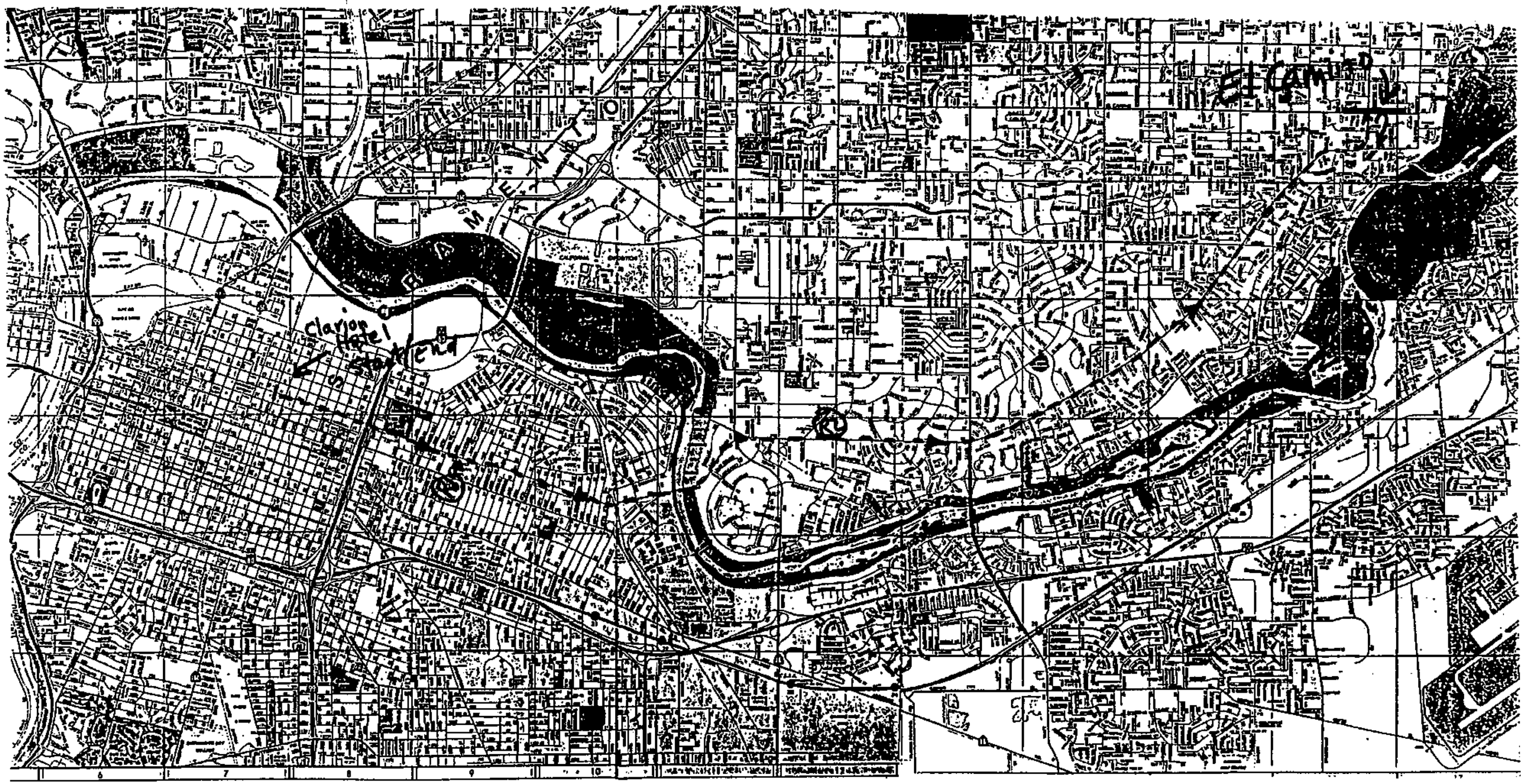
- Sacramento Freeway Commute Route Map
- Sacramento Arterial Commute Route Map
- Sacramento Rural Commute Route Map

- Los Angeles Freeway Commute Routes Map
- Los Angeles Arterial Commute Routes Map

- Roadside and Ambient Site Locations for Sacramento and Los Angeles

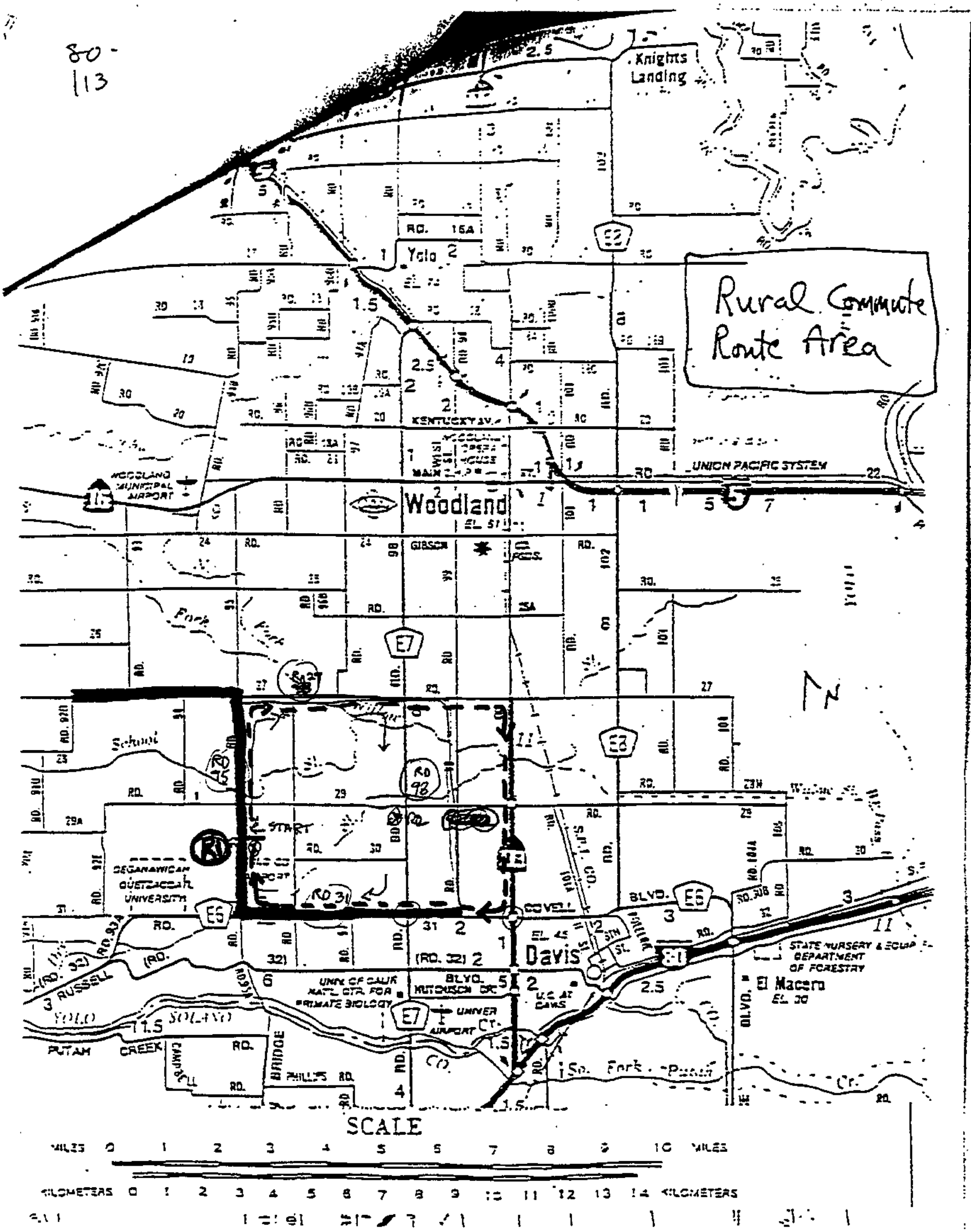
Sacramento Freeway Commute Route Map



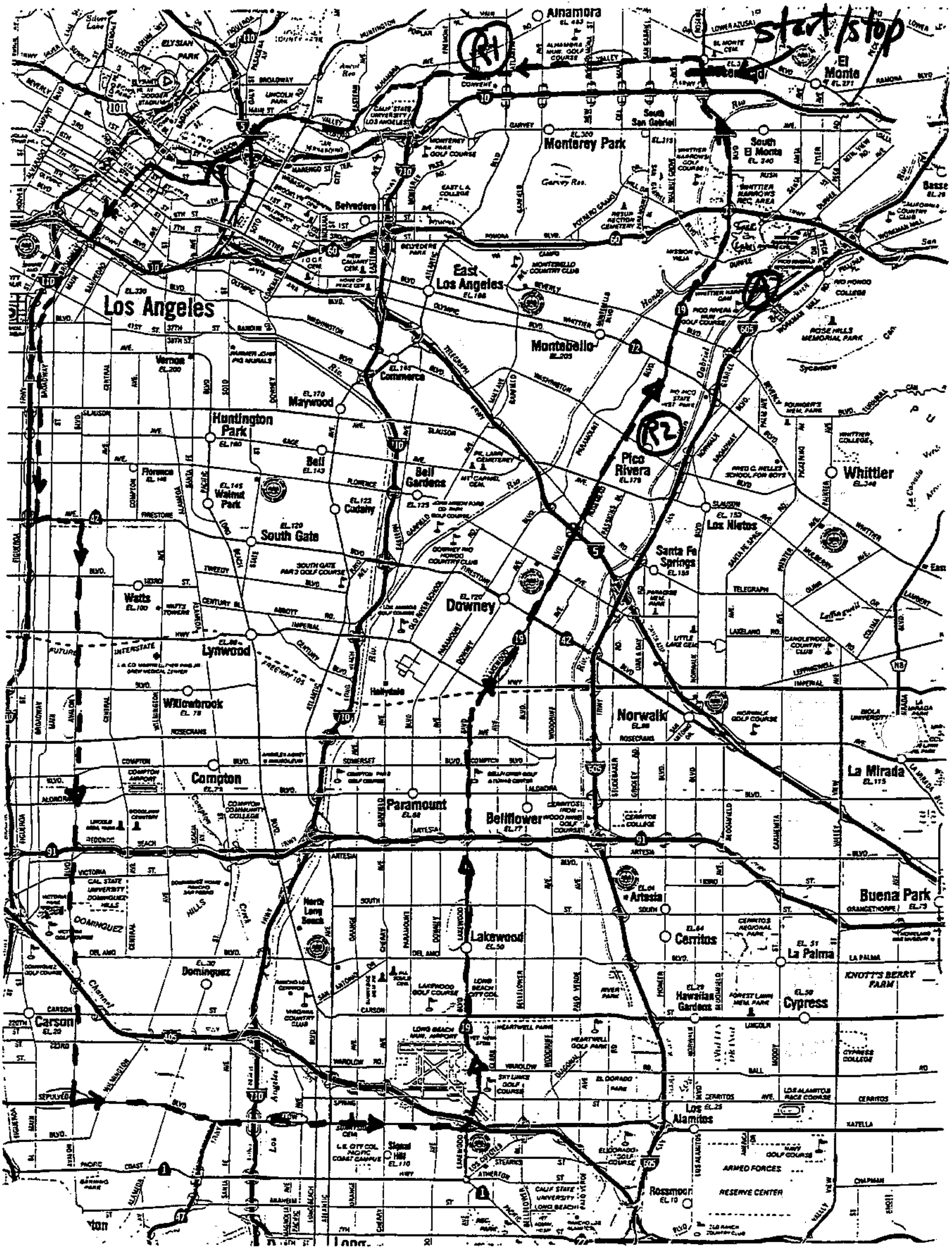


Sacramento Arterial Commute Route Map

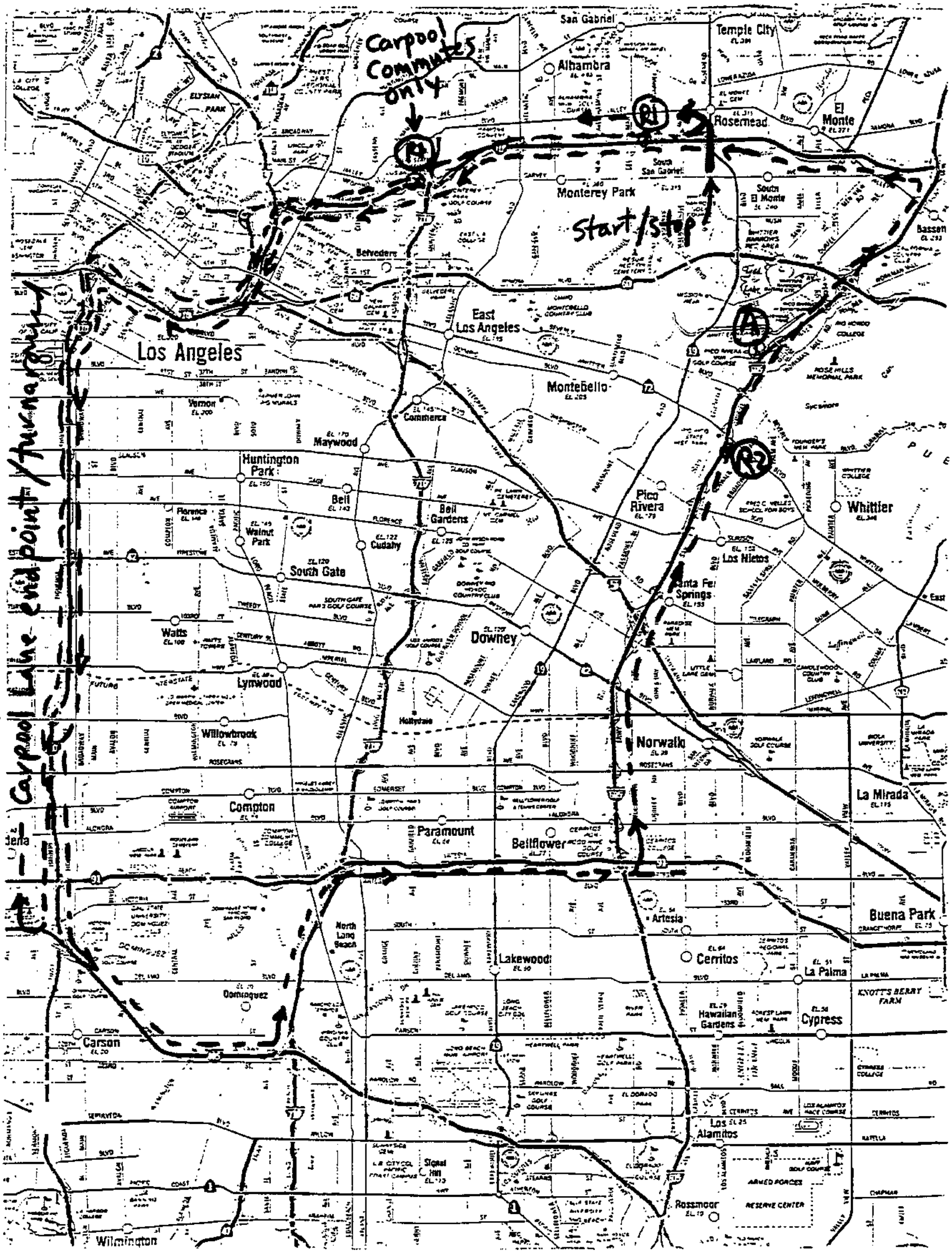
80-113



Sacramento Rural Commute Route Map



Los Angeles Arterial Commute Routes Map



PM direction shown

Los Angeles Freeway Commute Routes Map

ROADWAY and AMBIENT SAMPLING SITE LOCATIONS FOR EACH COMMUTING ROUTE

Sacramento - Freeway Roadside sites:

1. R1- (same as Pilot Study R1) located on the south side of Bus. 80 freeway, approx. 2/3's of the distance northbound from the A St. overpass to the railroad bridge overpass, approx. 15 feet from the edge of the roadway.
2. R2- (same as Pilot Study R3) located on the south side of Bus. 80 freeway, between Auburn Ave. and the freeway, approx. 2/3's of the distance northbound from the Marconi overpass to the (non-connecting) intersection of Howe Ave. and Bus. 80, approx. 15 feet from the edge of the roadway.

Sacramento - Arterial Roadside sites:

1. R1- Located at 38th and J Street. In front of NOVA Care Medical Building - 3800 J Street. Approximately 2 ft from street on south side.
2. R2- Located in the 2300 block of Fair Oaks Blvd. across from Kaiser Permanente Medical Offices sign. Located on traffic island approximately 4 ft from road on north side..

Sacramento (Davis) - Rural Roadside sites:

1. R1 - Located on east side of SR 95 at fire station, approximately 15 ft from road.
2. R2 - Located on west side of SR 98 approximately 1/4 to 1/3 mile south of SR 29, approximately 15 ft from road.

Sacramento - Ambient Site (same for arterial, school bus and freeway tests):

ARB 13th and T St. monitoring site (A on map)

Los Angeles- Freeway tests - Roadway sites:

1. R1- On I-10 W Between San Gabriel Blvd. and Delmar Av. Adjacent to call box 10-257
2. R2- On I-605 N at Whittier Blvd., just past the exit ramp off of I-605 N to Whittier Blvd.

Los Angeles Carpool tests - Roadway sites:

1. R1- Same as above.
2. R2- On I-10 W just past the I-710 exit, adjacent to call box 10-213.

Los Angeles Arterial tests - Roadway sites:

1. R1 - Located at 1749 Valley Blvd. near intersection of Valley and Campbell. Approximately 3 ft from road between sidewalk and street on north side of Valley Blvd.
2. R2- Located at 7246 Rosemead Blvd., in Pico Rivera, in front of Colonial Gardens Nursing Home, approximately 8 ft from street on east side of Rosemead Blvd.

Los Angeles - Ambient Site (same for arterial, carpool and freeway tests):

Pico Rivera South Coast monitoring site (A on map) - 3713 San Gabriel River Parkway

Appendix D

Comparison of Study $PM_{2.5}$ Samplers with EPA Reference Method

- Comparison Study Report
- Graphical Comparison of RTI vs EPA FRM $PM_{2.5}$ Sampler Data
- RTI $PM_{2.5}$ Inlet Comparison with EPA $PM_{2.5}$ Federal Reference Method Requirements

RESEARCH TRIANGLE INSTITUTE

RTI

August 29, 1997

Peggy Jenkins, Manager
Indoor Exposure Assessment Section
Research Division
California Air Resources Board
2020 L Street
Sacramento, CA 95814
ph. 916-323-1504
FAX 916-322-4357

Peggy,

Attached is the data and a brief summary report for the leak test/field evaluation of the eight refurbished $PM_{2.5}$ inlets that were used in the Pilot Study. We revised the manual leak test procedure, showed that all inlets passed the test, and (more importantly) demonstrated an excellent collocated precision and accuracy under field conditions.

The revised leak test procedure uses a modified pump that applies a maximum of 12 inches of water across the inlet (rather than running the pump uncontrolled at ~3 inches of Hg). The normal pressure drop across the filter is only 2 to 3 inches of water. Adding too much vacuum potentially can distort the internal seals and was not a realistic test. The procedure has been added to the Field Operations manual.

We followed the experimental plan FAXed earlier, using collocated field exposures for 4 and 8 hour periods. The results are described in the summary. The test also demonstrated the performance of the new 4 LPM pumps and flow controllers to be used in the Main Study.

Sincerely,

Charles E. Rodes, PhD
Senior Research Environmental Engineer
Center for Engineering and Environmental Technology

cc: Steve Hui, ARB
Linda Sheldon, RTI

Summary of Results

$PM_{2.5}$ MSP Inlet Leak Tests Prior to the ARB In-Vehicle Main Study

The sample flow and concentration results for the leak test field evaluation of the eight 4 LPM $PM_{2.5}$ MSP inlets are summarized in the attached tables. The first table summarizes the results of the (revised) leak tests and the flow control during the 4 hour and 8 hour test periods. The second table describes the filter collections and mass concentrations, and provide comparison data showing collocated $PM_{2.5}$ reference impactors operated simultaneously for the same period using EPA samplers. Salient Observations and Recommendations for the Main Study follow:

<u>Flowrate Data</u>

• Observation: All inlets were observed to have visibly appropriate sealing surfaces and subsequently *all <u>passed</u> the leak test* procedure applied to every inlet prior to being used in the field sampling.

Recommendation: The inlets seal adequately and the revised leak test is acceptable.

• Observation: All mean flowrates were well within 5% of the nominal 4.0 LPM inlet flowrate.

Recommendation: Flow control was acceptable.

• Observation: The pump stopped pre-maturely on 1 of 16 samples, traced to an internal set-screw loosening on the motor shaft.

Recommendation: Check the internal set-screws on all Main Study pumps prior to shipment {Done}

<u>Mass Collection Data</u>

• Observations: For the 6 acceptable filter samples for the 4-hour collocated inlet field comparison, the mean concentration was 10.9 $\mu g/m^3$, the standard deviation was $\pm$ 2.3 $\mu g/m^3$, and the coefficient of variation was 21.0 %. For the 3 EPA samplers operating at the same time, the mean concentration was 12.8 $\mu g/m^3$, the standard deviation was $\pm$ 1.3 $\mu g/m^3$, and the coefficient of variation was 10.0 %. The EPA sampler operated at 16.67 LPM. The MSP results are excellent, considering the extremely low ambient concentration level encountered during the testing (even lower than was observed in Sacramento during the Pilot Study). The MSP standard deviation was only 1 $\mu g/m^3$ poorer than the much higher flowrate EPA samplers. Assuming the EPA samplers were correct, the MSP accuracies were excellent.

Recommendation: The modified MSP inlets are acceptable for use in the Main Study.

• Observation: Two of the sampled filters (and one of the field blanks) were visibly contaminated with large black fibers on the <u>back sides</u> of the filters. This suggested that the filters picked up material from contact with other surfaces. The most obvious source of the fibers was the Mettler balance brush used to sweep clean debris from the balance pan prior to weighings.

Recommendation: Clean room pressurized air canisters will be used during weighings and inlet preparation to blow (clean) the balance pan and the inlet filter support screens to minimize contact contamination.

• Observation: For the 7 acceptable filter samples for the 8-hour collocated inlet comparison, the mean concentration was 16.3 $\mu g/m^3$, the standard deviation was $\pm$ 1.5 $\mu g/m^3$, and the coefficient of variation was 9.0 %. For the 2 EPA samplers operating at the same time (one failed to operate properly), the mean concentration was 15.2 $\mu g/m^3$, the standard deviation was $\pm$ 1.0 $\mu g/m^3$, and the coefficient of variation was 6.6 %. The larger total collection averaging 31 µg significantly improved the precision. The MSP standard deviation was only 0.5 $\mu g/m^3$ poorer than the much higher flowrate EPA samplers. Assuming the EPA samplers were correct, the MSP accuracies were excellent.

Recommendation: The modified MSP inlets are acceptable for use in the Main Study.

• Observation: Incorporating the filter blank weight changes appeared to bring the MSP concentration data almost exactly in agreement with the EPA reference samplers.

Recommendation: The mean field blank changes should be incorporated into a correction of the filter tare weights (as applied during the Pilot Study), if the corrections are greater than 2 µg.

C. Rodes, RTI, 8/25/97

ARB In-Vehicle Exposure Study

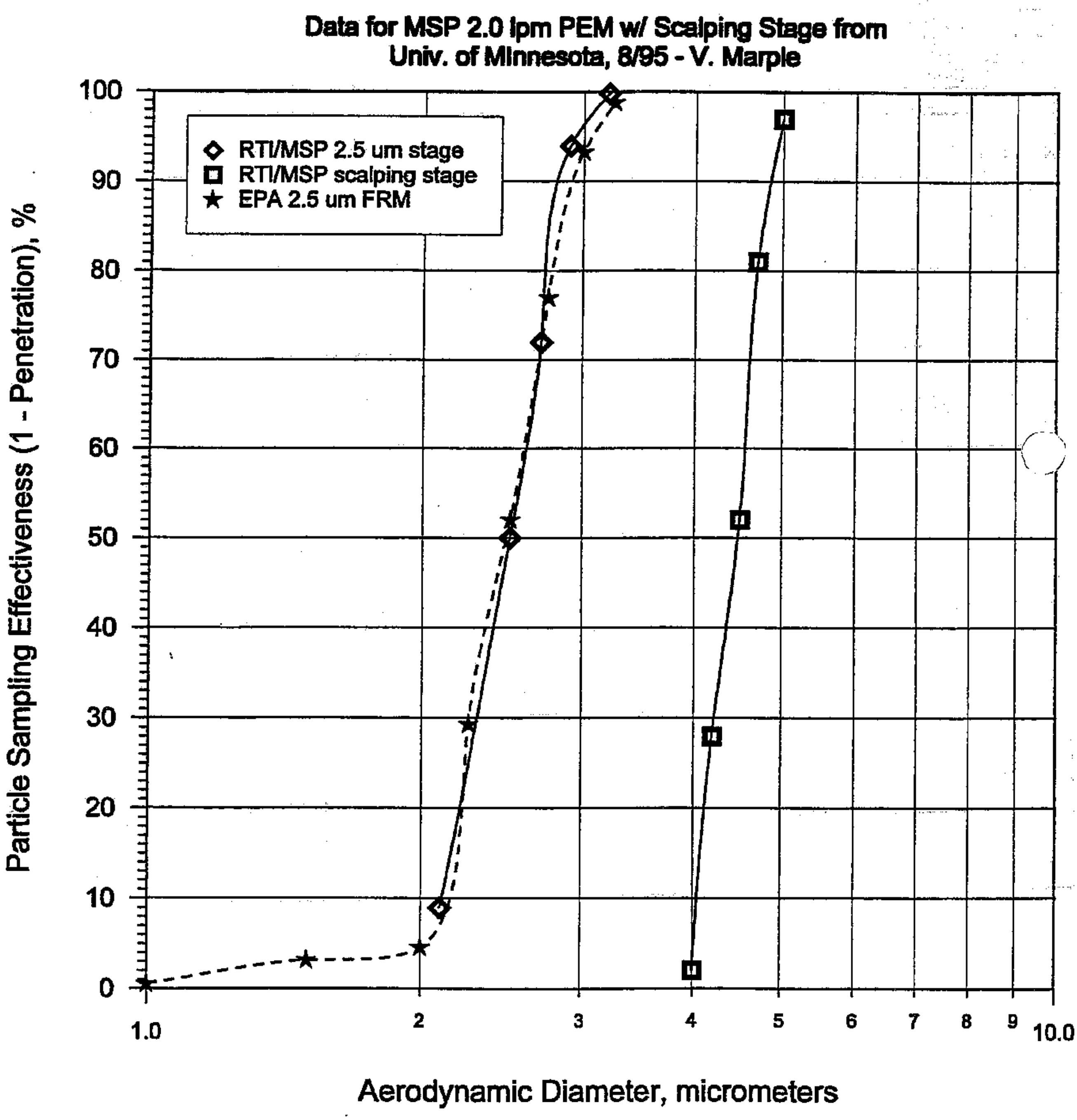
Leak Test - Reproducibility Evaluation of 4.0 LPM MSP PM2.5 Inlets

Flowrate Data

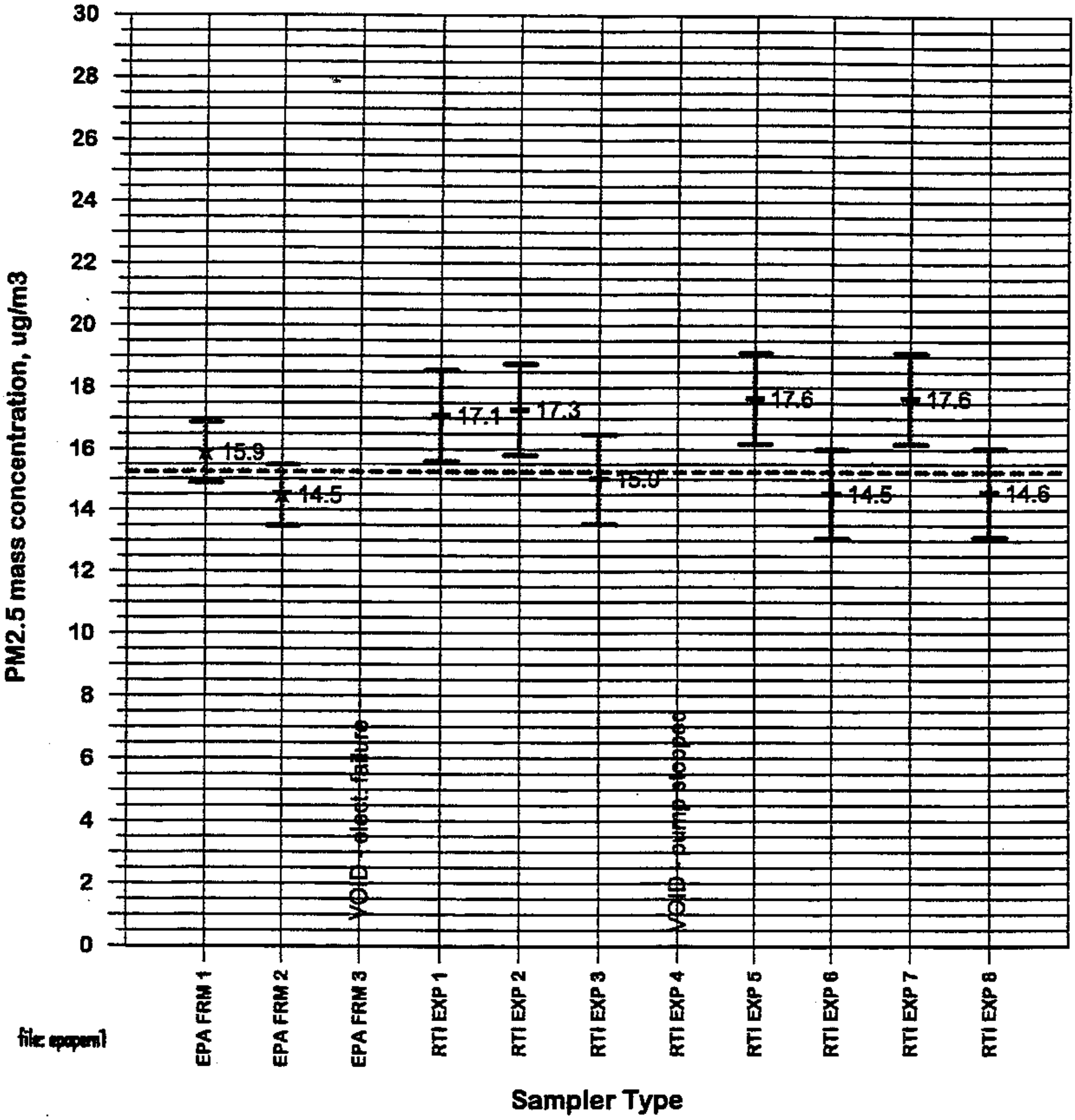
		8/22/97														
	Date	Nominal Test	Inlet ID#	Filter ID#	Passed Leak Tst?	Logger ID#	Start Time	End Time	Elapsed Time, min.	Start Magn.	Start Flow, LPM	End Magn.	End Flow, LPM	Mean Flow, LPM	Sampled Volume, M3	Comments
1	18-Aug	4 hr	1	ES01	YES	32688	11:46	13:50	244	4.85	4.01	4.45	3.83	3.92	0.956	Flow OK
2	18-Aug	4 hr	2	ES02	YES	28111	11:46	13:50	244	4.85	4.01	4.45	3.83	3.92	0.956	Flow OK
3	18-Aug	4 hr	3	ES03	YES	32739	11:46	13:50	244	4.85	4.01	4.75	3.96	3.99	0.972	Flow OK
4	18-Aug	4 hr	4	ES04	YES	28747	11:46	13:50	244	4.85	4.01	4.65	3.92	3.97	0.967	Flow OK
5	18-Aug	4 hr	5	ES05	YES	32664	11:46	13:50	244	4.85	4.01	4.70	3.94	3.98	0.970	Flow OK
6	18-Aug	4 hr	6	ES06	YES	28323	11:46	13:50	244	4.85	4.01	4.55	3.87	3.94	0.961	Flow OK
7	18-Aug	4 hr	7	ES07	YES	32667	11:46	13:50	244	4.85	4.01	4.80	3.99	4.00	0.976	Flow OK
8	18-Aug	4 hr	8	ES08	YES	28172	11:46	13:50	244	4.85	4.01	4.55	3.87	3.94	0.961	Flow OK
			Fld. blnk	ES09	na											
			Fld. blnk	ES10	na											
1	19-Aug	8 hr	1	ES11	YES	32688	9:04	5:10	486	4.85	4.01	4.70	3.94	3.98	1.932	Flow OK
2	19-Aug	8 hr	2	ES12	YES	28111	9:04	5:10	486	4.85	4.01	4.50	3.85	3.93	1.910	Flow OK
3	19-Aug	8 hr	3	ES13	YES	32739	9:04	5:10	486	4.85	4.01	4.70	3.94	3.98	1.932	Flow OK
4	19-Aug	8 hr	4	ES14	YES	28747	9:04	5:10	400	4.85	4.01	0.00	0.00	void	void	pump stopped
5	19-Aug	8 hr	5	ES15	YES	32664	9:04	5:10	486	4.85	4.01	4.65	3.92	3.97	1.927	Flow OK
6	19-Aug	8 hr	6	ES16	YES	28323	9:04	5:10	486	4.85	4.01	4.65	3.92	3.97	1.927	Flow OK
7	19-Aug	8 hr	7	ES17	YES	32667	9:04	5:10	486	4.85	4.01	4.65	3.92	3.97	1.927	Flow OK
8	19-Aug	8 hr	8	ES18	YES	28172	9:04	5:10	486	4.85	4.01	4.60	3.90	3.96	1.922	Flow OK
			Fld. blnk	ES19	na											
			Fld. blnk	ES20	na											
							Tests Conducted by:									
							R. J. Newsome/C.E. Rodes									

ARB In-Vehicle Exposure Study							Mass collection data		
Leak Test - Reproducibility Evaluation of 4.0 LPM MSP PM2.5 Inlets									
	8/22/97								
	Date	Filter ID#	Filter Pre-wt, gm.	Filter Post-wt, gm.	Collection, ug	Sampled Volume, m3	Sampled Conc., ug/m3	Comments	EPA Data, ug/m3
1	18-Aug	ES01	0.110995	0.111008	13	0.956	13.59	Sample OK	14.25
2	18-Aug	ES02	0.105320	0.105330	10	0.956	10.46	Sample OK	11.75
3	18-Aug	ES03	0.112851	0.112863	12	0.972	12.34	Sample OK	12.50
4	18-Aug	ES04	0.112694	0.112702	8	0.967	8.27	Sample OK	
5	18-Aug	ES05	0.104335	0.104356	21	0.970	21.65	fibers on filter back	
6	18-Aug	ES06	0.101605	0.101623	18	0.961	18.72	fibers on filter back	
7	18-Aug	ES07	0.100209	0.100217	8	0.976	8.20	Sample OK	
8	18-Aug	ES08	0.108744	0.108756	12	0.961	12.48	Sample OK	
	18-Aug	ES09	0.110519	0.110529	10		void	fibers on filter back	
	18-Aug	ES10	0.107874	0.107872	-2		-2.07	equiv. collection	
Notes:	1. Shaded area concentrations VOID: fiber on back of filter					n:	6		3
	2. Statistics computed w/o VOIDs (ES05 & ES06)					mean:	10.89		12.83
	3. EPA impactor operated for same time interval,					std. dev.:	2.29		1.28
	but at 16.67 LPM					coef. var., %:	21.04		10.00
						max:	13.59		14.25
						min:	8.20		11.75
1	19-Aug	ES11	0.106522	0.106555	33	1.932	17.08	Sample OK	15.88
2	19-Aug	ES12	0.108068	0.108101	33	1.910	17.28	Sample OK	14.47
3	19-Aug	ES13	0.097867	0.097896	29	1.932	15.01	Sample OK	void
4	19-Aug	ES14	0.098262	0.098288	26	void	void	pump stopped	
5	19-Aug	ES15	0.102874	0.102908	34	1.927	17.64	Sample OK	
6	19-Aug	ES16	0.104141	0.104169	28	1.927	14.53	Sample OK	
7	19-Aug	ES17	0.101390	0.101424	34	1.927	17.64	Sample OK	
8	19-Aug	ES18	0.108281	0.108309	28	1.922	14.57	Sample OK	
	19-Aug	ES19	0.114805	0.114807	2		1.04	equiv. collection	
	19-Aug	ES20	0.117463	0.117465	2		1.04	equiv. collection	
						n:	7		2
						mean:	16.25		15.18
						std. dev.:	1.47		1.00
						coef. var., %:	9.04		6.57
						max:	17.64		15.88
						min:	14.53		14.47
	Percent Data Capture (2 days): 94 %								

Particle Sampling PM2.5 Scalper and Primary Impactor Cutpoints for RTI Exposure Sampling Systems



Comparison of PM2.5 PEM's with EPA FRM PM2.5 Samplers at RTI RTP Field Site



Appendix E

Gelman Teflo Filter Background Metals' Analyses

- RTI Laboratory Report - ICP/MS Analyses for Background Elemental Analyses of ARB Study Gelman Teflo® Filters

RESEARCH TRIANGLE INSTITUTE

RTI

Ce. / for Environmental Measurements and Quality Assurance

Memorandum

To: Dr. Charles Rodes

From: Peter M. Grohse, PMG
Program Manager, Trace Metals Analyses

Subject: Analyses of Blank Teflo™ Filters

Attached are the trace metal analytical results for 10 blank Teflo™ filters. Procedures conformed to your memorandum accompanying the samples. Please call me if there are any questions at X6897.

40 Cornwallis Road • Post Office Box 12194 • Research Triangle Park, North Carolina 27709-2194 USA
Telephone 919 541-6914 • Fax 919 541-8778

Elemental Background Levels of Teflo Filters by ICP-MS

A brief summary of the sample preparation and analysis of the Teflo Filters is summarized below.

Sample Preparation

1. Filters were separated from their outside plastic rings with tweezers provided and placed in acid washed 15 mL centrifuge tubes.
2. 3 mLs of 50 % doubly distilled Ultrex Nitric Acid was added to each centrifuge tube (ten samples, two blanks, two blank spikes)
3. Spikes were added and the samples were mixed and microwaved using the following program: 1 min. 50 % power; 30 sec. at 65 % power and 15 sec. at 75 % power
4. Samples were allowed to cool, Internal Standard added and brought up to 14 mL total volume.

Sample Analysis

5. Calibration standards were prepared by serial dilution of a 10 ppm multi-element standard.
6. Internal standards were added to blanks and all calibration standards. The internal standard level was 5 ng/mL for Sc, Y, In, Bi. The instrument used interpolation to correct for drift.
7. Instrument was tuned and samples analyzed following ICP-MS SOP.

Results

8. Detection limits were calculated as 3 times the standard deviation of 6 blank analyses.
9. Precision and accuracy were calculated by a duplicate analysis of the two blank spikes. Total of N=4 for each element. Total spike amount was 100 ng. All recoveries were between 87% and 92%.

Analytical Results-Filter Analysis

Filter #	Cr	Mn	Ni	As	Cd	Pb
1	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
2	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
3	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
4	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
5	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
6	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
7	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
8	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
9	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng
10	< 0.4 ng	< 1 ng	< 2 ng	< 0.06 ng	< 0.2 ng	< 0.7 ng

Detection Limits, QC for Filter Analysis

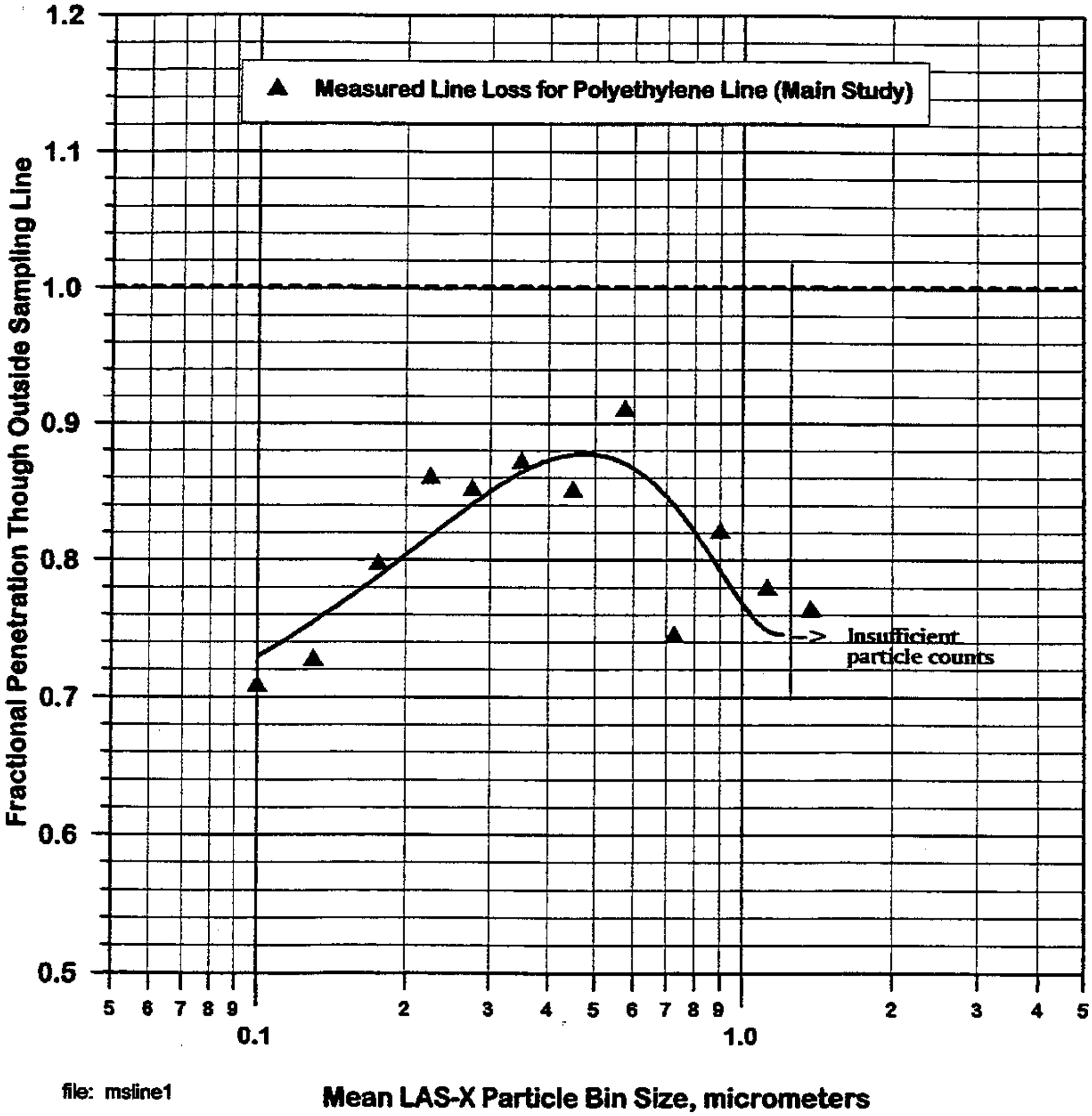
	Cr	Mn	Ni	As	Cd	Pb
Detection Limits	0.4 ng 0.008 ng/m^3	1 ng 0.02 ng/m^3	2 ng 0.04 ng/m^3	0.06 ng 0.001 ng/m^3	0.2 ng 0.003 ng/m^3	0.7 ng 0.01 ng/m^3
Blank Spike	0.092 μg +/- 0.001	0.087 μg +/- 0.0004	0.091 μg +/- 0.0003	0.091 μg +/- 0.0005	0.092 μg +/-0.0004	0.092 μg +/- 0.0006
Spike Amt	0.100 μg	0.100 μg	0.100 μg	0.100 μg	0.100 μg	0.100 μg
% Recovery	92	87	91	91	92	92

Appendix F

Outside Inlet Line Particle Loss Data; LAS-X Calibration Data

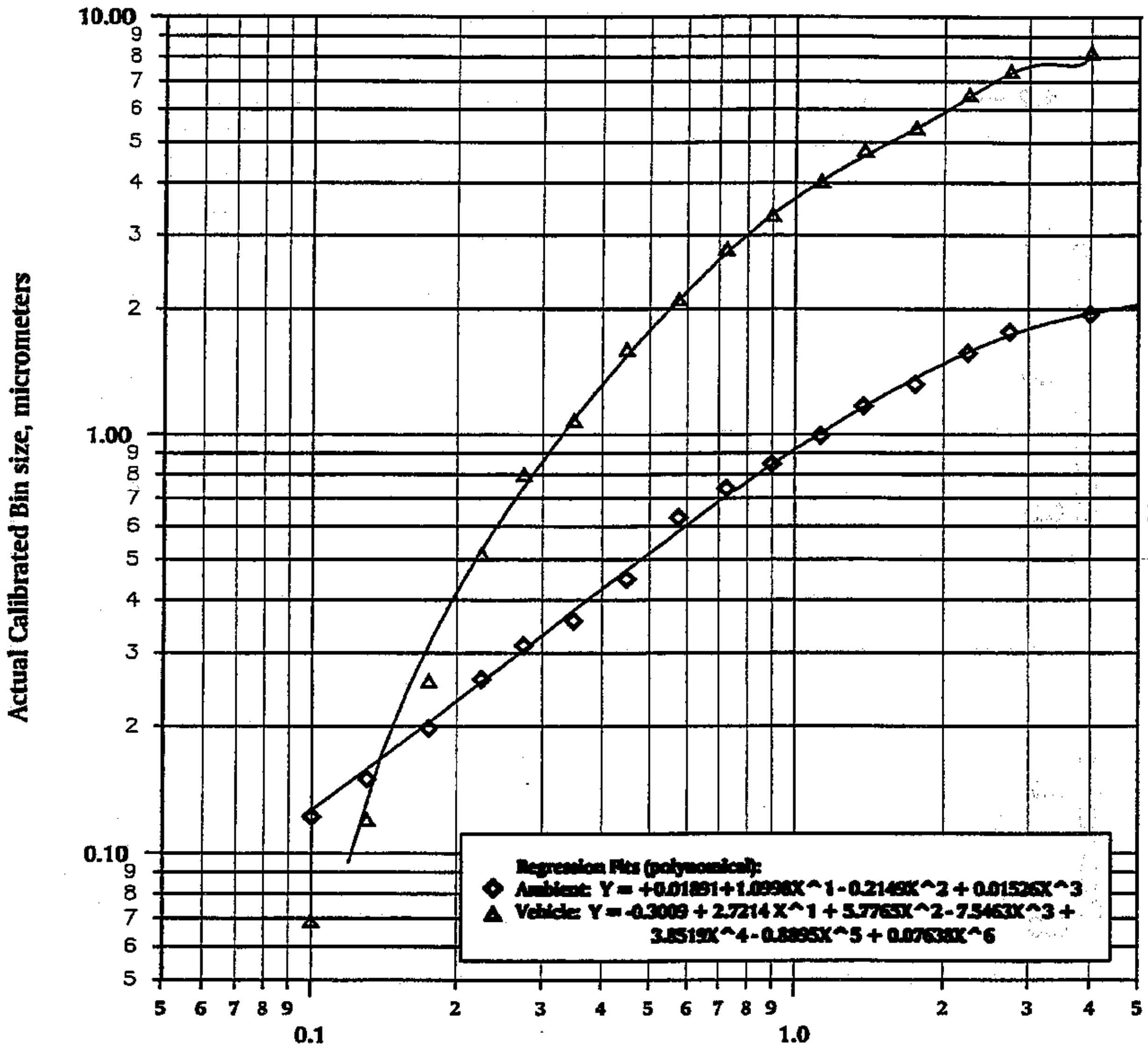
- Outside Sampling Line Particle Loss LAS-X Data
- LAS-X Bin Calibration Data - Aerosol Dynamics
- California Ambient and Vehicular Particle Density Data - Aerosol Dynamics
- Normalized Number Concentration Version of Figure 4-16

**In-Vehicle Study Outside Sampling Line
Penetration by Particle Size**



file: msline1

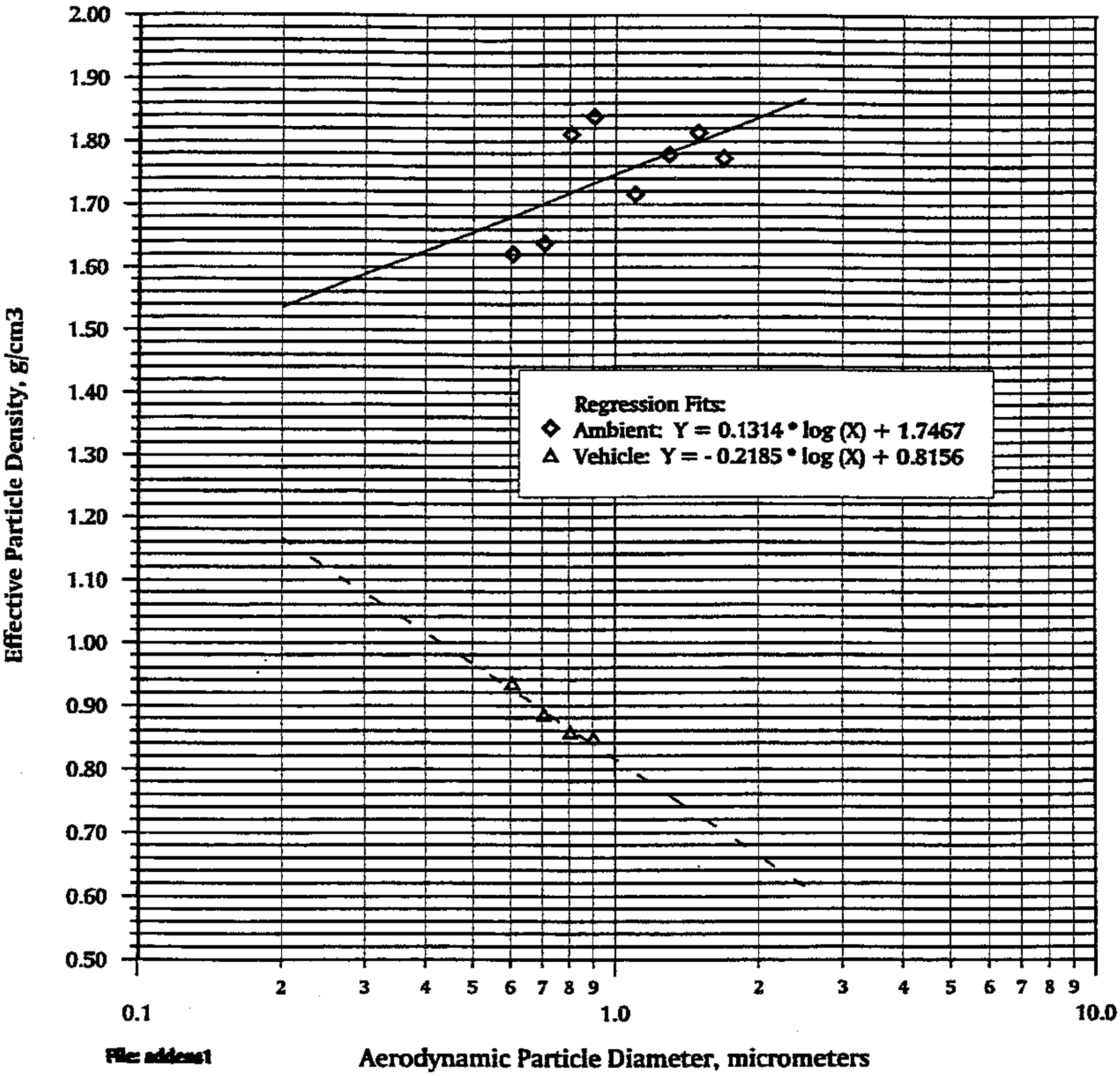
Aerosol Dynamics Calibration of RTI LAS-X
Using California Ambient and Vehicular Aerosols



File: adcal1t1

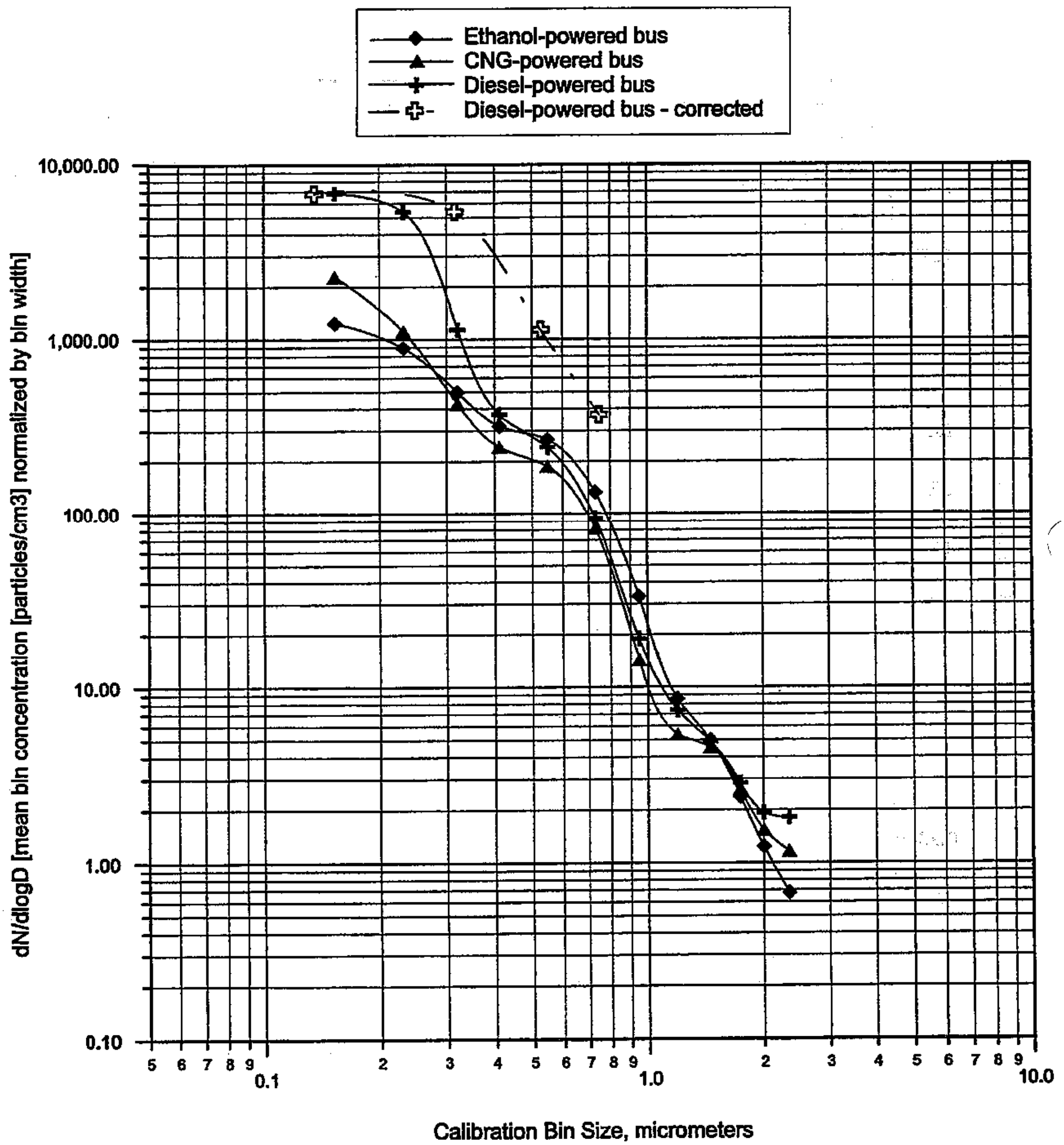
PMS Bin Particle Diameter, micrometers

Aerosol Dynamics Estimation of Particle Densities by Size Using California Ambient and Vehicular Aerosols



Normalized Version of Figure 4-16:
Particle Number Concentration Size Distribution

Commute #17: 9/27/97 PM, ANR



file: szdisn3a

[redacted]

Sacramento Caprice Data

Date	Trip Descriptn	Filename	Driver	Start Time	Odometer	End Time	Odometer
09/09/97	FNRH	09090.prn	FDG	09:05	56951.2	11:08	57054.5
09/09/97	FNRH	09092.prn	JML	12:05	57058.8	17:00	57161.7
09/10/97	FRH	09102.prn	JML	05:50	57161.7	10:00	57245.0
09/10/97	FRH	09105&6.prn	FDG	15:58	57245.7	18:00	57301.2
09/11/97	FRH	09111.prn	FDG	06:50	57305.0	08:51	57393.0
09/11/97	FRH	09113.prn	JML	15:59	57394.3	16:27	57407.8
inverter dies, park in lot to repair, no lasx or bc data in second file.							
09/11/97	FRH	09114.prn	JML	16:47	57407.8	18:00	57447.7
09/12/97	AR	0912 .prn	RLH	05:30	57449.6	09:04	57498.0
09/12/97	AR	091210 .prn	FDG	16:00	57541.3	18:00	57590.0
09/13/97	Rural	09133.prn	FDG	14:02	57624.8	16:03	57731.0
09/13/97	AER	09134.prn	FDG	16:30		16:50	
09/15/97	AR	09152.prn	RLH	05:47	57777.4	08:47	57827.4
09/15/97	AR	09155.prn	JML	16:00	57840.6	17:59	57884.9
09/16/97	SB	09161.prn	DM	07:45	57889.5	09:45	57931.5
09/16/97	SB	09165.prn	DM	13:45	57945.2	15:46	57971.9

Caprice Notes

09/09/97 PM: diesel truck brake lockup ~15:10-15:15.
Odo 57058.8 start - 57153.2 end

09/12/97 Sacto PM AR/hi

second	description
2614	emergency vehicle
2834	construction dust
5681	emergency vehicle
5914	construction dust

09/13/97 Rural drive by Davis
start 12:51:08 location Clarion odo 57,599.9
end 13:13:17 Davis>, 1st +C odo 57,615.8
15:33 following LDV but marked as HDD - made correction later (right after we turned into Rd 31).

09/15/97
06:15:13 start time
06:16:12
sec 6379 lot of smoke from HDD bus, sampling outside, confined space, 2 lanes each direction, trees on both sides + overhead.
sec 6839 following '40-'50 vintage Plymouth, LDV smoker, blue smoke, smell. MRP125 lic. , sampling outside, before and after Morse (st?)

09/15/97 Sacto PM AR/lo

second description

217 construction delay - no visible dust
3193 construction delay - dust visible
5805 tar/oil smoke
6519 construction delay - dust visible

September 16, 1997

School Bus Route

Some average statistics for Urbanized school bus driving patterns based on report by Valley Research titled, 'Study of the Driving Patterns of Transit Buses and School Buses Using Instrumented Chase Cars', April 1995.

37 minutes of idling per 2 hours of driving.
4 service stops every 30 minutes.
21 idling events.
17.5 mph average trip speed.
4.8 minutes of speed greater than 50 mph per 2 hour drive.

UCD 30' diesel school bus, engine made by International, chasis made by Carpenter
height = 11'2", seats 28, automatic transmission, wheel chair lift in rear right side.
Licence E 404006
UC Davis 54102
S1800
Driver: Meredith Armstrong, Feb 95, 2.5 years
3 windows on each side halfway down
Sampler on the fourth row, left side
Sample line out drivers window

AM Caprice
Driver: Dwight
Navigator: John
Start Odometer: 57902.5
Target switch new meanings:
0 = on route
1 = idle by school
2 = Service stop idle
3 = travel from school to begining of route (green highlight)

end odometer: 57931.5
Filename: 09161.pm

AM Bus
Passengers: Randy, Don, Frank, and Steve Hui.
Weather: Clear, cool ~65 deg. F
Caprice leads the bus.
Bus Odometer: 107439.8 @ 7:45 am

07:45	Start sample, bus idling in front of Abe Lincoln School
07:46	Other bus pulls away.
07:47	Idle at curb, door open
07:50	Smell of diesel in front seat area. Vinyl seats, rubber floor mats.
07:53	advance 50'
07:55	mnay students present, increased veh traffic, still idling with door open, two other buses present and both are idling.
07:56	another bus departs after 4 minutes.
08:10	level of activity declining, still a few drop offs occuring
08:13	Start route, south on Glenmore.
08:14:10	R on Ellenwood
08:14:52	L on Routier
08:16:24	R on Old Placerville
08:18:08	R on Bradshaw
08:19:33	R on Business Park Dr.
08:22:14	Stop for 1 minute by Fite Cir.
08:23:14	Resume drive
08:24:05	L on Routier
08:25:00	R on Folsom
08:26:12	R on Mather Feild Rd.
08:26:38	R Mills Station
08:28:00	Stop on Mills Station, Smell diesel
08:30:19	L on Routier
08:32:07	R on Lincoln Village Dr.
08:33:20	L on Asral
08:33:29	R on Redstone
08:34:03	L at Lyra
08:34:44	Stop at Burline
08:35:40	Resume
08:35:56	R on Burline
08:36:25	Stop by Kobias
08:37:25	Resume
08:38:16	L on Granby
08:39:38	R on Old Placerville
08:41:05	R on Bradshaw
08:41:58	R on Lincoln Village
08:44:43	L on Routier
08:45:51	R on Rockingham
08:46:30	R on Glenmore
08:47:30	Stop at school for 5 minutes with door open, little traffic
08:52:39	Start repeat of route.
08:53:37	R on Ellenwood
08:54:34	L on Routier
08:55:54	R on Old Placerville

08:57:00	R on Bradshaw
09:00:15	R on Business Park Dr.
09:01:45	R on Horn
09:02:51	Stop for 1 minute by Fite Cir.
09:03:51	Resume drive
09:04:30	L on Routier
09:05:40	R on Folsom (very dusty, road construction work)
09:06:56	R on Mather Feild Rd.
09:07:20	R Mills Station
09:08:50	Stop on Mills Station, door open for all stops, strong diesel smell here
09:09:50	Resume
09:11:19	L on Routier
09:13:10	R on Lincoln Village Dr.
09:14:13	L on Asral
09:14:26	R on Redstone
09:14:56	L at Lyra
09:15:35	Stop at Burline
09:16:35	Resume
09:17:00	R on Burline
09:17:17	Stop by Kobias
09:18:10	Resume
09:18:45	L on Granby
09:20:00	R on Goethe
09:20:39	R on Bradshaw
09:21:58	R on Lincoln Village
09:24:33	L on Routier
09:25:45	R on Rockingham
09:26:32	R on Glenmore
09:27:18	Stop at school
09:28:18	Resume
09:29:17	R on Ellenwood
09:30:16	L on Routier
09:31:44	R on Old Placerville
09:33:27	R on Bradshaw (a lot of smoking trucks)
09:36:10	R onto I50 westbound
09:40:45	Howe Ave Exit
09:41:13	South onto Howe
09:42:27	R on Folsom
09:43:00	Stop @ 7991 Folsom (Medimer Marble and Granite) idle
09:45:00	End of data gathering - Bus odometer = 107469.2
09:52	Start drive back to Sierra

PM Caprice
Driver: Dwight
Navigator: Lori
File: 09165.prn

PM Bus
Passengers: John and Steve Hui.
Weather: Clear, windy ~5-10 mph, ~75-80 deg. F

Caprice follows the bus.

13:45:00	Start at 7991 Folsom near Power Inn Rd.
13:47:20	Start On Ramp from Power Inn Rd. To I50 east
13:47:53	Start Freeway I50
13:52:15	Start Off Ramp I50 to Bradshaw south
13:53:00	On Bradshaw Rd.
14:00:40	Stop at School and wait
14:30:15	Leave School
14:40:15	Start 1 minute service stop on Horn Rd.
14:47:45	Start 1 minute service stop on Mills Station Rd.
14:53:30	Start 1 minute service stop on Lyra St.
14:55:05	Start 1 minute service stop on Burline St.
15:05:00	Stop and idle at school
15:14:30	Leave School
15:24:50	Start 1 minute service stop on Horn Rd.
15:30:25	Start 1 minute service stop on Mills Station Rd.
15:37:15	Start 1 minute service stop on Lyra St.
15:39:00	Start 1 minute service stop on Burline St.
15:45:00	End data collection - Bus odometer = 107150.0

RTI In-Vehicle Study
School Bus Route

Start near	**Watt Ave. and Folsom Blvd.**
North	Watt Ave.
Enter	Hwy 50 east
Exit	Bradshaw Rd.
Left	Bradshaw Rd.
	Begin Pickup Route
Right	Business Park Dr.
Right	Horn Rd.
Stop *	10026 Horn Rd.
Left	Routier Rd.
Right	Folsom Blvd.
Right	Matherfield Rd.
Right	Croydon Way
Left	Mills Station Rd.
Stop *	Centenial Mobile Home Park
Left	Routier Rd.
Right	Lincoln Village Rd.
Left	Astral Dr.
Right	Redstone Dr.
Left	Lyra St.
Right	Burline St.
Stop *	Burline St. & Lyra St.
Cont.	Burline St.
Stop *	Burline St. & Kobias St.
Left	Granby Dr.
Cross	Old Placerville Rd.
Right	Goethe Rd.
Right	Bradshaw Rd.
Right	Lincoln Village Rd.
Left	Routier Rd.
Right	Rockingham Dr.
Right	Smithlee Dr.
Stop *	Lincoln Elementary School
Stand-by	Idle 15 minutes
	Leave school
Right	Ellenwood Ave.
Left	Routier Rd.
Right	Old Placerville Rd.
Right	Bradshaw Rd.
	Start pickup loop again

Appendix G

Sierra Navigator's Event Logs for Sacramento and LA Commutes

- Sacramento Commute Notes
- Los Angeles Commute Notes
- Commute Start and Stop Times

Sierra Research
Event Log
[redacted]

Clock times are specified as PDT. Where shown in seconds, times are from start of data collection.

9/24/97Sacramento to LA drive (DM*)

9:30 leave gas station, odometer 57,988.1, added one quart of oil.
LASX start at 12:02:28; end at 12:03:27.
Camcorder 6 seconds ahead of other instruments.
Zeroth data file is 092497a. First file is 092497p. Second file is 092497d (time was wrong). Third file is 092497x. LASX start 14:14:21; end at 14:15:21.

9/25/97 am drive (FDG)

(First column shows number of seconds from start of data collection.)

-	Laser not reading reliably, apparently due to rain
435	Two car accident on I10 just west of I605 SB** turn, brief slowing
~600-1000	I605 SB, behind a long line of trucks
~723	Two car accident on I605 SB, no slowing
-	Note that there is a carpool lane from about Route 72 to Route 91. WB on Route 91 there is a carpool lane.
3535	There is a truck scale on I405 WB just east of 110.
-	I110 NB, carpool (2 or more) starts at Route 91.
-	I10 EB, carpool and bus lane starts near I710

9/26/97 am (FDG)

(First column shows number of seconds from start of data collection.)

-	Laser range finder was not operable during this run, apparently due to moisture from the previous day

---

* Observer's initials (DM-Dwight Mitchell, FDG-Frank Di Genova, JML-John Lee, LLW-Lori Williams)

** "SB" means southbound, etc.

~3400-4000 10-50 foot following distance behind HDD bus with heavy smoke, CA license CP38953, Bus number 100, Four Seasons Charter, phone 310-542-8834, 8V-92 turbocharged

3970-4470 Detour, missed turn for I10 NB segment, took Route 60 EB and then I710 NB to I10 EB.

4492 Resumption of driving on route.

- Inadvertantly turned off route near the end; ended the run at approximately 2 hours.

9/26 am supplemental drive

- Performed supplemental return drive to staging area. Started near Griffith and Figuroa, took I110 NB near I405. Videotaped supplemental drive. Set at high air exchange rate.

700-900 LASX showing elevated concentration on I110 NB.

9/26/97 pm (DM)

16:57 Distances or laser inconsistent during route (noticed at 16:57)

17:16 Accident; diamond lane NB I605 before Telegraph Road exit.

9/26/97 pm supplemental

- supplemental run from Adam exit on I110 SB to Vagabond Inn
- Laser returns appeared somewhat sporadic during this run. Problem resolved by replacing damaged skylight filters.

9/27/97 Arterial, nonrush, pm, high AER (JML)

14:47-14:53:20 MTA bus number 3617, dirty diesel bus

9/28/97 am (FDG)

~760 Start following VERY dirty city bus, sootiest so far; bus number 4471, CA license plate 433957

1793-1900 Following old Dodge pickup, no smoke but strong gasoline smell.

5000 Missed left turn onto Firestone from Avalon, so turned left on Florence (later determined that the correct turn is called Manchester at Avalon; it becomes Firestone further west).

5561 Late in switching from ramp to arterial by about 60 sec.

9/28/97 supplemental am run

- Supplemental am run from Elm, EB on Valley; no videotape made due to short drive

9/28/97 pm (FDG)

5894 Following Oldsmobile burning oil for ~1 minute on I710 NB
6730 Following smelly, smoking tanker truck

9/29/97 Freeway, rush, heavy duty influence, am drive (JML)

In this drive, the observer noted carefully the locations of starts and ends for carpool lanes and used switch no. 2 to denote these as follows: 0 no carpool lane, 1 2-person minimum carpool lane, 2 3-person minimum carpool lane and 3 2 carpool lanes (one of these may be a bus lane, which was sometimes indistinguishable from a second carpool lane.)

I605 SB*
6:48:40 @I5, start
6:53:25 turn off at Route 91

Route 91 WB
6:54:15 Start on Route 91
7:02:00 Transition from Route 91 to I110

I110 SB
7:17:50 Start carpool
7:38:00 End, left I110 to I10

I10 EB
7:45:00 Start at I710 off ramp
7:54:00 End past Rosemead Blvd before turnaround at Santa Anita

I605 SB
8:17:48 Start at I5

9/29/97 Supplemental am freeway drive (JML)

---

* Southbound

8:50:30-8:57:50 Smokey Metro bus.

9/29/97 Supplemental pm drive

- Supplemental drive begain at 190th St., 1 block west of I110 SB, near I405 interchange.

9/30/97 Freeway, rush, carpool, am (JML)

- Entered I10 WB at Rosemead, couldn't get into carpool lane on the first WB leg.

7:10 Exit I10 at Peck Road because couldn't move over in time for Santa Anita exit. Took wrong exit at Frazier and back on I10 WB at Frazier on ramp.

9/30/97 Freeway, rush, carpool, pm (FDG)

17:44:00 Entered carpool lane at Santa Anita but didn't mark that till about 17:44:35
17:22:30-17:25:16stopped for slow freight train at Sepulveda and Alameda in Carson; many HDD trucks on Alameda
18:00:45-18:05:03following HDD truck NB on I110, we were in right truck lane but it was mistakenly marked as ramp in dataset
18:06:30-18:10:26depressed ('cut') section of I110 NB, congestion F
18:12:49 There was a staled vehicle and two truck in number 4 lane
18:16:57-18:21:50MTA bus no 8645, Broadway NB@Venice, very dirty on acceleration
18:23:35-18:25:20MTA bus 8706, very dirty

10/1/97 Arterial, rush, a.m. (FDG)

7:19:00-50very dirty HDD truck

10/1/97 Arterial, rush, p.m. (LLW)

16:18:00-16:23:00MTA bus 2737, visible emissions on acceleration
16:42:49 Left on Broadway, following MTA bus 9089
16:45:10 MTA bus 2750, emissions on acceleration
16:49:20 MTA bus 8331, very smokey on acceleration
16:51:10 MTA bus 9001, smokey on acceleration
16:54:05 Right on Adams
16:58:40 I110 on ramp at Exposition

17:16:30 MTA bus 1340, ethanol
17:27:19 MTA bus 4761, CNG, Route 447
17:50 Major congestion on Willow due to road construction @ Redondo

10/2/97 Arterial, rush, a.m., low air-exchange, CCW (LLW)

6:39 Switched to "Norm A/C" switch setting. Was incorectly set to "Max" prior to this.
6:53 Target is cement truck, visible emissions on accelleration.
6:58 Target is "other diesel." Strong smell, visible emissions on acceleration.
7:22 Target is gasoline truck @ stoplight. Right turn (N) onto Avalon Blvd.
7:44:00 Target is small diesel delivrey vehicle, Chevrolet 6.2L.. Smelly, but no visible emissions.
7:55:38 Entering depressed corrior area on 110 freeway N. (@ Slauson Ave.) Trip odom: 37.2 miles.
7:59:31 Exiting depressed corridor area on 110 freeway N. (1 exit before Exposition Blvd.) Trip Odom: 38.4 miles.
8:07 Missed left turn from Manchester onto Broadway N. Instead, turned left on Main St., left on 25th St., right on Broadway, heading N.
8:07:45 Target is CNG powered MTA bus #4629, route #345.
8:11:56 Beginning of "downtown corridor" section.
8:13:00 Target is ethanol powered MTA bus #1280, route # 30. Slight smoke visible on acceleration.
8:16:25 End of "downtown corridor" @ corner of 1st and Broadway. Trip odom: 52.1 miles.
8:19:44 Target is Dash Bus #73, visible smoke on acceleration.
8:20:36 Target is ethanol powered MTA bus #1280, route #30.
8:24:43 Target is diesel powered MTA bus #8624.

10/2/97, Supplemental am drive, EB on Valley Blvd to Vagabond Inn parking lot

8:36:20 Target is ethanol powered MTA bus #1470, route #76.

10/2/97 pm

- Computer crashed and was restarted during this drive

16:12:15-16:12:47Following MTA bus 2931, diesel with high exhaust on left, light smoke on acceleration

16:22:45-16:30:04 @6.6 miles* from Vagabond on Valley stopped for railroad crossing behind Hino medium duty diesel, very congested intersection (marked as congestion B, but should have been congestion F).
16:31:38-16:31:51medium duty, U-haul
16:33:18 @8.6 miles, turn left at Lincoln Park onto Mission St.
16:38:50 @10.5 miles, turn right onto First St.
16:43-45 @11.6 miles, turn left onto Broadway, follow MTA bus 4637, CNG
16:48:12 MTA bus 2823, visible emissions on acceleration, high left exhaust
16:50:33 @12.7 miles, crossing Olympic, end downtown street canyon
16:54:00 MTA bus 4674, CNG, high left exhaust, bus route 68
16:59:00 odometer 59,517.0 miles
17:01:13 laser reading incorrectly, stop and restart it
17:03:35 resume driving
17:06:29 @mile 15.0, entering I110 SB
17:09:31 @15.7 miles, entering depressed section, congestion should be E, lane should be right hand truck lane
17:12:00 @16.9 miles, exit depressed section
17:14:37 @19.0 miles, left turn onto Manchester
17:16:47 MTA bus 2468, smokey, high left exhaust; should be marked as arterial, not ramp from about 17:15
17:19:37 @20 miles, right turn onto Avalon
17:28:14-17:29:27school bus, 3LAX846, not full size, bus no. 19135, Collins chassis, record as "other diesel"
17:35-17:40 MTA bus 2338, light smoke on acceleration
17:45:50 @30.7 miles, left onto Sepulveda

10/2/97, supplemental pm drive

18:12 @37.5 miles, turn onto Lakewood
18:50:00-18:52:16what is recorded as HDD for about 2 min was actually LDV

10/3/97 "Maximum Concentration" Drive, am

7:03:48 parked at gas station by Valley and Rosemead Blvds, positioned at pump #1, three car doors open
7:06:56 smell gasoline
7:08:48 start refueling, three car doors open, engine off
7:11:56 correct recording switch from arterial to other for the period stopped
7:13:59 pump shut off
7:14:53 start engine

---

* For this drive, the trip mileage counter was used to note various locations from start of route at Vagabond Inn.

7:20:24 windows up, drive away
7:23 enter I10 WB
7:27 follow other diesel (we had been following one car behind it for 1-2 miles already)
7:28:33 corrected switch setting to middle lane from RH truck lane
7:43 exit I10 at 101, Mission
7:45 WB at Caesar Chavez
7:48 following HDD MTA bus 1122, going SW on North High St., very smokey
7:50 right on Temple
7:51:12 left onto North Broadway
7:51:49 (start of street canyon), SB on Broadway
7:56 (end of street canyon) stop at Olympic
7:57 (start of 'non street canyon section,' for comparison)
8:01:52 left onto 30th St.
8:03:18 left onto Main
8:03:35 left onto 28th
8:04:20 right onto Broadway
8:05 paused near 23rd and Broadway waiting for bus 'target'
8:06:35 proceeding north on Broadway, no bus targets
8:10:45 pause for bus target near 12th
8:11:39 following MTA bus 2083, fast idle
8:14:53 @8th St.
8:18:25 following MTA bus 2041, very smokey, CA plate 079241, been on target but forgot to set target switch
8:20:09 continue, no target
8:21:30 waiting for bus target
8:22:11 resume target, MTA bus 2041, late on target switch, left on Sunset Blvd
~8:24:00-8:24:30 Uphill, following MTA bus 2041, sampling outside, smokey
8:28:30 Made right turn, then U turn on Elysian Park
8:29:32 Right onto Marion Blvd, headed for I101
8:32:28 left on Glendale to I101 SB
8:34:42 entering I101 SB
8:36:11 I110 SB
8:38:14 passing I10 exit
8:41:20 60-70 feet behind Honda (could not acquire HDD target)
8:44:46 double distance
~8:45 turned onto I105 WB
8:48 exit I105 at Crenshaw Blvd
8:49:20 EB on I105
8:50:33 following other diesel
8:51:51 ramp for I110 S
8:53 SB on I110
8:54:00 new target, other diesel, at 40 feet, smells
8:56 I405 SB
9:05 I405 SB to I710 NB

9:14:40 Artesia Blvd, 91EB
9:21:07 following other diesel
9:23:41 following at ~90 feet, lost target
9:25:18 "
9:26:03-57 end pursuit, can't follow at fixed distance
9:30:45 take I605 NB
9:32:46 smelly diesel, CA plate 2N38645
9:38-9:43:10 very congested section, diesel target, many diesels nearby, noticed that we were recording for ramp but should be middle lane; passed disabled vehicle which was the apparent cause of the slowdown
~9:46-9:49:30 following 80-100 feet behind other diesel
9:49:49 ~50 feet beind
9:53 break off pursuit

10/3/97 "Maximum Concentration" Drive, pm

15:03:30 behind Oldsmobile idling at In and Out Burger, Rosemead and Valley Blvds
15:06 restarted laser and data collection after noting suspicous laser readings, now reading normally
15:08 car ahead pulls out, target switch should have been on the entire time of our being stopped
15:09:40 right onto Mission Drive
15:15:00 LDV smoker at 40-50 feet (congestion should have been D on freeway)
15:17:27 target at about 100 feet
15:20:10 go back to 40-50 feet
15:23:03 end pursuit of smoker, target switch got bumped off prematurely
15:24:27 left onto Caesar Chavez
- left onto Broadway
15:28:03 computer error message, end data collection, odometer 59,658.2 miles when noticed
15:30:00 north on Broadway and Temple, resume data collection
15:31:35 enter Canyon section @odometer 59,658.4 miles
15:33 another computer failure, restart
15:36:57 restarted NB, looks ok
15:37:29 stop at Olympic, end of canyon section and start of comparable non-canyon section
15:41:41 right on Adams, end of non-canyon section
15:43:20 left onto Flower
15:45:39 up ramp
15:46:26 begin 'cut' section just south of Exposition, ramp
15:47:27 restart PC
15:48:54 exiting cut section
15:50:37 road type switch was set wrong
15:55:30 end of cut section

16:04:11	MTA bus 2089, lost it in red light, smoker
16:08:17	MTA bus 8442, very smokey on acceleration, left exhaust
16:21:40	outside sample during bus acceleration, expect very high concentrations
16:23:27	end 15 min following of bus
16:29:46	follow cement truck at about 30 feet in slow traffic
16:32:30	lost target
16:34:30	same cement truck at about 60 feet, smoking on acceleration
16:37:38	resume following at 30 feet
16:41:52	end following of cement truck
16:43:40	HDD at 30 feet
16:46:39	begin following at 60 feet
16:50:34	end following at 60 feet
16:58:28	idling at drive thru behind Chevy van

ARB In-Vehicle Exposure Main Study Commute Particle Sampling Start and End Times

SACRAMENTO

							Vehicle 1 (Caprice)			Vehicle 2 (Taurus)			Roadside 1			Roadside 2			Ambient		
Commute	Day	Date	DOW	Period	Type	Vent	Start Time	End Time	Elapsed Minutes	Start Time	End Time	Elapsed Minutes	Start Time	End Time	Elapsed Minutes	Start Time	End Time	Elapsed Minutes	Start Time	End Time	Elapsed Minutes
1	1	9-Sep-97	Tu	AM	FNRH	Hi	9:05	11:08	2:03	9:05	11:09	2:04	9:05	11:09	2:04	9:07	11:15	2:08	9:00	11:05	2:05
2	1	9-Sep-97	Tu	PM	FNRH	Hi	14:05	16:05	2:00	14:05	16:05	2:00	14:05	16:05	2:00	14:05	16:05	2:00	14:05	16:05	2:00
3	2	10-Sep	We	AM	FRH	Hi	6:50	8:50	2:00	6:49	8:50	2:01	6:45	8:45	2:00	6:45	8:45	2:00	6:50	8:50	2:00
4	2	10-Sep	We	PM	FRH	Hi	15:59	17:59	2:00	15:59	17:59	2:00	16:00	18:00	2:00	16:00	18:00	2:00	16:00	18:00	2:00
5	3	11-Sep	Th	AM	FRH	Lo	6:50	8:51	2:01	6:49	8:51	2:02	6:50	8:50	2:00	6:50	8:50	2:00	6:50	8:50	2:00
6	3	11-Sep	Th	PM	FRH	Lo	15:59	18:00	2:01	15:59	18:01	2:02	16:00	18:00	2:00	16:00	18:00	2:00	16:00	18:00	2:00
7	4	12-Sep	Fr	AM	AR	Hi	7:04	9:04	2:00	7:04	9:04	2:00	7:05	9:05	2:00	7:05	9:05	2:00	7:05	9:05	2:00
8	4	12-Sep	Fr	AM	AR	Hi	16:00	18:00	2:00	15:59	18:00	2:01	16:00	18:00	2:00	16:00	18:00	2:00	16:00	18:00	2:00
9	5	13-Sep	Sa	midday	R	Hi	14:01	16:02	2:01	14:02	16:03	2:01	14:00	16:05	2:05	14:09	16:05	1:56			
10	6	15-Sep	Mo	AM	AR	Lo	6:45	8:47	2:02	6:44	8:47	2:03							6:45	8:45	2:00
11	6	15-Sep	Mo	AM	AR	Lo	16:00	17:59	1:59	15:59	18:00	2:01							16:00	18:00	2:00
12	7	16-Sep	Tu	AM	SB	Hi	7:45	9:45	2:00	7:45	9:45	2:00							7:45	9:45	2:00
13	7	16-Sep	Tu	AM	SB	Hi	13:45	15:45	2:00	13:45	15:45	2:00							13:44	15:44	2:00
14	1	25-Sep-97	Th	AM	FNRH	Hi	8:59	11:01	2:02	9:00	11:02	2:02							9:01	11:01	2:00
15	2	26-Sep	Fr	AM	FRH	Hi	6:31	8:30	1:59	6:29	8:29	2:00	6:30	8:30	2:00	6:30	8:30	2:00	6:30	8:30	2:00
16	2	26-Sep	Fr	PM	FRH	Hi	15:59	18:02	2:03	15:59	18:02	2:03	16:00	18:00	2:00				16:00	18:00	2:00
17	3	27-Sep	Sa	PM	ANR	Hi	13:59	16:00	2:01	13:59	16:00	2:01							14:00	16:00	2:00
18	4	28-Sep	Su	AM	ANR	Hi	8:59	11:00	2:01	8:59	10:59	2:00							9:00	11:00	2:00
19	4	28-Sep	Su	PM	FNRH	Hi	12:59	15:01	2:02	12:59	15:00	2:01							13:00	15:00	2:00
20	5	29-Sep	Mo	AM	FRH	Low	6:29	8:29	2:00	6:29	8:30	2:01	6:30	8:30	2:00	6:30	8:30	2:00	6:32	8:32	2:00
21	5	29-Sep	Mo	PM	FRH	Low	15:59	18:02	2:03	16:03	18:02	1:59	16:00	18:00	2:00	16:00	18:00	2:00	16:00	18:00	2:00
22	6	30-Sep	Tu	AM	FRC	Hi	6:29	8:35	2:06	6:29	8:29	2:00	6:30	8:30	2:00	6:30	8:30	2:00	6:31	8:31	2:00
23	6	30-Sep	Tu	PM	FRC	Hi	15:59	18:01	2:02	16:00	18:00	2:00	16:00	18:00	2:00	16:00	18:00	2:00	16:00	18:00	2:00
24	7	1-Oct	We	AM	AR	Low	6:29	8:30	2:01	6:29	8:29	2:00	6:30	8:30	2:00	6:30	8:31	2:01	6:30	8:30	2:00
25	7	1-Oct	We	PM	AR	Low	15:59	17:59	2:00	15:59	17:59	2:00	16:00	18:00	2:00	16:00	18:00	2:00	16:00	18:00	2:00
26	8	2-Oct	Th	AM	AR	Hi	6:29	8:30	2:01	6:29	8:30	2:01	6:30	8:30	2:00	6:30	8:30	2:00	6:30	8:30	2:00
27	8	2-Oct	Th	PM	AR	Hi	15:59	18:01	2:02	15:59	18:00	2:01	16:00	18:00	2:00	16:00	18:00	2:00	16:00	18:13	2:13
28	9	3-Oct	Fr	AM	MC	Hi	6:59	9:01	2:02										7:00	9:04	2:04
29	9	3-Oct	Fr	PM	MC	Hi	14:59	17:04	2:05										15:00	17:00	2:00

Appendix H

Measurement Data for Individual Commutes

- Data for Sacramento Commutes 1 thru 13, and LA Commutes 14 thru 29

Commute Number	1
Location	Sac
Test Day	Tu
Test Date	9/9/1997
AM / PM	AM
Scenario	FNR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	1.1	6.6	4.5	5.4	3.4	1.1	1.4
1,3-Butadiene, µg/m3	< 0.6	2.2	1.3	1.8	1.0	< 0.6	< 0.6
TCFM, µg/m3	1.9	1.7	1.4	1.5	1.5	1.5	1.6
Acetonitrile, µg/m3	43.6	27.4	36.7	1.9	44.8	33.1	100.9
DCM, µg/m3	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
MTBE, µg/m3	2.9	9.3	7.5	10.8	9.7	3.0	3.9
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	< 2.2	7.4	7.6	6.8	7.8	< 2.2	< 2.2
Toluene, µg/m3	7.6	9.3	15.7	12.1	20.1	4.5	9.3
Ethylbenzene, µg/m3	6.0	3.0	2.5	2.7	2.4	< 1.6	< 1.6
M,P-Xylene, µg/m3	<2.4	12.7	11.0	11.2	10.5	<2.4	3.5
O-Xylene, µg/m3	<2.2	4.5	4.0	3.9	3.7	<2.2	<2.2
Formaldehyde, µg/m3	4.0	7.7	7.5	N/A	N/A	5.7	4.9
CO avg, ppm	< 2	< 2	4.2	NS	4.8	< 2	< 2
CO peak, ppm	< 2	7.0	15.0	NS	16.0	< 2	< 2
PM10 mass, µg/m3	28.5	30.6	< 19.74	N/A	N/A	28.5	57.7
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	19.9
PM2.5 S, µg/m3	0.78	0.88	0.58	0.87	0.81	0.80	0.73
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.90	0.80	0.70	N/A	N/A	0.86	1.12
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	1164	N/A	2100	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	7.6	N/A	3.3	N/A	N/A	N/A
Vehicle Speed, mph	N/A	50.2	50.2	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	97.0	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.5	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	35.8%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	50.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	104.2	104.2	N/A	N/A	N/A	N/A
Windspeed, mph	5.5	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	79.7	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	50.0	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
Values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number 2
Location Sac
Test Day Tu
Test Date 9/9/1997
AM / PM PM
Scenario FNR
AER Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	1.2	5.3	5.5	5.9	5.9	1.3	2.1
1,3-Butadiene, µg/m3	< 0.6	1.6	1.5	0.8	1.5	< 0.6	< 0.6
TCFM, µg/m3	1.7	1.6	1.6	1.8	1.6	1.8	1.8
Acetonitrile, µg/m3	1.5	62.0	44.0	2.1	43.2	10.1	70.8
DCM, µg/m3	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	2.3	< 2.2
MTBE, µg/m3	< 2	12.0	15.3	15.7	13.7	< 2	3.5
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	< 2.2	5.7	6.9	6.3	6.6	< 2.2	< 2.2
Toluene, µg/m3	3.9	17.0	14.8	16.1	16.5	3.7	7.2
Ethylbenzene, µg/m3	< 1.6	2.8	2.4	2.4	2.5	< 1.6	< 1.6
M,P-Xylene, µg/m3	<2.4	12.5	11.1	10.4	11.1	<2.4	3.4
O-Xylene, µg/m3	<2.2	4.4	3.8	3.7	3.8	<2.2	<2.2
Formaldehyde, µg/m3	NS	8.358	8.414	N/A	N/A	5.421	4.895
CO avg, ppm	< 2	< 2	2.8	2.2	3.0	< 2	< 2
CO peak, ppm	< 2	19.0	10.0	14.0	10.0	< 2	< 2
PM10 mass, µg/m3	30.3	28.7	< 19.74	N/A	N/A	23.7	27.6
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	27.5	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.40	0.46	0.46	0.46	0.49	0.39	0.44
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.46	0.42	0.27	N/A	N/A	0.51	0.43
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	818	N/A	1614	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	9.0	N/A	4.7	N/A	N/A	N/A
Vehicle Speed, mph	N/A	47.0	47.0	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	83.7	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.6	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	82.5%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	94.0	94.0	N/A	N/A	N/A	N/A
Windspeed, mph	7.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	85.1	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	29.0	N/A	N/A	N/A	N/A	N/A	N/A

NOTES
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	3
Location	Sac
Test Day	We
Test Date	9/10/1997
AM / PM	AM
Scenario	FR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	1.3	6.8	8.7	7.0	8.5	1.7	2.6
1,3-Butadiene, µg/m3	< 0.6	2.2	2.5	1.4	2.0	< 0.6	< 0.6
TCFM, µg/m3	2.2	1.6	2.1	1.9	2.1	1.8	1.9
Acetonitrile, µg/m3	16.0	31.0	41.6	1.6	42.6	44.1	64.1
DCM, µg/m3	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
MTBE, µg/m3	2.6	18.6	19.0	16.9	20.1	2.1	8.9
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	< 2.2	7.4	11.7	8.1	10.5	< 2.2	2.4
Toluene, µg/m3	5.3	23.7	20.2	21.1	23.7	6.8	8.1
Ethylbenzene, µg/m3	< 1.6	3.7	3.8	3.3	3.7	< 1.6	< 1.6
M,P-Xylene, µg/m3	<2.4	17.0	17.3	15.0	17.2	2.7	5.7
O-Xylene, µg/m3	<2.2	5.9	6.0	5.1	6.0	<2.2	2.2
Formaldehyde, µg/m3	3.14	11.805	9.304	N/A	N/A	3.798	3.989
CO avg, ppm	< 2	2.3	2.6	2.5	3.2	< 2	< 2
CO peak, ppm	< 2	12.0	8.0	14.0	10.0	< 2	< 2
PM10 mass, µg/m3	< 19.74	39.4	< 19.74	N/A	N/A	< 19.74	22.5
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.22	0.34	0.16	0.41	0.26	0.21	0.35
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.29	0.35	0.19	N/A	N/A	0.31	0.39
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	542	N/A	1325	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	5.0	N/A	4.7	N/A	N/A	N/A
Vehicle Speed, mph	N/A	37.3	37.3	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	79.1	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.8	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	12.5%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	74.6	74.6	N/A	N/A	N/A	N/A
Windspeed, mph	5.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	70.7	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	73.0	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
Values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number 4
Location Sac
Test Day We
Test Date 9/10/1997
AM / PM PM
Scenario FR
AER Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	1.8	10.7	14.2	9.2	12.9	1.6	2.1
1,3-Butadiene, µg/m3	< 0.6	1.6	1.7	2.6	3.4	< 0.6	< 0.6
TCFM, µg/m3	2.1	2.2	2.4	1.9	2.6	1.9	2.2
Acetonitrile, µg/m3	4.7	17.6	85.0	< 1.4	33.0	41.8	78.9
DCM, µg/m3	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
MTBE, µg/m3	2.9	29.4	26.8	29.7	24.7	< 2	3.9
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	< 2.2	10.8	15.6	10.5	13.9	< 2.2	< 2.2
Toluene, µg/m3	4.0	29.0	35.8	21.7	33.6	3.1	6.8
Ethylbenzene, µg/m3	< 1.6	5.1	5.8	4.4	5.7	< 1.6	< 1.6
M,P-Xylene, µg/m3	<2.4	23.8	26.7	20.7	26.3	<2.4	4.4
O-Xylene, µg/m3	<2.2	8.3	9.0	7.3	9.0	<2.2	<2.2
Formaldehyde, µg/m3	NS	12.291	11.437	N/A	N/A	6.581	6.282
CO avg, ppm	< 2	2.1	4.1	2.2	5.4	< 2	< 2
CO peak, ppm	< 2	10.0	52.0	11.0	67.0	< 2	2.0
PM10 mass, µg/m3	< 19.74	25.8	< 19.74	N/A	N/A	< 19.74	22.3
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	20.1	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.16	0.14	0.09	0.21	0.30	0.25	0.16
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.21	0.21	0.16	N/A	N/A	0.24	0.27
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	9.2	N/A	9.5	N/A	N/A	N/A
Vehicle Speed, mph	N/A	26.3	26.3	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	69.6	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	5.2	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	20.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	43.3%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	56.0	56.0	N/A	N/A	N/A	N/A
Windspeed, mph	6.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	76.1	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	41.0	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminents in ug/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	**5**
Location	**Sac**
Test Day	**Th**
Test Date	**9/11/1997**
AM / PM	**AM**
Scenario	**FR**
AER	**Low**

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	2.9	10.1	9.2	9.0	8.3	3.2	2.8
1,3-Butadiene, µg/m3	< 0.6	2.9	2.5	2.9	2.1	< 0.6	< 0.6
TCFM, µg/m3	2.3	2.7	2.5	2.5	2.9	2.6	2.6
Acetonitrile, µg/m3	152.5	279.2	136.7	< 1.4	92.4	27.9	92.7
DCM, µg/m3	3.1	< 2.2	< 2.2	< 2.2	3.6	2.6	< 2.2
MTBE, µg/m3	5.3	16.3	10.9	16.6	18.5	7.6	5.4
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	2.8	9.1	12.4	10.9	15.6	3.1	< 2.2
Toluene, µg/m3	6.0	36.8	22.2	20.6	22.4	7.3	7.2
Ethylbenzene, µg/m3	< 1.6	5.9	4.3	4.1	4.0	< 1.6	< 1.6
M,P-Xylene, µg/m3	4.5	28.1	16.9	15.6	15.5	4.9	5.6
O-Xylene, µg/m3	2.5	9.8	6.0	5.7	5.4	2.6	2.8
Formaldehyde, µg/m3	3.206	11.983	11.435	N/A	N/A	3.844	2.995
CO avg, ppm	< 2	< 2	2.6	< 2	4.5	< 2	< 2
CO peak, ppm	< 2	3.0	7.0	7.0	12.0	2.0	4.0
PM10 mass, µg/m3	39.1	36.0	< 19.74	N/A	N/A	42.5	40.5
PM2.5 mass, µg/m3	< 19.74	21.8	< 19.74	35.9	26.1	< 19.74	< 19.74
PM2.5 S, µg/m3	0.84	0.83	0.68	0.91	0.73	0.81	0.80
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.93	0.88	0.59	N/A	N/A	1.01	1.04
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	976	N/A	2559	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	9.5	N/A	13.5	N/A	N/A	N/A
Vehicle Speed, mph	N/A	44.3	44.3	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	56.2	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.9	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	90.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	88.5	88.5	N/A	N/A	N/A	N/A
Windspeed, mph	1.5	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	67.1	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	[illegible]	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
Values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number 6
Location Sac
Test Day Th
Test Date 9/11/1997
AM / PM PM
Scenario FR
AER Low

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	1.7	14.1	17.7	15.8	9.0	6.2	5.3
1,3-Butadiene, µg/m3	< 0.6	4.1	4.4	4.4	1.7	1.1	< 0.6
TCFM, µg/m3	2.1	3.0	5.0	2.9	3.3	2.2	2.6
Acetonitrile, µg/m3	8.0	138.8	626.6	4.7	263.3	3.7	37.3
DCM, µg/m3	< 2.2	< 2.2	3.4	< 2.2	< 2.2	2.3	4.4
MTBE, µg/m3	< 2	27.7	26.7	21.6	11.1	11.8	10.9
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	< 2.2	13.9	15.9	15.3	9.4	5.3	4.2
Toluene, µg/m3	3.2	38.4	32.0	33.2	21.3	10.6	8.8
Ethylbenzene, µg/m3	< 1.6	7.1	6.0	6.4	4.3	2.2	1.7
M,P-Xylene, µg/m3	<2.4	30.1	23.2	26.1	16.2	8.0	6.3
O-Xylene, µg/m3	<2.2	9.5	7.7	8.6	5.9	3.6	2.9
Formaldehyde, µg/m3	5.707	11.328	17.415	N/A	N/A	8.268	7.254
CO avg, ppm	< 2	< 2	3.2	2.1	3.8	< 2	< 2
CO peak, ppm	< 2	17.0	22.0	14.0	14.0	4.0	3.0
PM10 mass, µg/m3	22.9	19.9	< 19.74	N/A	N/A	31.4	36.8
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.37	0.37	0.24	0.32	0.37	0.45	0.42
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.51	0.44	0.25	N/A	N/A	0.44	0.55
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	3.3	N/A	4.0	N/A	N/A	N/A
Vehicle Speed, mph	N/A	25.4	25.4	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	70.8	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	4.5	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	7.5%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	26.7%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	53.9	53.9	N/A	N/A	N/A	N/A
Windspeed, mph	2.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	81.5	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	24.0	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	7
Location	Sac
Test Day	Fr
Test Date	9/12/1997
AM / PM	AM
Scenario	AR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	3.7	14.1	10.5	9.5	10.3	6.1	6.5
1,3-Butadiene, µg/m3	< 0.6	3.5	1.9	2.1	2.2	1.1	1.1
TCFM, µg/m3	2.4	5.3	3.0	3.6	3.7	2.1	2.4
Acetonitrile, µg/m3	23.0	167.0	52.7	2.3	39.4	9.7	109.1
DCM, µg/m3	3.3	3.7	< 2.2	2.3	2.4	2.7	3.0
MTBE, µg/m3	8.5	30.6	22.8	20.9	22.5	13.4	14.1
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	2.7	15.2	11.7	9.3	11.4	4.7	5.9
Toluene, µg/m3	8.8	26.3	26.6	21.9	26.9	14.8	14.7
Ethylbenzene, µg/m3	1.7	6.4	6.2	5.6	6.2	3.1	3.3
M,P-Xylene, µg/m3	5.2	27.4	21.1	19.3	21.6	10.4	10.9
O-Xylene, µg/m3	<2.2	9.0	7.7	7.1	8.1	3.7	3.8
Formaldehyde, µg/m3	3.181	10.231	8.767	N/A	N/A	5.225	5.435
CO avg, ppm	< 2	2.5	2.1	3.1	2.5	< 2	< 2
CO peak, ppm	< 2	16.0	12.0	30.0	14.0	2.0	3.0
PM10 mass, µg/m3	25.2	< 19.74	< 19.74	N/A	N/A	38.8	43.0
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	22.1	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.66	0.61	0.39	0.69	0.58	0.12	0.68
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.87	0.74	0.55	N/A	N/A	0.84	0.71
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	3.3	N/A	3.0	N/A	N/A	N/A
Vehicle Speed, mph	N/A	23.5	23.5	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	62.8	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	1.0	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	49.3	49.3	N/A	N/A	N/A	N/A
Windspeed, mph	4.5	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	69.8	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	77.0	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
Values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number 8
Location Sac
Test Day Fr
Test Date 9/12/1997
AM / PM PM
Scenario AR
AER Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	2.0	10.5	10.0	10.6	8.7	3.3	4.5
1,3-Butadiene, µg/m3	< 0.6	2.4	1.6	2.2	1.9	0.7	1.1
TCFM, µg/m3	6.8	2.9	3.0	3.0	9.8	6.3	6.7
Acetonitrile, µg/m3	18.6	53.2	52.0	2.0	27.1	11.2	27.5
DCM, µg/m3	5.9	< 2.2	< 2.2	< 2.2	5.3	5.3	5.5
MTBE, µg/m3	4.1	28.6	24.3	25.8	20.0	8.8	8.5
ETBE, µg/m3	< 2	< 2	< 2	< 2	2.4	< 2	< 2
Benzene, µg/m3	2.8	10.2	13.9	9.4	12.8	4.2	5.2
Toluene, µg/m3	5.6	28.1	27.7	24.2	23.0	9.4	10.5
Ethylbenzene, µg/m3	1.7	6.5	6.2	5.7	6.2	2.5	2.9
M,P-Xylene, µg/m3	3.5	22.9	22.1	19.9	18.8	6.5	7.6
O-Xylene, µg/m3	2.2	8.3	7.8	7.3	8.3	3.2	3.8
Formaldehyde, µg/m3	6.48	10.948	9.065	N/A	N/A	7.197	7.369
CO avg, ppm	< 2	2.0	5.1	NS	6.0	< 2	< 2
CO peak, ppm	< 2	10.0	14.0	NS	13.0	8.0	5.0
PM10 mass, µg/m3	23.1	< 19.74	< 19.74	N/A	N/A	22.6	< 19.74
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.57	0.52	0.30	0.62	0.26	0.44	0.44
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.44	0.53	0.30	N/A	N/A	0.45	0.56
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	< 0.6	N/A	3.1	N/A	N/A	N/A
Vehicle Speed, mph	N/A	24.6	24.6	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	91.8	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	3.8	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	49.2	49.2	N/A	N/A	N/A	N/A
Windspeed, mph	5.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	81.5	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	30.0	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	9
Location	Sac
Test Day	Sa
Test Date	9/13/1997
AM / PM	midday
Scenario	R
AER	Hi

Measure	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	3.6	1.1	1.7	1.3	0.9	0.7
1,3-Butadiene, µg/m3	0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
TCFM, µg/m3	2.2	2.2	1.9	2.2	2.8	3.2
Acetonitrile, µg/m3	29.8	39.9	3.0	12.4	2.2	3.4
DCM, µg/m3	< 2.2	2.6	< 2.2	< 2.2	2.4	2.8
MTBE, µg/m3	2.6	< 2	2.2	< 2	< 2	< 2
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	3.1	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
Toluene, µg/m3	7.4	3.2	4.1	3.0	< 2.2	2.2
Ethylbenzene, µg/m3	1.6	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6
M,P-Xylene, µg/m3	5.3	<2.4	2.6	<2.4	<2.4	<2.4
O-Xylene, µg/m3	<2.2	<2.2	<2.2	<2.2	<2.2	<2.2
Formaldehyde, µg/m3	4.902	5.772	N/A	N/A	4.997	4.282
CO avg, ppm	< 2	< 2	< 2	< 2	< 2	< 2
CO peak, ppm	22.0	6.0	8.0	11.0	< 2	< 2
PM10 mass, µg/m3	26.2	< 19.74	N/A	N/A	84.6	29.8
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.23	0.10	0.23	0.29	0.29	0.19
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.29	0.24	N/A	N/A	0.30	0.39
PM10 Cr, µg/m3	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	10	N/A	32	N/A	N/A	N/A
Black Carbon, µg/m3	< 0.6	N/A	1.4	N/A	N/A	N/A
Vehicle Speed, mph	53.2	53.2	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	122.1	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	1.0	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	152.0	152.0	N/A	N/A	N/A	N/A
Windspeed, mph	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	29.0	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
ues are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number 10
Location Sac
Test Day Mo
Test Date 9/15/1997
AM / PM AM
Scenario AR
AER Low

Measure	AMB	IN1	IN2	OUT1	OUT2
Isobutylene, µg/m3	3.6	11.0	8.4	10.2	9.1
1,3-Butadiene, µg/m3	0.9	2.8	1.7	2.8	2.4
TCFM, µg/m3	3.8	24.6	3.1	2.7	2.9
Acetonitrile, µg/m3	62.2	344.6	120.4	1.8	66.1
DCM, µg/m3	< 2.2	< 2.2	< 2.2	< 2.2	< 2.2
MTBE, µg/m3	11.7	36.3	22.0	33.4	22.0
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	4.2	12.1	10.0	11.2	9.9
Toluene, µg/m3	11.5	41.2	23.6	30.1	23.1
Ethylbenzene, µg/m3	2.9	9.7	5.7	8.0	5.8
M,P-Xylene, µg/m3	8.3	35.4	19.4	28.6	20.0
O-Xylene, µg/m3	3.4	12.4	7.1	10.4	7.2
Formaldehyde, µg/m3	3.263	13.945	11.105	N/A	N/A
CO avg, ppm	< 2	2.1	2.2	2.5	3.8
CO peak, ppm	3.0	8.0	8.0	18.0	11.0
PM10 mass, µg/m3	22.5	20.7	< 19.74	N/A	N/A
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	20.2	25.9
PM2.5 S, µg/m3	0.16	0.12	< 0.08	0.12	< 0.08
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	0.10	< 0.06
PM10 S, µg/m3	0.22	0.12	0.14	N/A	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A
PM10 Pb, µg/m3	< 0.06	0.08	< 0.06	N/A	N/A
Total Count (0.15-2.5 um),	N/A	33	N/A	139	N/A
Black Carbon, µg/m3	N/A	1.4	N/A	4.2	N/A
Vehicle Speed, mph	N/A	25.3	25.3	N/A	N/A
Vehicle Spacing, feet	N/A	53.1	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	1.9	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Total Mileage	N/A	52.1	52.1	N/A	N/A
Windspeed, mph	5.0	N/A	N/A	N/A	N/A
Temperature, deg. F	68.9	N/A	N/A	N/A	N/A
Relative Humidity, %	85.0	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	11
Location	Sac
Test Day	Mo
Test Date	9/15/1997
AM / PM	PM
Scenario	AR
AER	Low

Measure	AMB	IN1	IN2	OUT1	OUT2
Isobutylene, µg/m3	1.6	10.9	9.1	11.1	8.8
1,3-Butadiene, µg/m3	< 0.6	2.6	1.6	2.6	1.7
TCFM, µg/m3	3.8	2.8	2.8	3.0	2.2
Acetonitrile, µg/m3	43.0	131.6	455.9	1.9	244.6
DCM, µg/m3	5.3	< 2.2	< 2.2	< 2.2	< 2.2
MTBE, µg/m3	2.6	25.9	18.9	25.9	18.2
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	< 2.2	11.1	9.4	10.0	9.2
Toluene, µg/m3	7.0	45.9	19.8	25.7	20.2
Ethylbenzene, µg/m3	< 1.6	10.1	4.8	6.5	4.8
M,P-Xylene, µg/m3	2.9	38.2	16.7	23.0	16.6
O-Xylene, µg/m3	<2.2	13.0	5.9	8.3	5.9
Formaldehyde, µg/m3	3.369	12.483	18.481	N/A	N/A
CO avg, ppm	< 2	2.6	2.7	2.7	4.0
CO peak, ppm	< 2	9.0	4.0	23.0	16.0
PM10 mass, µg/m3	< 19.74	< 19.74	< 19.74	N/A	N/A
PM2.5 mass, µg/m3	< 19.74	< 19.74	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.19	0.09	0.08	0.15	0.17
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.22	0.09	0.13	N/A	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A
PM10 Mn, µg/m3	< 0.07	0.07	< 0.07	N/A	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A
Total Count (0.15-2.5 um),	N/A	N/A	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	< 0.6	N/A	2.1	N/A
Vehicle Speed, mph	N/A	22.9	22.9	N/A	N/A
Vehicle Spacing, feet	N/A	90.3	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	3.3	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	14.2%	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Total Mileage	N/A	45.8	45.8	N/A	N/A
Windspeed, mph	4.5	N/A	N/A	N/A	N/A
Temperature, deg. F	68.0	N/A	N/A	N/A	N/A
Relative Humidity, %	43.0	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
Values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	12
Location	Sac
Test Day	Tu
Test Date	9/16/1997
AM / PM	AM
Scenario	SB
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2
Isobutylene, µg/m3	1.3	3.3	3.1	2.7	3.2
1,3-Butadiene, µg/m3	< 0.6	0.7	0.8	< 0.6	0.9
TCFM, µg/m3	2.6	1.9	1.9	2.0	2.3
Acetonitrile, µg/m3	68.7	38.1	25.1	3.0	29.2
DCM, µg/m3	2.6	< 2.2	< 2.2	< 2.2	2.9
MTBE, µg/m3	2.8	8.7	7.4	7.6	7.0
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	< 2.2	3.7	3.6	3.2	3.4
Toluene, µg/m3	4.0	13.3	8.1	9.6	8.4
Ethylbenzene, µg/m3	< 1.6	2.8	1.9	2.1	1.8
M,P-Xylene, µg/m3	2.4	9.9	6.1	7.0	5.9
O-Xylene, µg/m3	<2.2	3.7	2.4	2.6	2.3
Formaldehyde, µg/m3	<3.1	4.598	10.869	N/A	N/A
CO avg, ppm	< 2	< 2	< 2	< 2	< 2
CO peak, ppm	< 2	2.0	3.0	3.0	4.0
PM10 mass, µg/m3	30.1	20.4	43.4	N/A	N/A
PM2.5 mass, µg/m3	< 19.74	< 19.74	22.8	< 19.74	< 19.74
PM2.5 S, µg/m3	0.28	0.24	0.21	0.09	0.26
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.28	0.33	0.28	N/A	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A
Total Count (0.15-2.5 um),	N/A	18	N/A	63	N/A
Black Carbon, µg/m3	N/A	0.9	N/A	4.8	N/A
Vehicle Speed, mph	N/A	14.6	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	129.1	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	1.0	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Total Mileage	N/A	0.0	N/A	N/A	N/A
Windspeed, mph	2.5	N/A	N/A	N/A	N/A
Temperature, deg. F	67.1	N/A	N/A	N/A	N/A
Relative Humidity, %	94.0	N/A	N/A	N/A	N/A

NOTES:

All contaminants in µg/m³ unless otherwise noted

N/A - No sample scheduled

NS - No sample, data lost or voided

< values are referenced to MDL's or MQL's defined in Table 3-3

Abbreviations defined in Section 7

Commute Number	13
Location	Sac
Test Day	Tu
Test Date	9/16/1997
AM / PM	PM
Scenario	SB
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2
Isobutylene, µg/m3	1.0	3.1	1.4	2.9	1.1
1,3-Butadiene, µg/m3	< 0.6	0.6	< 0.6	0.6	< 0.6
TCFM, µg/m3	1.5	1.3	1.3	1.5	1.0
Acetonitrile, µg/m3	64.7	30.2	10.0	2.2	28.8
DCM, µg/m3	7.6	< 2.2	< 2.2	< 2.2	< 2.2
MTBE, µg/m3	< 2	6.0	3.1	4.8	2.3
ETBE, µg/m3	< 2	< 2	< 2	< 2	< 2
Benzene, µg/m3	< 2.2	3.2	< 2.2	2.4	< 2.2
Toluene, µg/m3	3.3	11.0	3.8	6.5	3.7
Ethylbenzene, µg/m3	< 1.6	2.3	< 1.6	< 1.6	< 1.6
M,P-Xylene, µg/m3	<2.4	7.8	2.4	4.5	<2.4
O-Xylene, µg/m3	<2.2	2.8	<2.2	<2.2	<2.2
Formaldehyde, µg/m3	3.214	9.477	6.416	N/A	N/A
CO avg, ppm	< 2	< 2	NS	< 2	< 2
CO peak, ppm	< 2	3.0	NS	2.0	< 2
PM10 mass, µg/m3	28.9	31.9	20.7	N/A	N/A
PM2.5 mass, µg/m3	< 19.74	22.0	< 19.74	< 19.74	< 19.74
PM2.5 S, µg/m3	0.19	0.24	0.22	0.21	0.11
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.23	0.24	0.16	N/A	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A
Total Count (0.15-2.5 um),	N/A	29	N/A	129	N/A
Black Carbon, µg/m3	N/A	8.9	N/A	9.2	N/A
Vehicle Speed, mph	N/A	13.1	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	78.1	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	1.7	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Total Mileage	N/A	0.0	N/A	N/A	N/A
Windspeed, mph	3.0	N/A	N/A	N/A	N/A
Temperature, deg. F	75.2	N/A	N/A	N/A	N/A
Relative Humidity, %	36.0	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
lues are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	14
Location	LA
Test Day	Th
Test Date	9/25/1997
AM / PM	AM
Scenario	FNR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2
Isobutylene, µg/m3	4.0	15.3	13.4	15.1	13.5
1,3-Butadiene, µg/m3	0.7	4.1	3.4	4.0	3.5
TCFM, µg/m3	1.3	1.7	1.7	1.7	1.7
Acetonitrile, µg/m3	17.5	43.9	64.1	4.6	57.0
DCM, µg/m3	31.5	5.1	4.8	4.9	5.0
MTBE, µg/m3	9.9	32.1	28.1	31.1	28.9
ETBE, µg/m3	<1	<1	<1	<1	<1
Benzene, µg/m3	3.3	13.8	12.2	13.4	12.0
Toluene, µg/m3	67.9	42.3	37.5	43.2	41.5
Ethylbenzene, µg/m3	2.1	7.2	6.3	7.1	6.3
M,P-Xylene, µg/m3	6.7	27.7	23.4	26.7	23.8
O-Xylene, µg/m3	2.7	9.7	8.2	9.3	8.4
Formaldehyde, µg/m3	18.57	14.421	10.358	N/A	N/A
CO avg, ppm	< 2	4.1	3.9	4.8	4.0
CO peak, ppm	3.0	39.0	20.0	72.0	23.0
PM10 mass, µg/m3	36.9	61.0	58.6	N/A	N/A
PM2.5 mass, µg/m3	20.6	59.0	42.8	67.5	49.3
PM2.5 S, µg/m3	0.58	0.74	0.80	0.71	0.82
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	0.73	0.72	0.76	N/A	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A
Total Count (0.15-2.5 um),	N/A	4341	N/A	9227	N/A
Black Carbon, µg/m3	N/A	14.7	N/A	26.2	N/A
Vehicle Speed, mph	N/A	37.0	37.0	N/A	N/A
Vehicle Spacing, feet	N/A	18.9	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	4.3	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	90.8%	N/A	N/A	N/A
Total Mileage	N/A	74.1	74.0	N/A	N/A
Windspeed, mph	4.0	N/A	N/A	N/A	N/A
Temperature, deg. F	74.5	N/A	N/A	N/A	N/A
Relative Humidity, %	54.5	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	15
Location	LA
Test Day	Fr
Test Date	9/26/1997
AM / PM	AM
Scenario	FR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	2.0	11.6	15.1	16.1	14.3	16.6	7.4
1,3-Butadiene, µg/m3	0.3	2.9	3.6	4.3	3.5	3.7	1.5
TCFM, µg/m3	1.3	0.9	1.7	2.2	1.7	2.0	1.9
Acetonitrile, µg/m3	19.3	43.3	52.1	4.5	45.9	6.3	8.3
DCM, µg/m3	1.3	1.4	4.6	5.4	4.7	2.1	2.2
MTBE, µg/m3	5.4	19.7	29.0	30.6	26.3	32.9	17.7
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	1.8	9.8	14.3	14.1	12.9	14.5	6.8
Toluene, µg/m3	25.0	22.6	29.1	31.2	27.4	70.5	58.5
Ethylbenzene, µg/m3	1.1	4.7	5.9	6.3	5.2	6.6	3.1
M,P-Xylene, µg/m3	3.6	17.3	22.8	24.4	20.2	23.5	10.3
O-Xylene, µg/m3	1.4	6.1	8.2	8.6	7.3	8.6	3.8
Formaldehyde, µg/m3	<3.1	17	20.722	N/A	N/A	9.122	NS
CO avg, ppm	< 2	6.0	4.4	5.4	5.0	4.4	< 2
CO peak, ppm	< 2	67.0	12.0	41.0	13.0	11.0	3.0
PM10 mass, µg/m3	49.3	64.8	45.2	N/A	N/A	55.8	67.6
PM2.5 mass, µg/m3	24.8	47.8	38.9	60.8	47.9	42.9	35.3
PM2.5 S, µg/m3	1.56	1.40	1.44	1.45	1.41	1.50	1.64
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	1.64	1.44	1.32	N/A	N/A	1.53	1.79
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	3606	N/A	6784	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	13.4	N/A	20.1	N/A	N/A	N/A
Vehicle Speed, mph	N/A	48.0	47.5	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	5.2	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	3.7	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	84.2%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	93.4	95.0	N/A	N/A	N/A	N/A
Windspeed, mph	2.5	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	71.5	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	55	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
Values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	**16**
Location	**LA**
Test Day	**Fr**
Test Date	**9/26/1997**
AM / PM	**PM**
Scenario	**FR**
AER	**Hi**

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	2.6	13.4	16.7	14.4	15.4	12.1	6.0
1,3-Butadiene, µg/m3	0.4	2.8	3.5	3.1	3.2	2.8	1.2
TCFM, µg/m3	1.6	1.5	1.7	1.6	1.7	1.8	1.7
Acetonitrile, µg/m3	27.6	42.1	39.3	2.8	29.1	4.6	111.7
DCM, µg/m3	1.2	1.2	1.5	1.3	1.5	1.9	1.4
MTBE, µg/m3	7.3	30.0	33.5	32.3	31.3	25.1	15.3
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	2.5	12.4	15.6	12.5	14.5	11.1	5.4
Toluene, µg/m3	18.0	29.5	32.4	28.4	30.7	46.7	35.5
Ethylbenzene, µg/m3	1.5	6.3	6.7	6.0	6.2	5.2	2.7
M,P-Xylene, µg/m3	4.6	23.5	25.2	22.5	23.4	17.7	9.0
O-Xylene, µg/m3	1.9	8.6	8.9	8.1	8.2	6.6	3.4
Formaldehyde, µg/m3	6.916	16.872	16.292	N/A	N/A	15.409	9.356
CO avg, ppm	< 2	4.3	5.1	4.3	3.9	3.3	< 2
CO peak, ppm	< 2	49.0	22.0	33.0	20.0	5.0	5.0
PM10 mass, µg/m3	51.8	46.0	44.1	N/A	N/A	60.6	43.9
PM2.5 mass, µg/m3	20.8	38.0	28.1	37.9	32.9	37.2	37.6
PM2.5 S, µg/m3	1.33	1.54	1.49	1.35	1.47	1.85	1.32
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	1.46	1.53	1.35	N/A	N/A	1.97	1.38
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	2430	N/A	5202	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	7.9	N/A	14.5	N/A	N/A	N/A
Vehicle Speed, mph	N/A	37.4	38.0	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	66.4	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	3.3	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	20.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	70.8%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	74.8	76.0	N/A	N/A	N/A	N/A
Windspeed, mph	8.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	74.5	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	52	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	17
Location	LA
Test Day	Sa
Test Date	9/27/1997
AM / PM	PM
Scenario	ANR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2
Isobutylene, µg/m3	4.2	19.5	17.1	18.9	13.1
1,3-Butadiene, µg/m3	<0.3	3.4	2.3	3.2	1.7
TCFM, µg/m3	2.0	1.8	2.1	1.7	1.6
Acetonitrile, µg/m3	8.7	100.1	50.7	3.6	40.9
DCM, µg/m3	2.9	2.1	2.5	1.9	2.1
MTBE, µg/m3	17.6	41.8	33.5	38.9	28.2
ETBE, µg/m3	<1	<1	<1	<1	<1
Benzene, µg/m3	4.8	14.3	13.0	13.2	10.5
Toluene, µg/m3	19.3	35.0	27.5	31.5	23.2
Ethylbenzene, µg/m3	2.4	7.6	5.5	6.8	4.7
M,P-Xylene, µg/m3	5.4	27.5	20.1	24.4	16.8
O-Xylene, µg/m3	2.5	9.8	7.4	8.9	6.2
Formaldehyde, µg/m3	15.415	17.3	7.244	N/A	N/A
CO avg, ppm	< 2	3.1	4.1	2.9	4.8
CO peak, ppm	< 2	17.0	13.0	18.0	18.0
PM10 mass, µg/m3	59.2	53.7	37.1	N/A	N/A
PM2.5 mass, µg/m3	42.3	49.3	41.1	52.1	42.2
PM2.5 S, µg/m3	1.97	1.77	1.77	1.76	1.60
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	2.26	1.80	1.73	N/A	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A
Total Count (0.15-2.5 um),	N/A	2621	N/A	4610	N/A
Black Carbon, µg/m3	N/A	7.6	N/A	7.7	N/A
Vehicle Speed, mph	N/A	22.1	22.8	N/A	N/A
Vehicle Spacing, feet	N/A	56.7	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.1	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	5.0%	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Total Mileage	N/A	94.2	45.5	N/A	N/A
Windspeed, mph	9.0	N/A	N/A	N/A	N/A
Temperature, deg. F	83.5	N/A	N/A	N/A	N/A
Relative Humidity, %	42.5	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
Values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	18
Location	LA
Test Day	Su
Test Date	9/28/1997
AM / PM	AM
Scenario	ANR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2
Isobutylene, µg/m3	7.5	23.5	19.0	24.5	21.8
1,3-Butadiene, µg/m3	0.8	3.7	2.4	3.8	2.8
TCFM, µg/m3	1.9	1.8	1.8	1.9	2.0
Acetonitrile, µg/m3	8.0	27.7	24.2	2.5	27.0
DCM, µg/m3	4.4	3.3	3.0	3.2	3.5
MTBE, µg/m3	34.9	78.1	52.2	79.5	57.5
ETBE, µg/m3	<1	<1	<1	<1	<1
Benzene, µg/m3	8.5	19.0	14.7	18.9	15.8
Toluene, µg/m3	27.1	53.9	38.2	53.2	40.6
Ethylbenzene, µg/m3	4.6	11.8	7.5	11.8	8.1
M,P-Xylene, µg/m3	13.4	43.6	27.3	43.5	28.7
O-Xylene, µg/m3	5.4	15.9	10.3	16.6	10.5
Formaldehyde, µg/m3	22.764	22.183	23.626	N/A	N/A
CO avg, ppm	< 2	5.2	5.0	6.0	6.2
CO peak, ppm	3.0	31.0	12.0	39.0	16.0
PM10 mass, µg/m3	139.2	85.5	79.7	N/A	N/A
PM2.5 mass, µg/m3	84.6	86.0	71.7	94.1	56.1
PM2.5 S, µg/m3	1.98	1.69	1.47	1.75	1.40
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	0.07	< 0.06
PM10 S, µg/m3	2.27	1.63	1.51	N/A	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A
Total Count (0.15-2.5 um),	N/A	4606	N/A	7457	N/A
Black Carbon, µg/m3	N/A	22.9	N/A	16.5	N/A
Vehicle Speed, mph	N/A	26.3	26.0	N/A	N/A
Vehicle Spacing, feet	N/A	54.2	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	1.0	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	7.5%	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Total Mileage	N/A	22.0	52.0	N/A	N/A
Windspeed, mph	2.0	N/A	N/A	N/A	N/A
Temperature, deg. F	90.0	N/A	N/A	N/A	N/A
Relative Humidity, %	31	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	19
Location	LA
Test Day	Su
Test Date	9/28/1997
AM / PM	PM
Scenario	FNR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2
Isobutylene, µg/m3	7.6	19.2	16.0	20.4	20.7
1,3-Butadiene, µg/m3	<0.3	4.1	3.1	4.1	3.8
TCFM, µg/m3	1.4	1.6	1.7	1.7	2.0
Acetonitrile, µg/m3	1.8	6.3	27.8	2.4	22.5
DCM, µg/m3	2.3	2.0	2.5	2.0	2.3
MTBE, µg/m3	20.6	50.7	40.7	52.3	51.9
ETBE, µg/m3	<1	<1	<1	<1	<1
Benzene, µg/m3	4.5	15.1	12.8	15.6	15.9
Toluene, µg/m3	11.9	35.3	28.4	35.3	35.8
Ethylbenzene, µg/m3	2.2	7.5	5.8	7.6	7.3
M,P-Xylene, µg/m3	4.7	26.1	19.6	26.6	25.3
O-Xylene, µg/m3	2.2	9.6	7.3	9.8	9.4
Formaldehyde, µg/m3	23.718	NS	16.191	N/A	N/A
CO avg, ppm	2.3	4.6	5.0	3.9	5.4
CO peak, ppm	3.0	14.0	15.0	17.0	17.0
PM10 mass, µg/m3	70.7	72.1	67.3	N/A	N/A
PM2.5 mass, µg/m3	46.0	50.5	47.0	69.1	45.0
PM2.5 S, µg/m3	2.85	2.47	1.89	2.87	2.81
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	2.64	2.57	2.73	N/A	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A
Total Count (0.15-2.5 um),	N/A	3733	N/A	7830	N/A
Black Carbon, µg/m3	N/A	9.4	N/A	6.7	N/A
Vehicle Speed, mph	N/A	57.7	57.5	N/A	N/A
Vehicle Spacing, feet	N/A	72.6	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	3.0	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A
Total Mileage	N/A	116.4	115.0	N/A	N/A
Windspeed, mph	9.0	N/A	N/A	N/A	N/A
Temperature, deg. F	91.0	N/A	N/A	N/A	N/A
Relative Humidity, %	36	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
...ues are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	20
Location	LA
Test Day	Mo
Test Date	9/29/1997
AM / PM	AM
Scenario	FR
AER	Low

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	12.6	25.0	25.0	23.2	24.7	22.7	20.6
1,3-Butadiene, µg/m3	1.7	5.7	5.1	5.0	5.3	4.9	4.2
TCFM, µg/m3	2.0	2.2	2.1	2.0	2.0	2.0	1.8
Acetonitrile, µg/m3	25.5	142.0	258.9	8.3	132.6	3.0	12.2
DCM, µg/m3	4.0	4.3	3.6	3.8	3.9	2.4	3.9
MTBE, µg/m3	30.3	64.1	54.6	61.9	56.3	58.5	47.0
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	8.6	21.9	20.2	19.5	20.3	19.5	15.5
Toluene, µg/m3	22.7	52.4	39.7	46.7	42.9	48.4	39.0
Ethylbenzene, µg/m3	4.4	11.5	7.7	10.0	8.5	9.7	7.5
M,P-Xylene, µg/m3	15.4	45.4	28.9	38.4	32.9	36.9	27.7
O-Xylene, µg/m3	5.6	15.9	10.7	13.5	11.8	13.2	9.9
Formaldehyde, µg/m3	7.28	14.742	17.663	N/A	N/A	14.793	15.564
CO avg, ppm	< 2	5.8	7.6	7.4	9.0	5.2	4.6
CO peak, ppm	3.0	13.0	10.0	36.0	17.0	10.0	8.0
PM10 mass, µg/m3	70.1	56.3	32.6	N/A	N/A	93.0	129.8
PM2.5 mass, µg/m3	43.3	56.0	38.5	65.7	58.2	53.1	76.0
PM2.5 S, µg/m3	0.93	0.97	0.73	1.03	0.80	0.99	1.15
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	1.16	0.88	0.71	N/A	N/A	1.29	1.35
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	3547	N/A	8849	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	10.6	N/A	26.6	N/A	N/A	N/A
Vehicle Speed, mph	N/A	40.8	40.4	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	66.1	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.9	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	79.2%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	81.6	80.8	N/A	N/A	N/A	N/A
Windspeed, mph	2.5	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	76.5	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	50.5	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:

All contaminants in µg/m³ unless otherwise noted

N/A - No sample scheduled

NS - No sample, data lost or voided

< values are referenced to MDL's or MQL's defined in Table 3-3

Abbreviations defined in Section 7

Commute Number 21
Location LA
Test Day Mo
Test Date 9/29/1997
AM / PM PM
Scenario FR
AER Low

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	3.8	16.1	14.1	17.3	14.7	13.5	11.0
1,3-Butadiene, µg/m3	0.4	3.7	2.6	3.9	2.9	2.9	1.7
TCFM, µg/m3	2.2	1.7	1.3	1.6	1.5	1.8	1.8
Acetonitrile, µg/m3	7.1	375.3	374.8	7.3	179.5	3.1	9.7
DCM, µg/m3	5.3	3.5	2.4	2.5	2.3	2.9	3.4
MTBE, µg/m3	10.9	37.2	28.8	41.0	31.5	31.6	29.5
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	3.1	13.5	11.9	13.9	12.9	11.8	9.5
Toluene, µg/m3	10.5	31.6	23.7	31.4	26.9	30.2	22.5
Ethylbenzene, µg/m3	2.0	7.3	4.5	6.7	5.1	5.9	4.3
M,P-Xylene, µg/m3	6.1	26.5	16.7	25.5	19.2	20.6	15.6
O-Xylene, µg/m3	2.4	9.6	6.3	9.3	7.0	8.0	6.1
Formaldehyde, µg/m3	10.936	16.7	17.485	N/A	N/A	16.884	15.421
CO avg, ppm	< 2	4.0	4.4	4.2	4.3	3.2	2.4
CO peak, ppm	< 2	7.0	7.0	16.0	9.0	6.0	5.0
PM10 mass, µg/m3	66.9	52.4	22.9	N/A	N/A	83.8	83.6
PM2.5 mass, µg/m3	39.7	36.1	22.7	50.4	29.4	37.5	37.6
PM2.5 S, µg/m3	1.53	1.40	1.06	1.83	1.30	1.82	1.66
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	1.96	1.46	1.00	N/A	N/A	1.93	2.19
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	2258	N/A	6059	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	9.9	N/A	9.7	N/A	N/A	N/A
Vehicle Speed, mph	N/A	42.7	43.1	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	64.1	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	3.4	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	72.5%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	86.9	86.1	N/A	N/A	N/A	N/A
Windspeed, mph	6.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	79.0	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	46	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< :es are referenced to MDL's or MQL's defined in Table 3-3
A..reviations defined in Section 7

Commute Number	22
Location	LA
Test Day	Tu
Test Date	9/30/1997
AM / PM	AM
Scenario	FRC
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	3.0	16.4	20.3	15.8	21.1	13.2	14.6
1,3-Butadiene, µg/m3	0.4	3.8	4.4	3.6	4.3	2.5	3.3
TCFM, µg/m3	1.5	1.5	1.5	1.5	1.5	1.4	1.7
Acetonitrile, µg/m3	104.0	50.8	75.3	2.4	51.3	1.9	4.5
DCM, µg/m3	< 2.2	< 2.2	3.2	< 2.2	3.9	< 2.2	< 2.2
MTBE, µg/m3	8.2	35.0	46.5	34.6	45.5	30.8	29.2
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	2.5	14.8	18.6	13.8	18.3	11.6	12.5
Toluene, µg/m3	8.3	36.1	57.6	32.6	56.5	28.3	27.2
Ethylbenzene, µg/m3	1.3	7.2	8.0	6.3	7.9	5.4	5.2
M,P-Xylene, µg/m3	4.5	28.9	30.9	25.1	30.2	20.6	20.2
O-Xylene, µg/m3	1.7	10.3	11.2	9.1	10.7	7.6	7.3
Formaldehyde, µg/m3	4.925	14.126	18.627	N/A	N/A	10.966	12.462
CO avg, ppm	< 2	4.2	4.9	3.2	5.5	2.8	4.2
CO peak, ppm	< 2	12.0	15.0	13.0	18.0	8.0	9.0
PM10 mass, µg/m3	109.5	49.1	67.5	N/A	N/A	126.1	124.0
PM2.5 mass, µg/m3	53.9	39.3	39.1	< 19.74	99.8	61.8	78.1
PM2.5 S, µg/m3	2.87	2.22	2.03	0.29	2.18	2.55	2.83
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	0.06	< 0.06
PM10 S, µg/m3	3.35	2.19	2.20	N/A	N/A	3.26	3.20
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	2817	N/A	5289	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	3.3	N/A	13.3	N/A	N/A	N/A
Vehicle Speed, mph	N/A	47.4	29.3	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	89.0	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.8	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	98.3	58.6	N/A	N/A	N/A	N/A
Windspeed, mph	2.5	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	74.0	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	54.5	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number 23
Location LA
Test Day Tu
Test Date 9/30/1997
AM / PM PM
Scenario FRC
AER Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	4.7	12.1	18.5	12.7	19.0	13.2	10.9
1,3-Butadiene, µg/m3	0.4	2.2	3.7	2.2	3.4	2.7	2.1
TCFM, µg/m3	1.5	1.5	1.5	1.5	1.8	1.6	2.4
Acetonitrile, µg/m3	49.9	41.6	62.9	1.8	45.5	2.1	14.4
DCM, µg/m3	2.8	3.4	3.5	3.5	4.0	3.9	7.7
MTBE, µg/m3	12.2	27.4	47.5	27.9	50.1	28.3	22.2
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	3.6	10.6	16.1	10.8	16.5	11.7	9.2
Toluene, µg/m3	12.4	26.8	44.0	27.0	36.1	28.8	21.2
Ethylbenzene, µg/m3	2.0	4.9	8.0	5.0	7.3	5.1	3.8
M,P-Xylene, µg/m3	5.9	18.3	31.0	18.8	28.4	18.7	13.7
O-Xylene, µg/m3	2.3	6.7	11.1	6.8	10.3	7.0	5.1
Formaldehyde, µg/m3	12.95	13.941	15.414	N/A	N/A	20.25	18.001
CO avg, ppm	< 2	2.9	4.9	2.5	5.7	3.3	4.0
CO peak, ppm	< 2	6.0	22.0	9.0	30.0	7.0	10.0
PM10 mass, µg/m3	95.6	73.2	74.6	N/A	N/A	119.2	120.9
PM2.5 mass, µg/m3	62.4	54.6	47.5	80.4	58.0	64.1	74.8
PM2.5 S, µg/m3	5.30	3.94	3.62	4.37	4.27	4.65	4.44
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	6.11	4.15	3.94	N/A	N/A	5.02	5.13
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	NS	N/A	NS	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	5.5	N/A	NS	N/A	N/A	N/A
Vehicle Speed, mph	N/A	47.9	38.4	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	87.1	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.8	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	95.9	76.8	N/A	N/A	N/A	N/A
Windspeed, mph	8.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	73.5	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	59.5	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
Values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	24
Location	LA
Test Day	We
Test Date	10/1/1997
AM / PM	AM
Scenario	AR
AER	Low

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	4.8	23.3	20.5	24.0	19.9	10.4	7.4
1,3-Butadiene, µg/m3	0.5	4.5	3.5	4.9	3.5	1.7	1.0
TCFM, µg/m3	1.7	1.6	1.7	1.6	1.6	1.7	1.7
Acetonitrile, µg/m3	107.1	237.4	520.0	2.6	316.8	9.7	103.6
DCM, µg/m3	3.4	3.2	2.4	2.5	< 2.2	2.8	2.5
MTBE, µg/m3	13.4	50.3	38.6	51.4	39.2	22.4	18.1
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	3.9	20.7	14.9	21.5	15.2	8.5	6.2
Toluene, µg/m3	12.2	49.6	34.0	51.4	36.0	22.7	17.0
Ethylbenzene, µg/m3	2.0	10.2	6.2	10.4	6.8	4.0	3.1
M,P-Xylene, µg/m3	6.7	40.6	24.4	42.9	26.8	14.8	11.5
O-Xylene, µg/m3	2.6	14.1	8.9	15.2	9.6	5.6	4.2
Formaldehyde, µg/m3	NS	15.835	19.871	N/A	N/A	18.81	9.315
CO avg, ppm	< 2	6.0	5.0	6.6	6.2	< 2	< 2
CO peak, ppm	< 2	23.0	9.0	40.0	15.0	7.0	2.0
PM10 mass, µg/m3	159.1	53.1	111.0	N/A	N/A	143.5	166.0
PM2.5 mass, µg/m3	106.0	53.1	45.1	112.9	70.9	102.8	102.2
PM2.5 S, µg/m3	4.48	2.98	2.46	4.14	3.02	4.23	4.30
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	5.55	3.45	4.05	N/A	N/A	4.94	5.24
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	2868	N/A	6954	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	4.1	N/A	15.5	N/A	N/A	N/A
Vehicle Speed, mph	N/A	23.1	23.0	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	50.1	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.9	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	48.1	46.0	N/A	N/A	N/A	N/A
Windspeed, mph	2.5	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	71.0	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	[illegible]	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	25
Location	LA
Test Day	We
Test Date	10/1/1997
AM / PM	PM
Scenario	AR
AER	Low

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	5.3	13.8	16.2	16.7	14.7	8.8	7.1
1,3-Butadiene, µg/m3	0.4	2.1	2.1	3.0	2.1	1.3	1.0
TCFM, µg/m3	2.4	1.5	1.7	1.9	1.8	1.7	1.8
Acetonitrile, µg/m3	2.1	495.9	444.4	2.2	280.7	2.7	3.7
DCM, µg/m3	4.2	3.4	3.4	3.0	3.7	3.5	4.1
MTBE, µg/m3	12.4	24.3	24.9	32.1	23.8	18.5	15.4
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	3.4	10.2	10.6	12.9	10.3	6.3	5.2
Toluene, µg/m3	12.2	28.1	26.8	34.4	26.4	18.3	15.9
Ethylbenzene, µg/m3	2.0	5.9	5.3	6.7	5.1	3.5	2.8
M,P-Xylene, µg/m3	6.3	19.4	19.9	26.3	19.6	12.3	9.7
O-Xylene, µg/m3	2.5	7.1	7.9	9.4	7.5	4.7	3.7
Formaldehyde, µg/m3	17.142	19.6	22.625	N/A	N/A	15.229	13.23
CO avg, ppm	< 2	3.8	4.3	3.3	5.0	< 2	< 2
CO peak, ppm	< 2	7.0	6.0	25.0	10.0	3.0	3.0
PM10 mass, µg/m3	66.9	51.7	39.3	N/A	N/A	78.0	67.5
PM2.5 mass, µg/m3	35.6	43.5	31.2	56.4	37.6	55.8	50.8
PM2.5 S, µg/m3	3.20	2.59	2.54	3.11	2.64	4.04	2.99
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	3.27	2.72	2.86	N/A	N/A	4.49	3.45
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	2788	N/A	4746	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	12.9	N/A	11.6	N/A	N/A	N/A
Vehicle Speed, mph	N/A	19.1	28.5	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	54.0	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	3.0	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	37.5	57.0	N/A	N/A	N/A	N/A
Windspeed, mph	9.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	73.0	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	55.5	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
…ues are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	26
Location	LA
Test Day	Th
Test Date	10/2/1997
AM / PM	AM
Scenario	AR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	2.9	20.4	16.2	15.3	14.5	6.6	3.2
1,3-Butadiene, µg/m3	0.4	4.4	3.1	3.3	2.7	1.3	0.4
TCFM, µg/m3	1.4	1.7	1.7	1.5	1.4	1.5	1.7
Acetonitrile, µg/m3	2.0	48.1	122.0	2.0	53.4	3.9	167.2
DCM, µg/m3	2.8	2.7	5.0	4.0	3.8	4.1	4.1
MTBE, µg/m3	6.4	41.4	33.4	34.5	29.0	14.3	6.9
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	2.1	16.5	14.1	13.8	12.1	5.6	2.3
Toluene, µg/m3	6.9	41.4	32.0	30.5	28.5	14.6	6.9
Ethylbenzene, µg/m3	1.1	8.3	6.2	6.1	5.5	2.8	1.2
M,P-Xylene, µg/m3	4.1	33.5	24.9	24.9	22.2	11.0	4.3
O-Xylene, µg/m3	1.5	11.6	8.8	8.7	7.8	4.1	1.6
Formaldehyde, µg/m3	5.381	13.876	13.453	N/A	N/A	8.623	4.41
CO avg, ppm	< 2	4.1	4.7	4.7	4.5	< 2	< 2
CO peak, ppm	< 2	48.0	10.0	77.0	16.0	6.0	< 2
PM10 mass, µg/m3	31.0	42.9	26.6	N/A	N/A	61.7	31.0
PM2.5 mass, µg/m3	< 19.74	38.9	32.7	45.7	< 19.74	39.3	< 19.74
PM2.5 S, µg/m3	1.27	1.68	1.49	1.80	1.59	1.82	1.38
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	1.75	1.63	1.68	N/A	N/A	2.15	1.59
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	2850	N/A	4950	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	7.5	N/A	16.0	N/A	N/A	N/A
Vehicle Speed, mph	N/A	25.1	40.0	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	67.3	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.6	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	50.2	80.0	N/A	N/A	N/A	N/A
Windspeed, mph	3.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	71.5	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	55	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	27
Location	LA
Test Day	Th
Test Date	10/2/1997
AM / PM	PM
Scenario	AR
AER	Hi

Measure	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Isobutylene, µg/m3	4.2	13.1	13.5	12.6	14.1	7.2	6.1
1,3-Butadiene, µg/m3	0.3	2.5	2.2	2.3	2.4	1.0	0.5
TCFM, µg/m3	1.4	1.4	1.4	1.3	1.5	1.8	1.5
Acetonitrile, µg/m3	9.1	38.9	23.1	1.7	22.0	2.4	30.7
DCM, µg/m3	3.9	3.0	3.3	3.0	3.3	13.9	3.9
MTBE, µg/m3	6.7	28.0	25.5	26.5	25.5	15.7	8.4
ETBE, µg/m3	<1	<1	<1	<1	<1	<1	<1
Benzene, µg/m3	2.0	10.6	10.5	10.1	10.6	5.2	2.8
Toluene, µg/m3	7.2	28.8	27.5	27.5	27.9	27.4	8.4
Ethylbenzene, µg/m3	1.2	5.5	5.1	5.3	5.2	3.0	1.5
M,P-Xylene, µg/m3	4.0	22.0	20.3	20.3	20.7	10.8	5.1
O-Xylene, µg/m3	1.5	7.7	7.2	7.3	7.5	4.1	1.9
Formaldehyde, µg/m3	6.646	12.679	11.293	N/A	N/A	11.187	9.119
CO avg, ppm	< 2	3.0	3.6	2.8	3.7	< 2	< 2
CO peak, ppm	< 2	15.0	11.0	19.0	17.0	4.0	2.0
PM10 mass, µg/m3	52.1	34.6	28.9	N/A	N/A	57.9	52.0
PM2.5 mass, µg/m3	33.8	28.5	22.6	41.0	27.0	35.1	26.9
PM2.5 S, µg/m3	3.43	2.50	2.60	3.03	2.24	2.98	3.82
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	3.91	2.70	2.48	N/A	N/A	3.56	4.40
PM10 Cr, µg/m3	< 0.8	< 0.8	< 0.8	N/A	N/A	< 0.8	< 0.8
PM10 Mn, µg/m3	< 0.07	< 0.07	< 0.07	N/A	N/A	< 0.07	< 0.07
PM10 Ni, µg/m3	< 0.05	< 0.05	< 0.05	N/A	N/A	< 0.05	< 0.05
PM10 Cd, µg/m3	< 0.2	< 0.2	< 0.2	N/A	N/A	< 0.2	< 0.2
PM10 Pb, µg/m3	< 0.06	< 0.06	< 0.06	N/A	N/A	< 0.06	< 0.06
Total Count (0.15-2.5 um),	N/A	2253	N/A	4029	N/A	N/A	N/A
Black Carbon, µg/m3	N/A	5.4	N/A	9.0	N/A	N/A	N/A
Vehicle Speed, mph	N/A	19.7	18.0	N/A	N/A	N/A	N/A
Vehicle Spacing, feet	N/A	49.2	N/A	N/A	N/A	N/A	N/A
Level of Congestion (unitless)	N/A	2.4	N/A	N/A	N/A	N/A	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A	N/A	N/A	N/A	N/A
Total Mileage	N/A	36.1	36.0	N/A	N/A	N/A	N/A
Windspeed, mph	8.0	N/A	N/A	N/A	N/A	N/A	N/A
Temperature, deg. F	72.0	N/A	N/A	N/A	N/A	N/A	N/A
Relative Humidity, %	59.9	N/A	N/A	N/A	N/A	N/A	N/A

NOTES:
All contaminants in µg/m3 unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
lues are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number 28
Location LA
Test Day Fr
Test Date 10/3/1997
AM / PM AM
Scenario MC
AER Hi

Measure	AMB	IN1	OUT1
Isobutylene, µg/m3	4.5	23.9	19.9
1,3-Butadiene, µg/m3	0.5	4.4	3.8
TCFM, µg/m3	1.8	1.8	1.5
Acetonitrile, µg/m3	103.0	27.3	2.2
DCM, µg/m3	5.6	5.4	4.2
MTBE, µg/m3	11.2	90.0	72.4
ETBE, µg/m3	<1	<1	<1
Benzene, µg/m3	3.0	18.1	15.7
Toluene, µg/m3	10.8	42.0	41.5
Ethylbenzene, µg/m3	1.7	9.3	8.8
M,P-Xylene, µg/m3	6.0	39.5	36.1
O-Xylene, µg/m3	2.3	13.9	12.8
Formaldehyde, µg/m3	6.033	16.908	N/A
CO avg, ppm	< 2	4.4	4.6
CO peak, ppm	< 2	30.0	31.0
PM10 mass, µg/m3	63.8	73.2	N/A
PM2.5 mass, µg/m3	32.1	59.3	81.1
PM2.5 S, µg/m3	1.80	2.17	2.49
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	2.57	2.58	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	N/A
Total Count (0.15-2.5 um),	N/A	4237	7339
Black Carbon, µg/m3	N/A	21.4	21.6
Vehicle Speed, mph	N/A	21.6	N/A
Vehicle Spacing, feet	N/A	71.2	N/A
Level of Congestion (unitless)	N/A	2.9	N/A
Diesel Bus Influence (% of commute)	N/A	10.0%	N/A
HD Diesel Truck Influence (% of commute)	N/A	0.0%	N/A
Other Diesel Influence (% of commute)	N/A	0.0%	N/A
Total Mileage	N/A	43.1	N/A
Windspeed, mph	3.5	N/A	N/A
Temperature, deg. F	70.5	N/A	N/A
Relative Humidity, %	54.5	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute Number	29
Location	LA
Test Day	Fr
Test Date	10/3/1997
AM / PM	PM
Scenario	MC
AER	Hi

Measure	AMB	IN1	OUT1
Isobutylene, µg/m3	4.1	19.1	19.2
1,3-Butadiene, µg/m3	<0.3	5.0	4.9
TCFM, µg/m3	1.7	2.5	2.5
Acetonitrile, µg/m3	2.6	28.6	2.6
DCM, µg/m3	5.4	3.7	3.9
MTBE, µg/m3	10.2	30.3	29.4
ETBE, µg/m3	<1	<1	<1
Benzene, µg/m3	2.8	16.2	15.4
Toluene, µg/m3	9.7	33.6	32.2
Ethylbenzene, µg/m3	1.6	6.7	6.3
M,P-Xylene, µg/m3	4.5	25.6	23.3
O-Xylene, µg/m3	1.9	9.1	8.4
Formaldehyde, µg/m3	14.141	14.286	N/A
CO avg, ppm	< 2	4.6	4.4
CO peak, ppm	< 2	21.0	23.0
PM10 mass, µg/m3	50.0	105.0	N/A
PM2.5 mass, µg/m3	< 19.74	106.7	96.6
PM2.5 S, µg/m3	2.32	2.03	2.09
PM2.5 Cr, µg/m3	< 0.8	< 0.8	< 0.8
PM2.5 Mn, µg/m3	< 0.07	< 0.07	< 0.07
PM2.5 Ni, µg/m3	< 0.05	< 0.05	< 0.05
PM2.5 Cd, µg/m3	< 0.2	< 0.2	< 0.2
PM2.5 Pb, µg/m3	< 0.06	< 0.06	< 0.06
PM10 S, µg/m3	2.92	2.02	N/A
PM10 Cr, µg/m3	< 0.8	< 0.8	N/A
PM10 Mn, µg/m3	< 0.07	< 0.07	N/A
PM10 Ni, µg/m3	< 0.05	< 0.05	N/A
PM10 Cd, µg/m3	< 0.2	< 0.2	N/A
PM10 Pb, µg/m3	< 0.06	< 0.06	N/A
Total Count (0.15-2.5 um),	N/A	4413	7326
Black Carbon, µg/m3	N/A	20.4	18.1
Vehicle Speed, mph	N/A	20.0	N/A
Vehicle Spacing, feet	N/A	64.4	N/A
Level of Congestion (unitless)	N/A	3.5	N/A
Diesel Bus Influence (% of commute)	N/A	0.0%	N/A
HD Diesel Truck Influence (% of commute)	N/A	25.8%	N/A
Other Diesel Influence (% of commute)	N/A	11.7%	N/A
Total Mileage	N/A	38.6	N/A
Windspeed, mph	9.5	N/A	N/A
Temperature, deg. F	76.0	N/A	N/A
Relative Humidity, %	47.5	N/A	N/A

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
lues are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Appendix I

Measurement Data for Individual Commutes (Non-Target Elements)

- Data for Sacramento Commutes 1 thru 13, and LA Commutes 14 thru 29

Commute #	**1**
Location	**Sac**
Test Day	**Tu**
Test Date	**9/9/97**
AM / PM	**AM**
Scenario	**FNR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**0.75**	**0.90**	< 0.68	< 0.68	< 0.68	< 0.68	**1.55**
Mg, PM2.5	< 0.29	**0.83**	**0.62**	< 0.29	**0.81**	**0.30**	**0.62**
Al, PM2.5	**0.22**	**0.28**	< 0.16	< 0.16	< 0.16	< 0.16	**0.31**
Si, PM2.5	**0.16**	**0.56**	**0.30**	**0.56**	**0.36**	**0.35**	**0.37**
P, PM2.5	< 0.08	< 0.08	**0.12**	< 0.08	**0.13**	< 0.08	**0.09**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	**0.15**	< 0.12	< 0.12
Ca, PM2.5	< 0.13	**0.15**	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.10**	**0.50**	**0.11**	**0.58**	**0.75**	**0.05**	**0.07**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.06**	**0.04**	< 0.04	< 0.04	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in $\mu g/m^3$ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**1**
Location	**Sac**
Test Day	**Tu**
Test Date	**9/9/97**
AM / PM	**AM**
Scenario	**FNR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	**1.60**	< 0.68	**0.73**	< 0.68	**0.98**
Mg, PM10	**0.32**	**0.35**	**0.59**	**0.38**	**0.67**
Al, PM10	**1.49**	**1.01**	**0.37**	**1.74**	**3.66**
Si, PM10	**3.59**	**1.77**	**0.63**	**4.71**	**8.88**
P, PM10	**0.17**	< 0.08	**0.14**	**0.21**	**0.10**
Cl, PM10	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM10	**0.23**	**0.15**	**0.18**	**0.39**	**0.61**
Ca, PM10	**0.46**	**0.39**	< 0.13	**0.67**	**0.99**
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	**0.64**	**0.58**	**0.16**	**0.82**	**1.56**
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.14**	**0.04**	< 0.04	< 0.04
Zn, PM10	< 0.05	< 0.05	< 0.05	< 0.05	**0.05**
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:

All contaminants in µg/m³ unless otherwise noted

N/A - No sample scheduled

NS - No sample, data lost or voided

< values are referenced to MDL's or MQL's defined in Table 3-3

Abbreviations defined in Section 7

Commute #	2
Location	Sac
Test Day	Tu
Test Date	9/9/97
AM / PM	PM
Scenario	FNR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	< 0.68	**0.77**	< 0.68	< 0.68	**2.02**	< 0.68	< 0.68
Mg, PM2.5	**0.42**	< 0.29	**0.46**	< 0.29	< 0.29	**1.16**	< 0.29
Al, PM2.5	**0.17**	< 0.16	**0.23**	< 0.16	**0.24**	< 0.16	< 0.16
Si, PM2.5	**0.31**	**0.54**	< 0.06	**0.44**	**0.44**	**0.22**	**0.44**
P, PM2.5	< 0.08	< 0.08	< 0.08	< 0.08	**0.08**	< 0.08	**0.13**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.07**	**0.54**	**0.13**	**0.64**	**0.30**	**0.09**	**0.19**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	< 0.04	**0.06**	< 0.04	**0.05**	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	2
Location	Sac
Test Day	Tu
Test Date	9/9/97
AM / PM	PM
Scenario	FNR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	< 0.68	< 0.68	< 0.68	0.70	< 0.68
Mg, PM10	< 0.29	< 0.29	0.59	0.38	1.20
Al, PM10	2.03	1.21	0.93	1.63	1.88
Si, PM10	5.08	1.87	0.99	4.33	5.65
P, PM10	0.15	< 0.08	0.32	< 0.08	0.22
Cl, PM10	0.18	< 0.17	0.22	< 0.17	< 0.17
K, PM10	0.29	0.22	0.19	0.34	0.32
Ca, PM10	0.37	0.29	< 0.13	0.37	0.66
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.86	0.88	0.17	0.66	1.00
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.05	0.07	< 0.04	< 0.04
Zn, PM10	< 0.05	0.05	< 0.05	0.05	0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 3
Location Sac
Test Day We
Test Date 9/10/97
AM / PM AM
Scenario FR
AER Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	< 0.68	< 0.68	**1.28**	**0.70**	< 0.68	**1.59**	**1.06**
Mg, PM2.5	**0.52**	< 0.29	< 0.29	**1.12**	< 0.29	**0.77**	**0.70**
Al, PM2.5	< 0.16	**0.35**	**0.17**	**0.41**	**0.42**	< 0.16	< 0.16
Si, PM2.5	**0.08**	**0.52**	**0.15**	**0.50**	**0.36**	**0.10**	**0.10**
P, PM2.5	**0.10**	**0.12**	< 0.08	**0.15**	**0.08**	< 0.08	**0.10**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	**0.18**	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.06**	**0.63**	**0.12**	**0.63**	**0.33**	**0.07**	**0.09**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.06**	**0.10**	< 0.04	**0.06**	< 0.04	< 0.04
Zn, PM2.5	< 0.05	**0.10**	< 0.05	**0.09**	< 0.05	**0.05**	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	3
Location	Sac
Test Day	We
Test Date	9/10/97
AM / PM	AM
Scenario	FR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68
Mg, PM10	**0.59**	**0.73**	**0.42**	**0.47**	**0.60**
Al, PM10	**0.30**	**2.73**	< 0.16	**1.39**	**0.99**
Si, PM10	**1.93**	**6.32**	**0.82**	**3.50**	**3.80**
P, PM10	**0.09**	**0.15**	**0.11**	**0.11**	< 0.08
Cl, PM10	**0.74**	**0.22**	< 0.17	**0.80**	**0.75**
K, PM10	< 0.12	**0.46**	< 0.12	**0.35**	**0.23**
Ca, PM10	**0.18**	**0.65**	< 0.13	**0.34**	**0.55**
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	**0.38**	**1.56**	**0.10**	**0.67**	**0.86**
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.05**	**0.09**	< 0.04	< 0.04
Zn, PM10	**0.07**	**0.06**	< 0.05	**0.07**	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	4
Location	Sac
Test Day	We
Test Date	9/10/97
AM / PM	PM
Scenario	FR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	< 0.68	**1.19**	< 0.68	**1.22**	**0.79**	**1.24**	**1.54**
Mg, PM2.5	< 0.29	**0.96**	**0.59**	**0.78**	**0.76**	**0.58**	**0.54**
Al, PM2.5	**0.26**	**0.22**	< 0.16	**0.26**	**0.22**	**0.24**	**0.43**
Si, PM2.5	< 0.06	**0.47**	**0.14**	**0.34**	**0.11**	**0.31**	**0.08**
P, PM2.5	**0.11**	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	**0.08**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.09**	**0.37**	**0.04**	**0.41**	**0.23**	< 0.03	**0.07**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.09**	**0.04**	< 0.04	**0.04**	< 0.04	< 0.04
Zn, PM2.5	< 0.05	**0.05**	< 0.05	**0.06**	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
( )- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**4**
Location	**Sac**
Test Day	**We**
Test Date	**9/10/97**
AM / PM	**PM**
Scenario	**FR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	< 0.68	**1.12**	**1.79**	< 0.68	**0.88**
Mg, PM10	**0.86**	**0.51**	**0.53**	**0.62**	**0.65**
Al, PM10	**1.07**	**0.36**	**1.02**	**1.02**	**2.23**
Si, PM10	**2.92**	**1.28**	**0.97**	**3.21**	**3.41**
P, PM10	**0.30**	**0.12**	< 0.08	**0.14**	**0.14**
Cl, PM10	< 0.17	< 0.17	< 0.17	**0.29**	**0.17**
K, PM10	**0.28**	**0.14**	< 0.12	**0.29**	**0.31**
Ca, PM10	**0.34**	**0.22**	< 0.13	**0.21**	**0.35**
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	**0.51**	**0.62**	**0.16**	**0.52**	**0.65**
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.13**	**0.10**	< 0.04	< 0.04
Zn, PM10	< 0.05	**0.07**	**0.07**	< 0.05	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**5**
Location	**Sac**
Test Day	**Th**
Test Date	**9/11/97**
AM / PM	**AM**
Scenario	**FR**
AER	**Low**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**1.58**	< 0.68	< 0.68	< 0.68	**0.73**	**1.59**	**1.42**
Mg, PM2.5	**0.52**	**0.77**	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29
Al, PM2.5	< 0.16	< 0.16	< 0.16	< 0.16	**0.25**	**0.27**	< 0.16
Si, PM2.5	**0.14**	**0.41**	**0.35**	**0.49**	**0.33**	**0.28**	**0.22**
P, PM2.5	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	**0.18**	< 0.13	**0.15**	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.06**	**0.61**	**0.22**	**0.84**	**0.49**	**0.31**	**0.11**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	**0.05**	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	**0.04**	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**5**
Location	**Sac**
Test Day	**Th**
Test Date	**9/11/97**
AM / PM	**AM**
Scenario	**FR**
AER	**Low**

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	2.95	1.42	1.38	0.95	2.25
Mg, PM10	< 0.29	0.80	1.04	0.44	0.34
Al, PM10	0.95	1.18	0.58	1.69	1.46
Si, PM10	3.07	2.69	0.98	5.29	3.44
P, PM10	0.09	0.10	0.23	0.15	0.17
Cl, PM10	1.80	0.90	< 0.17	1.49	1.79
K, PM10	0.27	0.29	< 0.12	0.44	0.46
Ca, PM10	0.48	0.54	0.14	0.81	0.45
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.66	1.09	0.34	1.40	0.66
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.06	0.05	< 0.04	< 0.04
Zn, PM10	0.06	0.06	< 0.05	0.07	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	0.03	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 6
Location Sac
Test Day Th
Test Date 9/11/97
AM / PM PM
Scenario FR
AER Low

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**1.58**	< 0.68	< 0.68	< 0.68	< 0.68	**0.76**	**0.89**
Mg, PM2.5	< 0.29	**0.37**	**0.38**	**0.49**	**0.53**	< 0.29	**0.41**
Al, PM2.5	**0.34**	**0.30**	< 0.16	**0.27**	**0.30**	**0.21**	**0.24**
Si, PM2.5	**0.24**	**0.40**	**0.17**	**0.36**	**0.46**	**0.37**	**0.14**
P, PM2.5	< 0.08	< 0.08	< 0.08	**0.14**	**0.13**	**0.08**	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	**0.12**	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.07**	**0.35**	**0.45**	**0.61**	**0.38**	**0.46**	**0.32**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.07**	**0.07**	< 0.04	< 0.04	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 6
Location Sac
Test Day Th
Test Date 9/11/97
AM / PM PM
Scenario FR
AER Low

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	< 0.68	**1.33**	< 0.68	< 0.68	**0.82**
Mg, PM10	**0.39**	**0.68**	**1.04**	< 0.29	**1.01**
Al, PM10	**1.62**	**0.49**	**0.21**	**2.27**	**2.91**
Si, PM10	**5.44**	**1.05**	**0.83**	**5.25**	**5.80**
P, PM10	**0.25**	< 0.08	**0.09**	**0.25**	**0.20**
Cl, PM10	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM10	**0.31**	**0.21**	< 0.12	**0.31**	**0.37**
Ca, PM10	**0.30**	**0.21**	< 0.13	**0.42**	**0.34**
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	**0.82**	**0.60**	**0.49**	**1.81**	**1.30**
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.10**	**0.12**	**0.06**	< 0.04
Zn, PM10	< 0.05	< 0.05	**0.07**	< 0.05	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 7
Location Sac
Test Day Fr
Test Date 9/12/97
AM / PM AM
Scenario AR
AER Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**0.97**	< 0.68	< 0.68	**1.54**	< 0.68	< 0.68	**0.75**
Mg, PM2.5	**0.89**	**0.36**	**0.44**	< 0.29	**0.67**	< 0.29	**1.02**
Al, PM2.5	< 0.16	**0.37**	**0.22**	**0.34**	**0.20**	< 0.16	< 0.16
Si, PM2.5	**0.25**	**0.43**	< 0.06	**0.42**	**0.39**	< 0.06	**0.73**
P, PM2.5	**0.12**	**0.09**	< 0.08	< 0.08	< 0.08	< 0.08	**0.08**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	**0.19**	< 0.17	< 0.17	< 0.17
K, PM2.5	**0.15**	< 0.12	< 0.12	**0.18**	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	**0.16**	< 0.13	< 0.13	< 0.13	< 0.13	**0.16**
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.09**	**0.26**	**0.09**	**0.39**	**0.24**	< 0.03	**0.37**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.05**	**0.07**	< 0.04	**0.05**	< 0.04	< 0.04
Zn, PM2.5	< 0.05	**0.05**	**0.06**	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in $\mu g/m^3$ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	7
Location	Sac
Test Day	Fr
Test Date	9/12/97
AM / PM	AM
Scenario	AR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	< 0.68	0.72	< 0.68	2.25	1.97
Mg, PM10	0.66	0.89	0.50	0.49	0.94
Al, PM10	0.82	0.92	0.52	1.87	3.05
Si, PM10	2.85	1.44	0.69	3.83	7.96
P, PM10	0.12	< 0.08	0.11	< 0.08	0.10
Cl, PM10	1.95	0.30	< 0.17	1.92	1.49
K, PM10	0.22	0.13	< 0.12	0.25	0.56
Ca, PM10	0.38	0.15	< 0.13	0.57	1.04
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.61	0.45	0.15	1.58	1.92
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.11	0.11	< 0.04	0.04
Zn, PM10	0.07	< 0.05	< 0.05	< 0.05	0.06
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**8**
Location	**Sac**
Test Day	**Fr**
Test Date	**9/12/97**
AM / PM	**PM**
Scenario	**AR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**0.94**	< 0.68	< 0.68	< 0.68	**1.31**	**1.54**	< 0.68
Mg, PM2.5	**0.70**	**0.59**	< 0.29	**1.08**	**0.51**	< 0.29	**0.32**
Al, PM2.5	< 0.16	**0.22**	< 0.16	**0.27**	**0.20**	**0.23**	< 0.16
Si, PM2.5	**0.25**	**0.23**	**0.08**	**0.14**	**0.13**	**0.38**	**0.45**
P, PM2.5	**0.08**	**0.10**	**0.13**	< 0.08	< 0.08	< 0.08	**0.12**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	**0.13**	**0.16**	< 0.12	**0.19**	**0.13**	< 0.12	< 0.12
Ca, PM2.5	**0.15**	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.12**	**0.31**	**0.06**	**0.41**	**0.18**	**0.05**	**0.24**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.05**	**0.05**	< 0.04	< 0.04	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	**0.05**	**0.07**	**0.06**	**0.05**	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
\- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**8**
Location	**Sac**
Test Day	**Fr**
Test Date	**9/12/97**
AM / PM	**PM**
Scenario	**AR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	0.82	< 0.68	1.17	< 0.68	0.75
Mg, PM10	0.93	0.60	1.03	0.55	< 0.29
Al, PM10	0.96	1.21	0.34	1.46	1.72
Si, PM10	2.92	0.90	0.63	3.26	3.88
P, PM10	0.15	< 0.08	< 0.08	< 0.08	0.18
Cl, PM10	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM10	0.20	0.31	0.24	0.27	0.21
Ca, PM10	0.21	0.24	0.15	0.31	0.37
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.51	0.48	0.11	0.69	1.32
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.10	0.04	< 0.04	0.06
Zn, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	0.05	0.04	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**9**
Location	**Sac**
Test Day	**Sa**
Test Date	**9/13/97**
AM / PM	**midday**
Scenario	**R**
AER	**Hi**

Element, Size ug/m3	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**0.86**	< 0.68	< 0.68	< 0.68	**1.18**	**1.28**
Mg, PM2.5	**1.00**	**0.52**	**0.88**	**0.66**	**0.53**	**0.63**
Al, PM2.5	< 0.16	< 0.16	< 0.16	**0.42**	**0.18**	**0.45**
Si, PM2.5	**0.33**	< 0.06	**0.49**	**0.75**	**0.45**	**0.30**
P, PM2.5	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	**0.15**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	**0.16**	**0.13**	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	**0.14**	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.13**	< 0.03	**0.12**	**0.22**	**0.09**	< 0.03
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.07**	< 0.04	< 0.04	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
[ ] - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**9**
Location	**Sac**
Test Day	**Sa**
Test Date	**9/13/97**
AM / PM	**midday**
Scenario	**R**
AER	**Hi**

Element, Size ug/m3	IN1	IN2	ROAD1	ROAD2
Na, PM10	< 0.68	0.80	0.75	< 0.68
Mg, PM10	0.83	0.33	< 0.29	< 0.29
Al, PM10	1.27	1.31	1.43	2.04
Si, PM10	2.93	3.20	4.97	4.54
P, PM10	0.23	< 0.08	< 0.08	0.23
Cl, PM10	< 0.17	< 0.17	0.61	0.51
K, PM10	0.22	0.27	0.29	0.30
Ca, PM10	0.42	0.19	0.23	0.19
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.41	0.28	0.65	0.62
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	0.08	0.09	< 0.04	< 0.04
Zn, PM10	< 0.05	< 0.05	< 0.05	0.08
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	10
Location	Sac
Test Day	Mo
Test Date	9/15/97
AM / PM	AM
Scenario	AR
AER	Low

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2
Na, PM2.5	**1.05**	< 0.68	< 0.68	**1.49**	< 0.68
Mg, PM2.5	**0.32**	**0.71**	**0.65**	**1.01**	**0.29**
Al, PM2.5	**0.19**	< 0.16	**0.22**	< 0.16	**0.36**
Si, PM2.5	< 0.06	**0.35**	**0.14**	**0.34**	**0.43**
P, PM2.5	**0.11**	**0.08**	< 0.08	**0.17**	**0.14**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.08**	**0.27**	**0.17**	**0.36**	**0.24**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.06**	**0.05**	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	**0.09**	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**10**
Location	**Sac**
Test Day	**Mo**
Test Date	**9/15/97**
AM / PM	**AM**
Scenario	**AR**
AER	**Low**

Element, Size ug/m3	AMB	IN1	IN2
Na, PM10	< 0.68	< 0.68	< 0.68
Mg, PM10	0.41	0.57	0.92
Al, PM10	1.56	0.96	0.70
Si, PM10	2.69	2.25	1.39
P, PM10	0.19	< 0.08	0.22
Cl, PM10	< 0.17	< 0.17	< 0.17
K, PM10	0.25	0.20	0.16
Ca, PM10	0.37	0.36	< 0.13
Ti, PM10	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23
Fe, PM10	0.57	0.71	0.43
Co, PM10	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.05	0.11
Zn, PM10	0.05	< 0.05	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**11**
Location	**Sac**
Test Day	**Mo**
Test Date	**9/15/97**
AM / PM	**PM**
Scenario	**AR**
AER	**Low**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2
Na, PM2.5	**1.20**	< 0.68	< 0.68	< 0.68	< 0.68
Mg, PM2.5	**0.76**	< 0.29	< 0.29	**0.38**	< 0.29
Al, PM2.5	**0.23**	**0.37**	< 0.16	**0.23**	**0.36**
Si, PM2.5	**0.22**	< 0.06	< 0.06	**0.13**	**0.34**
P, PM2.5	**0.09**	< 0.08	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	< 0.03	**0.09**	**0.22**	**0.25**	**0.29**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.10**	**0.06**	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	**0.03**
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
ι - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**11**
Location	**Sac**
Test Day	**Mo**
Test Date	**9/15/97**
AM / PM	**PM**
Scenario	**AR**
AER	**Low**

Element, Size ug/m3	AMB	IN1	IN2
Na, PM10	< 0.68	**1.03**	< 0.68
Mg, PM10	< 0.29	< 0.29	**0.38**
Al, PM10	**0.76**	**0.63**	**0.68**
Si, PM10	**2.14**	**0.86**	**1.43**
P, PM10	**0.13**	**0.13**	< 0.08
Cl, PM10	< 0.17	< 0.17	< 0.17
K, PM10	**0.18**	**0.24**	**0.20**
Ca, PM10	**0.16**	< 0.13	**0.21**
Ti, PM10	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23
Fe, PM10	**0.44**	**0.19**	**0.52**
Co, PM10	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.10**	**0.15**
Zn, PM10	< 0.05	**0.06**	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**12**
Location	**Sac**
Test Day	**Tu**
Test Date	**9/16/97**
AM / PM	**AM**
Scenario	**SB**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2
Na, PM2.5	**1.12**	< 0.68	< 0.68	**0.98**	< 0.68
Mg, PM2.5	**0.41**	**0.52**	**0.32**	**0.79**	**0.61**
Al, PM2.5	< 0.16	**0.17**	**0.19**	**0.48**	< 0.16
Si, PM2.5	**0.42**	**0.39**	**0.37**	**0.30**	**0.43**
P, PM2.5	< 0.08	< 0.08	< 0.08	**0.11**	**0.09**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.10**	**0.15**	**0.31**	**0.12**	**0.27**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.04**	< 0.04	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	**0.07**	< 0.05	**0.07**
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in $\mu g/m^3$ unless otherwise noted
A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**12**
Location	**Sac**
Test Day	**Tu**
Test Date	**9/16/97**
AM / PM	**AM**
Scenario	**SB**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2
Na, PM10	1.01	< 0.68	< 0.68
Mg, PM10	< 0.29	0.58	< 0.29
Al, PM10	0.72	< 0.16	1.71
Si, PM10	2.68	1.29	4.91
P, PM10	0.14	0.10	< 0.08
Cl, PM10	0.43	< 0.17	0.41
K, PM10	0.22	0.22	0.36
Ca, PM10	0.34	0.27	0.96
Ti, PM10	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23
Fe, PM10	0.55	0.30	1.33
Co, PM10	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.11	0.06
Zn, PM10	< 0.05	< 0.05	0.09
Ga, PM10	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	0.03
Mo, PM10	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 13
Location Sac
Test Day Tu
Test Date 9/16/97
AM / PM PM
Scenario SB
AER Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2
Na, PM2.5	< 0.68	< 0.68	< 0.68	< 0.68	< 0.68
Mg, PM2.5	**0.33**	**0.51**	**0.78**	**0.50**	**0.52**
Al, PM2.5	< 0.16	< 0.16	**0.31**	**0.23**	**0.23**
Si, PM2.5	**0.19**	**0.22**	**0.29**	**0.43**	**0.33**
P, PM2.5	**0.09**	< 0.08	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	< 0.03	**0.16**	**0.16**	**0.19**	**0.08**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**13**
Location	**Sac**
Test Day	**Tu**
Test Date	**9/16/97**
AM / PM	**PM**
Scenario	**SB**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2
Na, PM10	2.04	1.01	0.74
Mg, PM10	0.60	< 0.29	0.62
Al, PM10	0.66	0.41	0.74
Si, PM10	3.51	1.78	3.55
P, PM10	< 0.08	< 0.08	< 0.08
Cl, PM10	< 0.17	< 0.17	< 0.17
K, PM10	0.27	0.17	0.30
Ca, PM10	0.25	0.18	0.26
Ti, PM10	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23
Fe, PM10	0.39	0.28	0.70
Co, PM10	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.06	< 0.04
Zn, PM10	< 0.05	< 0.05	0.05
Ga, PM10	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**14**
Location	**LA**
Test Day	**Th**
Test Date	**9/25/97**
AM / PM	**AM**
Scenario	**FNR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2
Na, PM2.5	**1.02**	**2.41**	< 0.68	**0.90**	< 0.68
Mg, PM2.5	< 0.29	**0.52**	< 0.29	**0.34**	**0.57**
Al, PM2.5	**0.16**	< 0.16	**0.31**	**0.20**	< 0.16
Si, PM2.5	**0.32**	**0.74**	**0.53**	**0.72**	**0.47**
P, PM2.5	< 0.08	< 0.08	**0.10**	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	**0.26**	**0.27**	**0.21**	**0.13**
Ca, PM2.5	< 0.13	**0.55**	**0.35**	**0.51**	**0.27**
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.22**	**0.82**	**0.54**	**0.98**	**0.58**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.12**	**0.07**	< 0.04	**0.06**
Zn, PM2.5	**0.11**	**0.14**	**0.10**	**0.10**	**0.08**
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	14
Location	LA
Test Day	Th
Test Date	9/25/97
AM / PM	AM
Scenario	FNR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2
Na, PM10	1.90	< 0.68	1.28
Mg, PM10	< 0.29	< 0.29	< 0.29
Al, PM10	0.90	1.10	0.49
Si, PM10	3.60	2.15	1.46
P, PM10	0.15	< 0.08	0.08
Cl, PM10	< 0.17	< 0.17	0.30
K, PM10	0.56	0.49	0.40
Ca, PM10	0.87	0.83	0.65
Ti, PM10	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23
Fe, PM10	1.08	0.98	0.77
Co, PM10	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.12	0.09
Zn, PM10	0.12	0.15	0.35
Ga, PM10	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in $\mu g/m^3$ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	15
Location	LA
Test Day	Fr
Test Date	9/26/97
AM / PM	AM
Scenario	FR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**1.56**	**2.75**	< 0.68	**2.02**	**1.23**	**3.01**	**1.55**
Mg, PM2.5	< 0.29	< 0.29	< 0.29	**0.81**	< 0.29	< 0.29	**0.34**
Al, PM2.5	< 0.16	**0.18**	**0.20**	< 0.16	< 0.16	< 0.16	**0.34**
Si, PM2.5	**0.17**	**0.56**	**0.42**	**0.54**	**0.51**	**0.36**	**0.45**
P, PM2.5	**0.09**	**0.09**	**0.12**	**0.18**	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	**0.20**	< 0.17	< 0.17	**0.27**	< 0.17	< 0.17
K, PM2.5	**0.14**	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.07**	**0.76**	**0.62**	**0.95**	**0.67**	**0.42**	**0.42**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.11**	**0.08**	**0.08**	< 0.04	< 0.04	< 0.04
Zn, PM2.5	< 0.05	**0.06**	**0.08**	**0.08**	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
\- - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	15
Location	LA
Test Day	Fr
Test Date	9/26/97
AM / PM	AM
Scenario	FR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	**2.68**	**1.82**	**3.31**	**3.36**	**2.40**
Mg, PM10	**0.58**	**0.63**	< 0.29	< 0.29	**0.85**
Al, PM10	**0.57**	**0.54**	**1.05**	**0.42**	**1.73**
Si, PM10	**1.65**	**1.43**	**1.56**	**1.90**	**2.52**
P, PM10	**0.15**	**0.16**	< 0.08	< 0.08	**0.24**
Cl, PM10	**3.32**	**0.65**	**0.43**	**1.75**	**2.47**
K, PM10	**0.39**	**0.26**	**0.16**	**0.30**	**0.33**
Ca, PM10	**0.40**	**0.41**	**0.30**	**0.53**	**0.54**
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	**0.42**	**0.89**	**0.75**	**1.31**	**1.22**
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.09**	**0.07**	**0.08**	< 0.04
Zn, PM10	< 0.05	**0.06**	< 0.05	< 0.05	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in $\mu g/m^3$ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 16
Location LA
Test Day Fr
Test Date 9/26/97
AM / PM PM
Scenario FR
AER Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**1.02**	**0.82**	**1.99**	**1.02**	< 0.68	**0.77**	< 0.68
Mg, PM2.5	**0.51**	**0.40**	< 0.29	**0.91**	< 0.29	< 0.29	< 0.29
Al, PM2.5	< 0.16	**0.44**	< 0.16	< 0.16	**0.43**	< 0.16	< 0.16
Si, PM2.5	**0.07**	**0.32**	**0.31**	**0.49**	**0.27**	**0.31**	**0.38**
P, PM2.5	< 0.08	< 0.08	**0.19**	**0.09**	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.13**	**0.52**	**0.42**	**0.76**	**0.44**	**0.65**	**0.37**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.08**	**0.07**	**0.13**	< 0.04	< 0.04	**0.07**
Zn, PM2.5	< 0.05	< 0.05	< 0.05	**0.11**	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	16
Location	LA
Test Day	Fr
Test Date	9/26/97
AM / PM	PM
Scenario	FR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	2.41	1.44	< 0.68	1.88	2.39
Mg, PM10	0.36	< 0.29	0.65	0.91	0.44
Al, PM10	0.89	0.80	0.40	0.97	1.13
Si, PM10	2.70	1.24	0.92	2.44	1.58
P, PM10	0.12	0.21	0.14	< 0.08	0.11
Cl, PM10	0.61	< 0.17	< 0.17	0.27	0.38
K, PM10	0.34	0.13	0.12	0.37	0.30
Ca, PM10	0.53	0.24	0.16	0.66	0.46
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.61	0.70	0.54	1.83	1.01
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.12	0.08	0.08	< 0.04
Zn, PM10	< 0.05	0.05	< 0.05	0.07	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**17**
Location	**LA**
Test Day	**Sa**
Test Date	**9/27/97**
AM / PM	**PM**
Scenario	**ANR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2
Na, PM2.5	**3.17**	< 0.68	**1.74**	**0.72**	**2.33**
Mg, PM2.5	**0.55**	< 0.29	< 0.29	< 0.29	**0.30**
Al, PM2.5	**0.38**	< 0.16	**0.22**	< 0.16	**0.25**
Si, PM2.5	**0.23**	**0.48**	**0.36**	**0.33**	**0.34**
P, PM2.5	< 0.08	< 0.08	**0.13**	**0.12**	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.10**	**0.24**	**0.18**	**0.37**	**0.21**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.09**	**0.06**	**0.05**	**0.07**
Zn, PM2.5	**0.07**	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 17
Location LA
Test Day Sa
Test Date 9/27/97
AM / PM PM
Scenario ANR
AER Hi

Element, Size ug/m3	AMB	IN1	IN2
Na, PM10	1.38	1.03	1.48
Mg, PM10	< 0.29	< 0.29	< 0.29
Al, PM10	0.92	< 0.16	0.55
Si, PM10	3.03	1.30	1.27
P, PM10	0.10	0.18	0.37
Cl, PM10	< 0.17	< 0.17	< 0.17
K, PM10	0.43	< 0.12	0.16
Ca, PM10	0.61	0.25	0.19
Ti, PM10	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23
Fe, PM10	0.77	0.45	0.33
Co, PM10	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.11	0.07
Zn, PM10	0.07	< 0.05	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 18
Location LA
Test Day Su
Test Date 9/28/97
AM / PM AM
Scenario ANR
AER Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2
Na, PM2.5	< 0.68	**1.68**	**0.92**	< 0.68	< 0.68
Mg, PM2.5	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29
Al, PM2.5	< 0.16	**0.41**	**0.23**	**0.17**	< 0.16
Si, PM2.5	**0.31**	**0.48**	**0.15**	**0.55**	**0.30**
P, PM2.5	**0.18**	< 0.08	< 0.08	< 0.08	**0.12**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	**0.17**	< 0.12	**0.13**	**0.14**	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.31**	**0.50**	**0.30**	**0.69**	**0.29**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.09**	**0.11**	**0.05**	**0.07**
Zn, PM2.5	**0.07**	**0.06**	< 0.05	**0.06**	**0.05**
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	**0.02**	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	18
Location	LA
Test Day	Su
Test Date	9/28/97
AM / PM	AM
Scenario	ANR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2
Na, PM10	1.84	1.75	< 0.68
Mg, PM10	0.64	< 0.29	0.34
Al, PM10	1.35	0.46	0.86
Si, PM10	3.26	1.70	1.25
P, PM10	0.20	0.12	0.35
Cl, PM10	< 0.17	< 0.17	< 0.17
K, PM10	0.39	0.14	0.19
Ca, PM10	0.65	0.33	0.25
Ti, PM10	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23
Fe, PM10	1.35	0.68	0.46
Co, PM10	< 0.05	< 0.05	< 0.05
Cu, PM10	0.06	0.13	0.12
Zn, PM10	0.14	0.10	0.06
Ga, PM10	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	19
Location	LA
Test Day	Su
Test Date	9/28/97
AM / PM	PM
Scenario	FNR
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2
Na, PM2.5	**1.44**	**1.49**	**1.88**	< 0.68	< 0.68
Mg, PM2.5	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29
Al, PM2.5	**0.21**	< 0.16	< 0.16	**0.41**	**0.38**
Si, PM2.5	**0.48**	**0.48**	**0.27**	**0.41**	**0.37**
P, PM2.5	**0.11**	**0.15**	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	**0.15**	**0.13**	< 0.12	**0.12**	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	**0.15**	**0.14**
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.10**	**0.36**	**0.28**	**0.60**	**0.46**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.09**	< 0.04	< 0.04	**0.08**
Zn, PM2.5	< 0.05	**0.05**	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	**0.26**
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**19**
Location	**LA**
Test Day	**Su**
Test Date	**9/28/97**
AM / PM	**PM**
Scenario	**FNR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2
Na, PM10	**3.44**	**1.89**	**1.44**
Mg, PM10	< 0.29	< 0.29	**0.43**
Al, PM10	**1.82**	**0.61**	< 0.16
Si, PM10	**3.44**	**1.38**	**1.08**
P, PM10	**0.21**	**0.09**	< 0.08
Cl, PM10	< 0.17	< 0.17	**0.21**
K, PM10	**0.56**	**0.33**	**0.31**
Ca, PM10	**0.62**	**0.40**	**0.34**
Ti, PM10	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23
Fe, PM10	**0.81**	**0.54**	**0.64**
Co, PM10	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.09**	**0.08**
Zn, PM10	**0.07**	< 0.05	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in $\mu g/m^3$ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	20
Location	LA
Test Day	Mo
Test Date	9/29/97
AM / PM	AM
Scenario	FR
AER	Low

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	< 0.68	1.93	1.90	< 0.68	1.97	1.42	0.79
Mg, PM2.5	< 0.29	< 0.29	0.42	< 0.29	0.29	< 0.29	0.73
Al, PM2.5	< 0.16	0.22	0.21	0.29	0.35	< 0.16	0.20
Si, PM2.5	0.36	0.41	0.45	0.63	0.57	0.39	0.66
P, PM2.5	0.10	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	0.36	0.16	0.15	< 0.12	0.18	< 0.12	0.21
Ca, PM2.5	< 0.13	< 0.13	< 0.13	0.14	0.19	< 0.13	0.19
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	0.42	0.90	0.87	1.36	0.80	0.44	1.05
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	0.05	0.07	0.08	0.04	0.05	< 0.04	0.05
Zn, PM2.5	< 0.05	< 0.05	< 0.05	0.08	0.05	< 0.05	0.07
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	20
Location	LA
Test Day	Mo
Test Date	9/29/97
AM / PM	AM
Scenario	FR
AER	Low

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	2.13	< 0.68	< 0.68	2.37	1.74
Mg, PM10	0.62	0.71	< 0.29	< 0.29	0.57
Al, PM10	1.89	< 0.16	0.98	1.60	1.35
Si, PM10	5.84	1.93	1.39	4.76	5.02
P, PM10	< 0.08	0.17	0.08	0.15	0.12
Cl, PM10	0.27	0.37	0.26	0.23	0.43
K, PM10	0.86	0.29	0.22	0.64	0.76
Ca, PM10	1.35	0.55	0.31	0.89	1.48
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	2.05	1.28	1.53	2.04	3.25
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.08	0.12	0.06	0.06
Zn, PM10	0.06	0.05	0.07	0.08	0.14
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**21**
Location	**LA**
Test Day	**Mo**
Test Date	**9/29/97**
AM / PM	**PM**
Scenario	**FR**
AER	**Low**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**2.35**	**0.73**	< 0.68	**0.69**	**2.02**	**1.52**	**2.19**
Mg, PM2.5	**0.35**	< 0.29	< 0.29	**0.78**	**0.70**	< 0.29	< 0.29
Al, PM2.5	< 0.16	< 0.16	**0.25**	< 0.16	< 0.16	**0.31**	< 0.16
Si, PM2.5	**0.31**	**0.35**	**0.36**	**0.52**	**0.31**	**0.41**	**0.52**
P, PM2.5	< 0.08	< 0.08	**0.08**	**0.14**	< 0.08	**0.12**	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	**0.14**	**0.13**	< 0.12	**0.18**	< 0.12	< 0.12	< 0.12
Ca, PM2.5	**0.14**	< 0.13	< 0.13	**0.20**	< 0.13	< 0.13	**0.20**
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.13**	**0.53**	**0.42**	**0.93**	**0.53**	**0.55**	**0.48**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.04**	**0.08**	< 0.04	**0.05**	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 21
Location LA
Test Day Mo
Test Date 9/29/97
AM / PM PM
Scenario FR
AER Low

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	2.53	2.81	1.17	4.43	5.29
Mg, PM10	0.65	< 0.29	< 0.29	1.12	1.11
Al, PM10	0.75	0.56	< 0.16	2.08	1.83
Si, PM10	3.84	1.57	0.89	4.16	3.38
P, PM10	0.21	0.10	0.22	0.19	0.17
Cl, PM10	0.62	0.27	< 0.17	0.24	0.73
K, PM10	0.56	0.32	< 0.12	0.57	0.64
Ca, PM10	0.86	0.42	0.21	1.01	1.04
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.89	0.89	0.77	2.14	1.74
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.08	0.12	0.07	0.06
Zn, PM10	< 0.05	< 0.05	< 0.05	0.07	0.08
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	22
Location	LA
Test Day	Tu
Test Date	9/30/97
AM / PM	AM
Scenario	FRC
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	1.93	1.79	1.90	< 0.68	1.19	< 0.68	1.47
Mg, PM2.5	< 0.29	< 0.29	0.64	< 0.29	< 0.29	0.34	0.49
Al, PM2.5	0.19	0.18	< 0.16	0.26	0.25	0.31	0.36
Si, PM2.5	0.39	0.31	0.22	0.09	0.42	0.38	0.57
P, PM2.5	0.08	< 0.08	< 0.08	0.08	< 0.08	0.12	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	0.17	0.12	< 0.12	< 0.12	< 0.12	0.16	0.21
Ca, PM2.5	< 0.13	0.15	< 0.13	< 0.13	< 0.13	< 0.13	0.14
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	0.08	0.44	0.38	0.05	0.41	0.25	0.70
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	0.12	0.08	< 0.04	0.07	0.04	0.04
Zn, PM2.5	0.06	< 0.05	0.05	< 0.05	0.07	0.10	0.06
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	<0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**22**
Location	**LA**
Test Day	**Tu**
Test Date	**9/30/97**
AM / PM	**AM**
Scenario	**FRC**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	3.08	1.18	1.78	2.76	3.00
Mg, PM10	0.50	< 0.29	< 0.29	0.39	0.59
Al, PM10	1.55	1.24	0.74	2.87	0.73
Si, PM10	3.69	1.62	1.49	6.72	3.33
P, PM10	0.19	0.14	< 0.08	< 0.08	0.12
Cl, PM10	0.46	< 0.17	< 0.17	0.60	0.31
K, PM10	0.68	0.25	0.25	0.72	0.48
Ca, PM10	0.82	0.28	0.23	1.10	0.80
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.78	0.67	0.55	2.31	2.23
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.15	0.10	0.06	0.11
Zn, PM10	0.05	0.08	0.07	0.17	0.08
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	0.03
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	0.34	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 23
Location LA
Test Day Tu
Test Date 9/30/97
AM / PM PM
Scenario FRC
AER Hi

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	< 0.68	**1.36**	**2.12**	< 0.68	< 0.68	**2.01**	**1.15**
Mg, PM2.5	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29
Al, PM2.5	< 0.16	**0.17**	< 0.16	< 0.16	< 0.16	< 0.16	**0.40**
Si, PM2.5	**0.27**	**0.60**	**0.36**	**0.50**	**0.46**	**0.55**	**0.70**
P, PM2.5	< 0.08	< 0.08	**0.12**	**0.09**	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	**0.13**	< 0.12	**0.20**	< 0.12	**0.13**	< 0.12
Ca, PM2.5	< 0.13	**0.14**	< 0.13	**0.16**	< 0.13	**0.17**	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.12**	**0.32**	**0.27**	**0.52**	**0.51**	**0.59**	**0.52**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.07**	**0.08**	**0.05**	**0.06**	**0.08**	**0.05**
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	**0.08**	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
NA - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	23
Location	LA
Test Day	Tu
Test Date	9/30/97
AM / PM	PM
Scenario	FRC
AER	Hi

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	**1.13**	**1.47**	**1.52**	**2.07**	**1.58**
Mg, PM10	**0.80**	< 0.29	**0.79**	**0.87**	**0.76**
Al, PM10	**2.09**	**0.43**	**0.61**	**0.97**	**1.14**
Si, PM10	**5.09**	**1.50**	**1.66**	**5.18**	**4.39**
P, PM10	< 0.08	< 0.08	**0.31**	< 0.08	< 0.08
Cl, PM10	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM10	**0.55**	**0.25**	**0.17**	**0.59**	**0.55**
Ca, PM10	**0.94**	**0.30**	**0.29**	**0.92**	**1.06**
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	**1.07**	**0.58**	**0.58**	**2.30**	**2.08**
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.12**	**0.12**	**0.07**	**0.07**
Zn, PM10	**0.05**	< 0.05	< 0.05	**0.11**	**0.08**
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in $\mu g/m^3$ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**24**
Location	**LA**
Test Day	**We**
Test Date	**10/1/97**
AM / PM	**AM**
Scenario	**AR**
AER	**Low**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	< 0.68	**1.19**	**2.62**	< 0.68	**1.47**	< 0.68	< 0.68
Mg, PM2.5	< 0.29	**0.67**	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29
Al, PM2.5	< 0.16	**0.29**	**0.36**	**0.21**	< 0.16	< 0.16	< 0.16
Si, PM2.5	**0.32**	**0.54**	**0.21**	**0.49**	**0.42**	**0.24**	**0.34**
P, PM2.5	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
Cl, PM2.5	**0.37**	< 0.17	< 0.17	< 0.17	< 0.17	**0.21**	< 0.17
K, PM2.5	**0.21**	< 0.12	< 0.12	< 0.12	**0.12**	**0.17**	**0.14**
Ca, PM2.5	< 0.13	< 0.13	< 0.13	**0.15**	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.11**	**0.37**	**0.41**	**0.67**	**0.39**	**0.18**	**0.16**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.06**	**0.17**	**0.04**	**0.11**	< 0.04	< 0.04
Zn, PM2.5	**0.09**	< 0.05	< 0.05	**0.10**	< 0.05	**0.07**	**0.06**
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	24
Location	LA
Test Day	We
Test Date	10/1/97
AM / PM	AM
Scenario	AR
AER	Low

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	2.49	1.11	< 0.68	2.06	1.55
Mg, PM10	0.65	< 0.29	< 0.29	0.96	0.33
Al, PM10	1.71	< 0.16	1.24	2.05	1.55
Si, PM10	3.90	1.63	3.82	4.17	4.44
P, PM10	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
Cl, PM10	0.29	< 0.17	0.46	< 0.17	0.68
K, PM10	0.66	0.21	0.57	0.58	0.56
Ca, PM10	0.95	0.28	0.91	0.62	0.90
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.94	0.79	1.52	1.16	1.29
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.17	0.28	0.07	< 0.04
Zn, PM10	0.10	0.09	0.14	0.11	0.09
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in $\mu g/m^3$ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	25
Location	LA
Test Day	We
Test Date	10/1/97
AM / PM	PM
Scenario	AR
AER	Low

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**1.96**	**1.58**	< 0.68	**1.58**	< 0.68	**0.68**	< 0.68
Mg, PM2.5	**0.48**	< 0.29	< 0.29	< 0.29	**0.36**	< 0.29	< 0.29
Al, PM2.5	< 0.16	**0.27**	< 0.16	< 0.16	< 0.16	< 0.16	**0.19**
Si, PM2.5	**0.44**	**0.34**	**0.25**	**0.62**	**0.39**	**0.24**	**0.47**
P, PM2.5	< 0.08	**0.09**	< 0.08	< 0.08	**0.11**	**0.20**	**0.09**
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	**0.15**	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.10**	**0.25**	**0.32**	**0.48**	**0.31**	**0.20**	**0.21**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.05**	**0.13**	**0.04**	**0.09**	< 0.04	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
N.S - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 25
Location LA
Test Day We
Test Date 10/1/97
AM / PM PM
Scenario AR
AER Low

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	2.72	< 0.68	1.76	1.45	1.69
Mg, PM10	< 0.29	0.33	0.31	0.59	0.65
Al, PM10	1.60	0.95	0.76	2.15	1.74
Si, PM10	3.81	2.24	1.67	4.36	4.46
P, PM10	< 0.08	0.18	0.09	0.09	< 0.08
Cl, PM10	< 0.17	< 0.17	< 0.17	0.18	< 0.17
K, PM10	0.35	0.16	0.15	0.47	0.41
Ca, PM10	0.71	0.30	0.30	0.83	0.76
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.80	0.54	1.15	1.36	1.14
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.12	0.23	0.04	0.05
Zn, PM10	< 0.05	0.06	< 0.05	< 0.05	0.06
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**26**
Location	**LA**
Test Day	**Th**
Test Date	**10/2/97**
AM / PM	**AM**
Scenario	**AR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**1.65**	< 0.68	< 0.68	< 0.68	< 0.68	**1.66**	**1.90**
Mg, PM2.5	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29	**0.51**	< 0.29
Al, PM2.5	< 0.16	**0.33**	< 0.16	< 0.16	< 0.16	< 0.16	**0.28**
Si, PM2.5	**0.17**	**0.43**	**0.40**	**0.41**	**0.36**	**0.29**	**0.15**
P, PM2.5	< 0.08	< 0.08	**0.19**	< 0.08	**0.15**	**0.11**	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	**0.14**	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.07**	**0.34**	**0.31**	**0.49**	**0.32**	**0.18**	**0.07**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.08**	**0.13**	< 0.04	**0.06**	< 0.04	**0.04**
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute # 26
Location LA
Test Day Th
Test Date 10/2/97
AM / PM AM
Scenario AR
AER Hi

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	2.64	0.71	< 0.68	2.96	1.76
Mg, PM10	< 0.29	< 0.29	0.35	< 0.29	< 0.29
Al, PM10	1.44	0.23	1.00	1.05	1.74
Si, PM10	2.18	1.18	1.62	3.25	2.41
P, PM10	0.42	< 0.08	0.29	0.12	0.12
Cl, PM10	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM10	< 0.12	< 0.12	0.16	0.36	0.19
Ca, PM10	0.48	0.34	0.26	0.47	0.47
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	0.47	0.60	0.53	1.13	0.54
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	0.14	0.13	< 0.04	< 0.04
Zn, PM10	< 0.05	0.07	< 0.05	0.07	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**27**
Location	**LA**
Test Day	**Th**
Test Date	**10/2/97**
AM / PM	**PM**
Scenario	**AR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	OUT1	OUT2	ROAD1	ROAD2
Na, PM2.5	**1.89**	**1.33**	< 0.68	**1.14**	**0.86**	**2.15**	**1.55**
Mg, PM2.5	< 0.29	**0.40**	< 0.29	< 0.29	< 0.29	< 0.29	< 0.29
Al, PM2.5	**0.35**	< 0.16	< 0.16	**0.26**	< 0.16	< 0.16	**0.22**
Si, PM2.5	**0.46**	**0.31**	**0.29**	**0.49**	**0.15**	**0.14**	**0.30**
P, PM2.5	< 0.08	**0.09**	< 0.08	< 0.08	< 0.08	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.09**	**0.32**	**0.19**	**0.40**	**0.18**	**0.16**	**0.18**
Co, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.10**	**0.09**	**0.04**	**0.11**	**0.04**	< 0.04
Zn, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ga, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**27**
Location	**LA**
Test Day	**Th**
Test Date	**10/2/97**
AM / PM	**PM**
Scenario	**AR**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	IN2	ROAD1	ROAD2
Na, PM10	**1.65**	**0.79**	**1.54**	**1.12**	**0.72**
Mg, PM10	**0.51**	< 0.29	**0.48**	< 0.29	**0.59**
Al, PM10	**1.54**	**0.68**	< 0.16	**1.46**	**1.92**
Si, PM10	**3.23**	**1.90**	**1.10**	**3.26**	**3.36**
P, PM10	< 0.08	**0.13**	**0.11**	< 0.08	< 0.08
Cl, PM10	< 0.17	< 0.17	< 0.17	< 0.17	< 0.17
K, PM10	**0.32**	**0.22**	**0.17**	**0.35**	**0.32**
Ca, PM10	**0.55**	**0.33**	**0.22**	**0.67**	**0.57**
Ti, PM10	< 0.54	< 0.54	< 0.54	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23	< 0.23	< 0.23	< 0.23
Fe, PM10	**0.75**	**0.61**	**0.30**	**1.05**	**0.82**
Co, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Cu, PM10	< 0.04	**0.16**	**0.13**	**0.04**	< 0.04
Zn, PM10	**0.06**	< 0.05	< 0.05	**0.07**	< 0.05
Ga, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19	< 0.19	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32	< 0.32	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38	< 0.38	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44	< 1.44	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97	< 1.97	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	**28**
Location	**LA**
Test Day	**Fr**
Test Date	**10/3/97**
AM / PM	**AM**
Scenario	**MC**
AER	**Hi**

Element, Size ug/m3	AMB	IN1	OUT1
Na, PM2.5	**1.55**	< 0.68	< 0.68
Mg, PM2.5	< 0.29	< 0.29	< 0.29
Al, PM2.5	**0.21**	< 0.16	< 0.16
Si, PM2.5	**0.38**	**0.39**	**0.54**
P, PM2.5	< 0.08	**0.08**	**0.16**
Cl, PM2.5	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	**0.15**
Ti, PM2.5	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.24**	**0.48**	**0.69**
Co, PM2.5	< 0.05	< 0.05	< 0.05
Cu, PM2.5	< 0.04	**0.11**	**0.08**
Zn, PM2.5	< 0.05	**0.10**	**0.11**
Ga, PM2.5	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	28
Location	LA
Test Day	Fr
Test Date	10/3/97
AM / PM	AM
Scenario	MC
AER	Hi

Element, Size ug/m3	AMB	IN1
Na, PM10	1.48	1.45
Mg, PM10	0.37	< 0.29
Al, PM10	1.18	0.48
Si, PM10	2.67	2.36
P, PM10	< 0.08	0.16
Cl, PM10	< 0.17	< 0.17
K, PM10	0.34	0.19
Ca, PM10	0.62	0.49
Ti, PM10	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23
Fe, PM10	0.86	0.81
Co, PM10	< 0.05	< 0.05
Cu, PM10	0.04	0.17
Zn, PM10	< 0.05	0.14
Ga, PM10	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	29
Location	LA
Test Day	Fr
Test Date	10/3/97
AM / PM	PM
Scenario	MC
AER	Hi

Element, Size ug/m3	AMB	IN1	OUT1
Na, PM2.5	**1.51**	< 0.68	**1.12**
Mg, PM2.5	< 0.29	< 0.29	< 0.29
Al, PM2.5	**0.18**	< 0.16	< 0.16
Si, PM2.5	**0.37**	**1.11**	**0.83**
P, PM2.5	**0.09**	< 0.08	< 0.08
Cl, PM2.5	< 0.17	< 0.17	< 0.17
K, PM2.5	< 0.12	< 0.12	< 0.12
Ca, PM2.5	< 0.13	< 0.13	< 0.13
Ti, PM2.5	< 0.54	< 0.54	< 0.54
V, PM2.5	< 0.23	< 0.23	< 0.23
Fe, PM2.5	**0.12**	**0.45**	**0.62**
Co, PM2.5	< 0.05	< 0.05	< 0.05
Cu, PM2.5	**0.05**	**0.09**	< 0.04
Zn, PM2.5	**0.05**	**0.12**	**0.08**
Ga, PM2.5	< 0.04	< 0.04	< 0.04
As, PM2.5	< 0.04	< 0.04	< 0.04
Se, PM2.5	< 0.03	< 0.03	< 0.03
Br, PM2.5	< 0.02	< 0.02	< 0.02
Rb, PM2.5	< 0.02	< 0.02	< 0.02
Sr, PM2.5	< 0.02	< 0.02	< 0.02
Y, PM2.5	< 0.02	< 0.02	< 0.02
Zr, PM2.5	< 0.03	< 0.03	< 0.03
Mo, PM2.5	< 0.05	< 0.05	< 0.05
Pd, PM2.5	< 0.19	< 0.19	< 0.19
Ag, PM2.5	< 0.20	< 0.20	< 0.20
In, PM2.5	< 0.25	< 0.25	< 0.25
Sn, PM2.5	< 0.32	< 0.32	< 0.32
Sb, PM2.5	< 0.38	< 0.38	< 0.38
Ba, PM2.5	< 1.44	< 1.44	< 1.44
La, PM2.5	< 1.97	< 1.97	< 1.97
Au, PM2.5	< 0.07	< 0.07	< 0.07
Hg, PM2.5	< 0.06	< 0.06	< 0.06
Tl, PM2.5	< 0.05	< 0.05	< 0.05
U, PM2.5	< 0.05	< 0.05	< 0.05

NOTES:
All contaminants in μg/m³ unless otherwise noted
- No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Commute #	29
Location	LA
Test Day	Fr
Test Date	10/3/97
AM / PM	PM
Scenario	MC
AER	Hi

Element, Size ug/m3	AMB	IN1
Na, PM10	0.86	1.99
Mg, PM10	< 0.29	< 0.29
Al, PM10	0.92	< 0.16
Si, PM10	3.22	2.71
P, PM10	< 0.08	0.12
Cl, PM10	< 0.17	< 0.17
K, PM10	0.29	0.18
Ca, PM10	0.63	0.24
Ti, PM10	< 0.54	< 0.54
V, PM10	< 0.23	< 0.23
Fe, PM10	0.75	0.68
Co, PM10	< 0.05	< 0.05
Cu, PM10	0.04	0.12
Zn, PM10	0.07	0.12
Ga, PM10	< 0.04	< 0.04
As, PM10	< 0.04	< 0.04
Se, PM10	< 0.03	< 0.03
Br, PM10	< 0.02	< 0.02
Rb, PM10	< 0.02	< 0.02
Sr, PM10	< 0.02	< 0.02
Y, PM10	< 0.02	< 0.02
Zr, PM10	< 0.03	< 0.03
Mo, PM10	< 0.05	< 0.05
Pd, PM10	< 0.19	< 0.19
Ag, PM10	< 0.20	< 0.20
In, PM10	< 0.25	< 0.25
Sn, PM10	< 0.32	< 0.32
Sb, PM10	< 0.38	< 0.38
Ba, PM10	< 1.44	< 1.44
La, PM10	< 1.97	< 1.97
Au, PM10	< 0.07	< 0.07
Hg, PM10	< 0.06	< 0.06
Tl, PM10	< 0.05	< 0.05
U, PM10	< 0.05	< 0.05

NOTES:
All contaminants in µg/m³ unless otherwise noted
N/A - No sample scheduled
NS - No sample, data lost or voided
< values are referenced to MDL's or MQL's defined in Table 3-3
Abbreviations defined in Section 7

Appendix J

Data Treatment Guidelines for Summary Tables

Data Treatment Guidelines for ARB Summary Tables

Individual Commute Summaries (e.g. Appendix H, Appendix I)
[Only *Censored* Data reported, where censored is defined as:]

If MDL and MQL are defined (e.g. $PM_{2.5}$ & PM_{10} mass, particle count, black carbon, speed, spacing)::
value is above MQL, report data value
MQL is reported when data value is less than or equal to MQL (e.g. <0.22 $\mu g/m^3$ for Los Angeles isobutylene)

If only MQL is defined (e.g. VOC's, formaldehyde, CO):
value is above MQL, report data value
MQL is reported when data value is less than or equal to MQL (e.g. <0.22 $\mu g/m^3$ for Los Angeles isobutylene)

If only MDL is defined:
value is above MDL, report data value
MDL is reported instead of MQL when data value is <MDL (e.g. <0.2 $\mu g/m^3$ for $PM_{2.5}$ cadmium)

Composite Summaries (e.g. Tables 3-4, 3-4, 4-1, 4-2, 4-3, etc.)
[*Uncensored* data utilized to compute scenario means; except when data value is below MDL:]

If MDL and MQL are both defined (e.g. $PM_{2.5}$ & PM_{10} mass, particle count, black carbon, speed, spacing): and
value is above MDL, use *uncensored* data in mean computation
value is equal to or below MDL, use ½ of MDL in mean computation

If only MQL is defined (e.g. VOC's, formaldehyde, CO):
use *uncensored* data in mean computation

If only MDL is defined (e.g. metals for $PM_{2.5}$ & PM_{10}): and
value is above MDL, use *uncensored* data in mean computation
value is equal to or below MDL, use ½ of MDL in mean computation

If neither MDL or MQL are defined (e.g. Level of Congestion)
use *uncensored* data

Additional Notes:
1. All particle count data were above the MDL.
2. If two values of MQL exist in a mixed computation (e.g. Sacramento VOC data) use higher value of MQL)
3. Means with only 1 data point (e.g. rural commute), revert to rules above for Individual Commute Summaries.

Appendix K

Measurement Summary Data for Selected Target Pollutants

- $PM_{2.5}$ Data
- MTBE Data
- CO Data
- Formaldehyde Data
- $PM_{2.5}$ Sulfur (S)

PM2.5 Data Summary

Commute											PM2.5											
#	Day	1998 Date	Day of Week	City	Special Test Type	Vehicle 2 Type	Time Period	Roadway Type	Rush Period	AER Level	IN1 - AMB	OUT1 - IN1	Cor. OUT1 - IN1	IN1 - ROAD X	IN2 - AMB	OUT2 - IN2	IN2 - ROAD X	OUT1-OUT2	IN1-OUT1	Cor. IN1-OUT1	IN2-OUT2
1	1	9/9	Tu	SAC		Taurus	AM	Freeway	Non-Rush	High	-1.9	6.4	10.1	-3.8	0.1	2.0	-1.8	2.3	-6.4	-10.1	-2.0
2	1	9/9	Tu	SAC		Taurus	AM	Freeway	Non-Rush	High	10.2	10.9	16.4	13.4	4.1	4.0	7.4	12.9	-10.9	-16.4	-4.0
3	2	9/10	We	SAC		Taurus	AM	Freeway	Rush	High	14.5	-4.1	-2.0	16.5	4.1	6.2	6.1	0.1	4.1	2.0	-6.2
4	2	9/10	We	SAC		Taurus	AM	Freeway	Rush	High	14.4	1.6	5.6	16.4	-2.1	10.4	0.0	7.7	-1.6	-5.6	-10.4
5	3	9/11	Th	SAC		Taurus	AM	Freeway	Rush	Low	11.4	14.1	21.3	5.5	5.8	9.9	0.0	9.8	-14.1	-21.3	-9.9
6	3	9/11	Th	SAC		Taurus	AM	Freeway	Rush	Low		11.8	15.0	-3.2		-4.1	-3.1	15.8	-11.8	-15.0	4.1
7	4	9/12	Fr	SAC		Taurus	AM	Arterial	Rush	High	-0.2	14.0	18.5	-2.4	-6.2	8.4	-8.4	11.6	-14.0	-18.5	-8.4
8	4	9/12	Fr	SAC		Taurus	AM	Arterial	Rush	High	6.1	4.5	7.4	9.2	8.2	-10.4	11.3	12.8	-4.5	-7.4	10.4
9	5	9/13	Sa	SAC	Rural	Taurus	AM	Rural	Rush	High	na	-4.1	-3.6		na				4.1	3.6	0.0
10	6	9/14	Mo	SAC		Taurus	AM	Arterial	Rush	Low	-2.2	10.2	14.3	na	-4.1	17.8	na	-5.6	-10.2	-14.3	-17.8
11	6	9/14	Mo	SAC		Taurus	AM	Arterial	Rush	Low	-8.6	2.5	5.0	na	-2.3	-4.0	na	0.2	-2.5	-5.0	4.0
12	7	9/15	Tu	SAC	School Bus	Bus	AM	Resid.	Rush	High	3.9	-3.9	-2.2	na	14.7	-4.7	na	-9.9	3.9	2.2	4.7
13	7	9/15	Tu	SAC	School Bus	Bus	AM	Resid.	Rush	High		-3.2	0.6	na		-2.6	na	4.5	3.2	-0.6	2.6
14	8	9/25	Th	LA		Explorer	AM	Freeway	Non-Rush	High	38.3	8.5	22.0	na	22.2	6.5	na	16.1	-8.5	-22.0	-6.5
15	8	9/26	Fr	LA		Explorer	AM	Freeway	Rush	High	23.0	13.0	25.1	8.7	14.1	9.0	-0.2	12.8	-13.0	-25.1	-9.0
16	9	9/26	Fr	LA		Explorer	AM	Freeway	Rush	High	17.2	-0.1	7.5	0.6	7.3	4.8	-9.3	5.0	0.1	-7.5	-4.8
17	10	9/27	Sa	LA		Explorer	AM	Arterial	Non-Rush	High	7.0	2.8	13.2	na	-1.2	1.1	na	9.9	-2.8	-13.2	-1.1
18	11	9/28	Su	LA		Explorer	AM	Arterial	Non-Rush	High	1.4	8.1	26.9	na	-12.9	-15.6	na	38.0	-8.1	-26.9	15.6
19	11	9/28	Su	LA		Explorer	AM	Freeway	Non-Rush	High	4.6	18.6	32.4	na	1.0	-2.0	na	24.2	-18.6	-32.4	2.0
20	12	9/29	Mo	LA		Explorer	AM	Freeway	Rush	Low	12.7	9.8	22.9	-8.6	-4.8	19.7	-26.1	7.5	-9.8	-22.9	-19.7
21	12	9/29	Mo	LA		Explorer	AM	Freeway	Rush	Low	-3.6	14.4	24.4	-1.5	-17.0	6.7	-14.9	21.1	-14.4	-24.4	-6.7
22	13	9/30	Tu	LA	Carpool	Explorer	AM	Freeway	Rush	High	-14.6	-37.3	-36.9	-30.7	-14.8	60.7	-30.9	-97.8	37.3	36.9	-60.7
23	13	9/30	Tu	LA	Carpool	Explorer	AM	Freeway	Rush	High	-7.8	25.8	41.9	-14.9	-14.8	10.5	-21.9	22.4	-25.8	-41.9	-10.5
24	14	10/1	We	LA		Explorer	AM	Arterial	Rush	Low	-52.9	59.8	82.3	-49.3	-60.9	25.8	-57.4	42.0	-59.8	-82.3	-25.8
25	14	10/1	We	LA		Explorer	AM	Arterial	Rush	Low	7.9	12.9	24.2	-9.8	-4.5	6.5	-22.1	18.8	-12.9	-24.2	-6.5
26	15	10/2	Th	LA		Explorer	AM	Arterial	Rush	High	22.4	6.8	16.0	14.1	16.2	-14.0	7.9	27.0	-6.8	-16.0	14.0
27	15	10/2	Th	LA		Explorer	AM	Arterial	Rush	High	-5.3	12.5	20.7	-2.5	-11.1	4.4	-8.4	14.0	-12.5	-20.7	-4.4
28	16	10/3	Fr	LA	Max Conc.	none	AM	Freeway	Rush	High	27.2	21.8	38.0		na	na	na	na	-21.8	-38.0	
29	16	10/3	Fr	LA	Max Conc.	none	AM	Freeway	Rush	High	96.2	-10.1	9.3		na	na	na	na	10.1	-9.3	

MTBE Data Summary											MTBE										
Commute																					
#	Day	1998 Date	Day of Week	City	Special Test Type	Vehicle 2 Type	Time Period	Roadway Type	Rush Period	AER Level	IN1 - AMB	IN1 - OUT1	IN1 - ROAD X	IN2 - AMB	IN2 -OUT2	IN2 - ROAD X	OUT1-OUT2	OUT1 - AMB	OUT2 - AMB	MTBE IN1/OUT1	MTBE IN2/OUT2
1	1	9/9	Tu	SAC		Taurus	AM	Freeway	Non-Rush	High	6.4	-1.7	5.9	4.6	-2.2	4.1	1.3	8.1	6.8	0.845	0.773
2	1	9/9	Tu	SAC		Taurus	PM	Freeway	Non-Rush	High	11.0	-4.0	9.7	14.0	1.0	12.7	2.0	15.0	13.0	0.750	1.071
3	2	9/10	We	SAC		Taurus	AM	Freeway	Rush	High	16.4	2.0	13.5	16.4	-1.0	13.5	-3.0	14.4	17.4	1.118	0.950
4	2	9/10	We	SAC		Taurus	PM	Freeway	Rush	High	26.1	-1.0	26.2	24.1	2.0	24.2	5.0	27.1	22.1	0.967	1.080
5	3	9/11	Th	SAC		Taurus	AM	Freeway	Rush	Low	10.7	-1.0	9.5	5.7	-7.0	4.5	-1.0	11.7	12.7	0.941	0.611
6	3	9/11	Th	SAC		Taurus	PM	Freeway	Rush	Low		6.0	16.5		16.0	15.5	11.0			1.273	2.455
7	4	9/12	Fr	SAC		Taurus	AM	Arterial	Rush	High	22.5	10.0	17.5	14.5	0.0	9.5	-2.0	12.5	14.5	1.476	1.000
8	4	9/12	Fr	SAC		Taurus	PM	Arterial	Rush	High	24.9	3.0	20.4	19.9	4.0	15.4	6.0	21.9	15.9	1.115	1.200
9	5	9/13	Sa	SAC	Rural	Taurus	noon	Rural	Rush	High	na	0.4		na						1.182	
10	6	9/14	Mo	SAC		Taurus	AM	Arterial	Rush	Low	24.0	3.0	na	10.0	0.0	na	11.0	21.0	10.0	1.091	1.000
11	6	9/14	Mo	SAC		Taurus	PM	Arterial	Rush	Low	23.4	0.0	na	16.4	1.0	na	8.0	23.4	15.4	1.000	1.056
12	7	9/15	Tu	SAC	School Bus	Bus	AM	Resid.	Rush	High	5.9	1.1	na	4.6	0.4	na	0.6	4.8	4.2	1.145	1.057
13	7	9/15	Tu	SAC	School Bus	Bus	PM	Resid.	Rush	High		1.2	na		0.8	na	2.5			1.250	1.348
14	8	9/25	Th	LA		Explorer	AM	Freeway	Non-Rush	High	22.1	1.0	na	18.1	-1.0	na	2.0	21.1	19.1	1.032	0.966
15	9	9/26	Fr	LA		Explorer	AM	Freeway	Rush	High	14.6	-11.0	-5.5	23.6	3.0	3.5	5.0	25.6	20.6	0.645	1.115
16	9	9/26	Fr	LA		Explorer	PM	Freeway	Rush	High	22.7	-2.0	10.0	26.7	3.0	14.0	1.0	24.7	23.7	0.938	1.097
17	10	9/27	Sa	LA		Explorer	PM	Arterial	Non-Rush	High	24.0	3.0	na	16.0	6.0	na	11.0	21.0	10.0	1.077	1.214
18	11	9/28	Su	LA		Explorer	AM	Arterial	Non-Rush	High	43.0	-2.0	na	17.0	-5.0	na	23.0	45.0	22.0	0.975	0.912
19	11	9/28	Su	LA		Explorer	PM	Freeway	Non-Rush	High	30.0	-1.0	na	20.0	-11.0	na	0.0	31.0	31.0	0.981	0.788
20	12	9/29	Mo	LA		Explorer	AM	Freeway	Rush	Low	34.0	2.0	11.0	25.0	-1.0	2.0	6.0	32.0	26.0	1.032	0.982
21	12	9/29	Mo	LA		Explorer	PM	Freeway	Rush	Low	26.0	-4.0	6.5	18.0	-2.0	-1.5	10.0	30.0	20.0	0.902	0.935
22	13	9/30	Tu	LA	Carpool	Explorer	AM	Freeway	Rush	High	26.8	0.0	5.0	38.8	2.0	17.0	-10.0	26.8	36.8	1.000	1.044
23	13	9/30	Tu	LA	Carpool	Explorer	PM	Freeway	Rush	High	15.0	-1.0	2.0	35.0	-3.0	22.0	-22.0	16.0	38.0	0.964	0.940
24	14	10/1	We	LA		Explorer	AM	Arterial	Rush	Low	37.0	-1.0	30.0	26.0	0.0	19.0	12.0	38.0	26.0	0.980	1.000
25	14	10/1	We	LA		Explorer	PM	Arterial	Rush	Low	12.0	-8.0	7.0	13.0	1.0	8.0	8.0	20.0	12.0	0.750	1.042
26	15	10/2	Th	LA		Explorer	AM	Arterial	Rush	High	34.6	7.0	30.6	26.6	4.0	22.6	5.0	27.6	22.6	1.206	1.138
27	15	10/2	Th	LA		Explorer	PM	Arterial	Rush	High	21.3	1.0	15.8	19.3	1.0	13.8	2.0	20.3	18.3	1.037	1.040
28	16	10/3	Fr	LA	Max Conc.	none	AM	Freeway	Rush	High	79.0	18.0	#REF!	na	na	na	na	61.0	-11.0	1.250	
29	16	10/3	Fr	LA	Max Conc.	none	PM	Freeway	Rush	High	20.0	1.0	#REF!	na	an	na	na	19.0	-10.0	1.034	

Data Summary

Commute											CO								
#	Day	1998 Date	Day of Week	City	Special Test Type	Vehicle 2 Type	Time Period	Roadway Type	Rush Period	AER Level	IN1 - AMB	IN1 - OUT1	IN1 - ROAD X	IN2 - AMB	IN2 - OUT2	IN2 - ROAD X	OUT1-OUT2	OUT1 - AMB	OUT2 - AMB
1	1	9/9	Tu	SAC		Taurus	AM	Freeway	Non-Rush	High	1.2	1.2	1.2	4.2	-0.6	4.2	-4.8	0.0	4.8
2	1	9/9	Tu	SAC		Taurus	PM	Freeway	Non-Rush	High	1.6	-0.6	1.6	2.8	-0.2	2.8	-0.8	2.2	3.0
3	2	9/10	We	SAC		Taurus	AM	Freeway	Rush	High	2.3	-0.2	2.3	2.6	-0.6	2.6	-0.8	2.5	3.2
4	2	9/10	We	SAC		Taurus	PM	Freeway	Rush	High	2.1	-0.1	2.1	4.1	-1.3	4.1	-3.2	2.2	5.4
5	3	9/11	Th	SAC		Taurus	AM	Freeway	Rush	Low	1.8	0.1	1.6	2.6	-1.9	2.4	-2.7	1.8	4.5
6	3	9/11	Th	SAC		Taurus	PM	Freeway	Rush	Low		-0.2	0.9		-0.6	2.1	-1.7	2.1	3.8
7	4	9/12	Fr	SAC		Taurus	AM	Arterial	Rush	High	2.4	-0.7	2.1	2.1	-0.4	1.7	0.7	3.1	2.4
8	4	9/12	Fr	SAC		Taurus	PM	Arterial	Rush	High	2.0	2.0	1.6	5.1	-0.9	4.7	-6.0	0.0	6.0
9	5	9/13	Sa	SAC	Rural	Taurus	noon	Rural	Rush	High	na	0.5		na	-0.2			0.2	0.6
10	6	9/14	Mo	SAC		Taurus	AM	Arterial	Rush	Low	1.9	-0.4	na	2.1	-1.6	na	-1.4	2.3	3.7
11	6	9/14	Mo	SAC		Taurus	PM	Arterial	Rush	Low	2.5	-0.2	na	2.7	-1.3	na	-1.3	2.7	4.0
12	7	9/15	Tu	SAC	School Bus	Bus	AM	Resid.	Rush	High	0.4	0.1	na	0.3	-0.2	na	-0.1	0.4	0.4
13	7	9/15	Tu	SAC	School Bus	Bus	PM	Resid.	Rush	High		0.1	na			na	0.2	0.2	0.0
14	8	9/25	Th	LA		Explorer	AM	Freeway	Non-Rush	High	3.9	-0.8	na	3.7	-0.2	na	0.8	4.7	3.9
15	9	9/26	Fr	LA		Explorer	AM	Freeway	Rush	High	6.0	0.6	3.5	4.3	-0.7	1.8	0.4	5.4	5.0
16	9	9/26	Fr	LA		Explorer	PM	Freeway	Rush	High	4.3	0.0	2.2	5.1	1.2	2.9	0.5	4.3	3.9
17	10	9/27	Sa	LA		Explorer	PM	Arterial	Non-Rush	High	3.1	0.2	na	4.1	-0.8	na	-1.9	2.9	4.8
18	11	9/28	Su	LA		Explorer	AM	Arterial	Non-Rush	High	3.6	-0.8	na	3.4	-1.1	na	-0.1	4.4	4.5
19	11	9/28	Su	LA		Explorer	PM	Freeway	Non-Rush	High	2.3	0.8	na	2.7	-0.4	na	-1.6	1.5	3.1
20	12	9/29	Mo	LA		Explorer	AM	Freeway	Rush	Low	3.9	-1.7	0.9	5.7	-1.5	2.7	-1.6	5.5	7.1
21	12	9/29	Mo	LA		Explorer	PM	Freeway	Rush	Low	4.0	-0.1	1.2	4.4	0.2	1.6	-0.1	4.1	4.2
22	13	9/30	Tu	LA	Carpool	Explorer	AM	Freeway	Rush	High	4.2	1.0	0.7	4.9	-0.6	1.5	-2.3	3.2	5.5
23	13	9/30	Tu	LA	Carpool	Explorer	PM	Freeway	Rush	High	2.9	0.5	-0.8	4.9	-0.8	1.3	-3.3	2.4	5.7
24	14	10/1	We	LA		Explorer	AM	Arterial	Rush	Low	6.0	-0.6	5.1	5.0	-1.2	4.1	0.5	6.6	6.1
25	14	10/1	We	LA		Explorer	PM	Arterial	Rush	Low	3.8	0.5	3.2	4.3	-0.7	3.7	-1.7	3.3	5.0
26	15	10/2	Th	LA		Explorer	AM	Arterial	Rush	High	4.1	-0.6	3.5	4.7	0.2	4.0	0.2	4.7	4.5
27	15	10/2	Th	LA		Explorer	PM	Arterial	Rush	High	3.0	0.2	2.8	3.6	-0.2	3.3	-0.9	2.8	3.7
28	16	10/3	Fr	LA	Max Conc.	none	AM	Freeway	Rush	High	4.2	-0.3		na	na	na	na	4.4	-0.2
29	16	10/3	Fr	LA	Max Conc.	none	PM	Freeway	Rush	High	4.6	0.3		na	na	na	na	4.3	-0.1

PM2.5 S (Sulfur) Data Summary																			
Commute											PM2.5 S								
#	Day	1998 Date	Day of Week	City	Special Test Type	Vehicle 2 Type	Time Period	Roadway Type	Rush Period	AER Level	IN1 - AMB	OUT1 - IN1	IN1 - ROAD X	IN2 - AMB	OUT2 - IN2	IN2 - ROAD X	OUT1-OUT2	IN1-OUT1	IN2-OUT2
1	1	9/9	Tu	SAC		Taurus	AM	Freeway	Non-Rush	High	-0.52	-0.01	0.12	-0.19	0.22	-0.18	0.07	0.01	-0.22
2	1	9/9	Tu	SAC		Taurus	AM	Freeway	Non-Rush	High	-0.94	0.00	0.03	0.06	0.00	0.02	0.00	0.00	0.00
3	2	9/10	We	SAC		Taurus	AM	Freeway	Rush	High	-2.06	0.07	0.06	-0.05	0.09	-0.12	0.16	-0.07	-0.09
4	2	9/10	We	SAC		Taurus	AM	Freeway	Rush	High	-1.56	0.07	-0.06	-0.07	0.20	-0.11	-0.09	-0.07	-0.20
5	3	9/11	Th	SAC		Taurus	AM	Freeway	Rush	Low	na	0.09	0.02	-0.17	0.05	-0.13	0.18	-0.09	-0.05
6	3	9/11	Th	SAC		Taurus	AM	Freeway	Rush	Low	-3.83	-0.05	-0.06	-0.13	0.13	-0.19	-0.05	0.05	-0.13
7	4	9/12	Fr	SAC		Taurus	AM	Arterial	Rush	High	-5.29	0.08	0.20	-0.27	0.18	-0.01	0.11	-0.08	-0.18
8	4	9/12	Fr	SAC		Taurus	AM	Arterial	Rush	High	-4.68	0.10	0.09	-0.27	-0.04	-0.14	0.36	-0.10	0.04
9	5	9/13	Sa	SAC	Rural	Taurus	AM	Rural	Rush	High	na	0.00	-0.01	-0.33	0.19	-0.13	-0.06	0.00	-0.19
10	6	9/14	Mo	SAC		Taurus	AM	Arterial	Rush	Low	na	0.00	na	na	na	na	na	0.00	na
11	6	9/14	Mo	SAC		Taurus	AM	Arterial	Rush	Low	na	0.06	na	-0.11	0.09	na	-0.03	-0.06	-0.09
12	7	9/15	Tu	SAC	School Bus	Bus	AM	Resid.	Rush	High	na	-0.15	na	-0.07	0.05	na	-0.17	0.15	-0.05
13	7	9/15	Tu	SAC	School Bus	Bus	AM	Resid.	Rush	High	na	-0.03	na	0.03	-0.11	na	0.10	0.03	0.11
14	8	9/25	Th	LA		Explorer	AM	Freeway	Non-Rush	High	na	-0.03	na	0.22	0.02	na	-0.12	0.03	-0.02
15	8	9/26	Fr	LA		Explorer	AM	Freeway	Rush	High	-5.40	0.04	-0.17	-0.11	-0.03	-0.12	0.03	-0.04	0.03
16	9	9/26	Fr	LA		Explorer	AM	Freeway	Rush	High	-3.86	-0.19	-0.04	0.16	-0.02	-0.09	-0.12	0.19	0.02
17	10	9/27	Sa	LA		Explorer	AM	Arterial	Non-Rush	High	na	-0.01	na	-0.20	-0.17	na	0.16	0.01	0.17
18	11	9/28	Su	LA		Explorer	AM	Arterial	Non-Rush	High	na	0.06	na	-0.51	-0.07	na	0.36	-0.06	0.07
19	11	9/28	Su	LA		Explorer	AM	Freeway	Non-Rush	High	na	0.40	na	-0.96	0.93	na	0.06	-0.40	-0.93
20	12	9/29	Mo	LA		Explorer	AM	Freeway	Rush	Low	-15.03	0.06	-0.10	-0.20	0.07	-0.34	0.24	-0.06	-0.07
21	12	9/29	Mo	LA		Explorer	AM	Freeway	Rush	Low	-8.10	0.43	-0.34	-0.47	0.24	-0.68	0.53	-0.43	-0.24
22	13	9/30	Tu	LA	Carpool	Explorer	AM	Freeway	Rush	High	-9.78	-1.94	-0.47	-0.84	0.16	-0.66	-1.90	1.94	-0.16
23	13	9/30	Tu	LA	Carpool	Explorer	AM	Freeway	Rush	High	-5.26	0.43	-0.60	-1.68	0.65	-0.92	0.10	-0.43	-0.65
24	14	10/1	We	LA		Explorer	AM	Arterial	Rush	Low	-3.22	1.16	-1.28	-2.01	0.56	-1.80	1.13	-1.16	-0.56
25	14	10/1	We	LA		Explorer	AM	Arterial	Rush	Low	-2.61	0.52	-0.92	-0.66	0.10	-0.97	0.47	-0.52	-0.10
26	15	10/2	Th	LA		Explorer	AM	Arterial	Rush	High	-0.62	0.12	0.08	0.22	0.10	-0.11	0.20	-0.12	-0.10
27	15	10/2	Th	LA		Explorer	AM	Arterial	Rush	High	-0.30	0.53	-0.90	-0.83	-0.36	-0.80	0.79	-0.53	0.36
28	16	10/3	Fr	LA	Max Conc.	none	AM	Freeway	Rush	High	2.17	0.16	na	na	na	na	na	-0.16	na
29	16	10/3	Fr	LA	Max Conc.	none	AM	Freeway	Rush	High	2.03	0.06	na	na	na	na	na	-0.06	na

Formaldehyde Data Summary

Commute #	Commute Day	1998 Date	Day of Week	City	Special Test Type	Vehicle 2 Type	Time Period	Roadway Type	Rush Period	AER Level	MTBE IN1 - AMB	IN1 - OUT1	IN1 - ROAD X	IN2 - AMB	IN2 -OUT2	IN2 - ROAD X	OUT1-OUT2	OUT1 - AM	OUT2 - AM	IN1/OUT1	IN2/OUT2
1	1	9/9	Tu	SAC		Taurus	AM	Freeway	Non-Rush	High	3.7	na	2.4	3.5	na	2.2	na	na	na	na	na
2	1	9/9	Tu	SAC		Taurus	PM	Freeway	Non-Rush	High	na	na	3.3	na	na	3.3	na	na	na	na	na
3	2	9/10	We	SAC		Taurus	AM	Freeway	Rush	High	8.9	na	8.1	6.2	na	5.4	na	na	na	na	na
4	2	9/10	We	SAC		Taurus	PM	Freeway	Rush	High	na	na	5.6	na	na	4.6	na	na	na	na	na
5	3	9/11	Th	SAC		Taurus	AM	Freeway	Rush	Low	8.8	na	na	7.8	na	na	na	na	na	na	na
6	3	9/11	Th	SAC		Taurus	PM	Freeway	Rush	Low	5.3	na	3.2	11.3	na	9.2	na	na	na	na	na
7	4	9/12	Fr	SAC		Taurus	AM	Arterial	Rush	High	6.8	na	4.7	5.8	na	3.5	na	na	na	na	na
8	4	9/12	Fr	SAC		Taurus	PM	Arterial	Rush	High	4.5	na	3.7	2.6	na	1.8	na	na	na	na	na
9	5	9/13	Sa	SAC	Rural	Taurus	noon	Rural	Rush	High	na	na	0.3	na	na	1.2	na	na	na	na	na
10	6	9/14	Mo	SAC		Taurus	AM	Arterial	Rush	Low	10.7	na	na	7.7	na	na	na	na	na	na	na
11	6	9/14	Mo	SAC		Taurus	PM	Arterial	Rush	Low	8.6	na	na	14.6	na	na	na	na	na	na	na
12	7	9/15	Tu	SAC	School Bus	Bus	AM	Resid.	Rush	High	na	na	na	na	na	na	na	na	na	na	na
13	7	9/15	Tu	SAC	School Bus	Bus	PM	Resid.	Rush	High	6.3	na	na	3.2	na	na	na	na	na	na	na
14	8	9/25	Th	LA		Explorer	AM	Freeway	Non-Rush	High	-5.0	na	na	-9.0	na	na	na	na	na	na	na
15	9	9/26	Fr	LA		Explorer	AM	Freeway	Rush	High	na	na	na	na	na	na	na	na	na	na	na
16	9	9/26	Fr	LA		Explorer	PM	Freeway	Rush	High	10.1	na	4.8	9.1	na	3.8	na	na	na	na	na
17	10	9/27	Sa	LA		Explorer	PM	Arterial	Non-Rush	High	2.0	na	na	-7.8	na	na	na	na	na	na	na
18	11	9/28	Su	LA		Explorer	AM	Arterial	Non-Rush	High	-1.0	na	na	1.0	na	na	na	na	na	na	na
19	11	9/28	Su	LA		Explorer	PM	Freeway	Non-Rush	High	na	na	na	-8.0	na	na	na	na	na	na	na
20	12	9/29	Mo	LA		Explorer	AM	Freeway	Rush	Low	7.7	na	-0.5	10.7	na	2.5	na	na	na	na	na
21	12	9/29	Mo	LA		Explorer	PM	Freeway	Rush	Low	6.0	na	1.0	6.0	na	1.0	na	na	na	na	na
22	13	9/30	Tu	LA	Carpool	Explorer	AM	Freeway	Rush	High	9.1	na	2.5	14.1	na	7.5	na	na	na	na	na
23	13	9/30	Tu	LA	Carpool	Explorer	PM	Freeway	Rush	High	1.0	na	-5.0	2.0	na	-4.0	na	na	na	na	na
24	14	10/1	We	LA		Explorer	AM	Arterial	Rush	Low	na	na	1.9	na	na	5.9	na	na	na	na	na
25	14	10/1	We	LA		Explorer	PM	Arterial	Rush	Low	3.0	na	6.0	6.0	na	9.0	na	na	na	na	na
26	15	10/2	Th	LA		Explorer	AM	Arterial	Rush	High	8.6	na	7.5	7.6	na	6.5	na	na	na	na	na
27	15	10/2	Th	LA		Explorer	PM	Arterial	Rush	High	6.4	na	3.0	4.4	na	0.9	na	na	na	na	na
28	16	10/3	Fr	LA	Max Conc.	none	AM	Freeway	Rush	High	11.0	na	17.0	na	na	na	na	na	na	na	na
29	16	10/3	Fr	LA	Max Conc.	none.	PM	Freeway	Rush	High	0.0	na	14.0	na	na	na	na	na	na	na	na

Appendix L

Ranking of Los Angeles Particle Data for Video Relational Analysis

Rank	Ranking of Los Angeles Particle Data for Video Relational Analysis																							
								Sedan 1						Ambient		Sedan 2 or Bus			Roadside 1		Roadside 2		Ambient	
								Inside					Outside			Inside		Outside						
Rank	Commute #	Day	Date	DOW	Period	Type	Vent	PM2.5	BC PM2.5	PM2.5 DUP	PM10	PM10 DUP	PM2.5	PM2.5	PM10	PM2.5	PM10	PM2.5	PM2.5	PM10	PM2.5	PM10	PM2.5	PM10
1	29	9	10/3	Fr	PM	MC	HI	106.7	96.2	98.0	105.0		96.6	10.5	50.0								10.5	50.0
2	14	1	9/25	Th	AM	FNRH	HI	59.0	38.3		61.0		67.5	20.6	36.9	42.8	58.6	49.3					20.6	36.9
	28	9	10/3	Fr	AM	MC	HI	59.3	27.2		73.2		81.1	32.1	63.8								32.1	63.8
3	15	2	9/26	Fr	AM	FRH	HI	47.8	23.0		64.8		60.8	24.8	49.3	38.9	45.2	47.9	42.9	55.8	35.3	67.6	24.8	49.3
4	26	8	10/2	Th	AM	AR	HI	38.9	22.4		42.9		45.7	16.5	31.0	32.7	26.6	18.7	39.3	61.7	10.3	31.0	16.5	31.0
	16	2	9/26	Fr	PM	FRH	HI	38.0	17.2		46.0	33.9	37.9	20.8	51.8	28.1	44.1	32.9	37.2	60.6	37.6	43.9	20.8	51.8
	20	5	9/29	Mo	AM	FRH	Low	56.0	12.7		56.3		65.7	43.3	70.1	38.5	32.6	58.2	53.1	93.0	76.0	129.8	43.3	70.1
	25	7	10/1	We	PM	AR	Low	43.5	7.9	45.3	51.7		56.4	35.6	66.9	31.2	39.3	37.6	55.8	78.0	50.8	67.5	35.6	66.9
5	17	3	9/27	Sa	PM	ANR	HI	49.3	7.0	41.2	53.7		52.1	42.3	59.2	41.1	37.1	42.2					42.3	59.2
	19	4	9/28	Su	PM	FNRH	Hi	50.5	4.6	64.7	72.1		69.1	46.0	70.7	47.0	67.3	45.0					46.0	70.7
	18	4	9/28	Su	AM	ANR	HI	86.0	1.4		85.5		94.1	84.6	139.2	71.7	79.7	56.1					84.6	139.2
	21	5	9/29	Mo	PM	FRH	Low	36.1	-3.6	34.4	52.4		50.4	39.7	66.9	22.7	22.9	29.4	37.5	83.8	37.6	83.6	39.7	66.9
	27	8	10/2	Th	PM	AR	HI	28.5	-5.3		34.6	38.6	41.0	33.8	52.1	22.6	28.9	27.0	35.1	57.9	26.9	52.0	33.8	52.1
	23	6	9/30	Tu	PM	FRC	HI	54.6	-7.8		73.2	73.0	80.4	62.4	95.6	47.5	74.6	58.0	64.1	119.2	74.8	120.9	62.4	95.6
	22	6	9/30	Tu	AM	FRC	HI	39.3	-14.6		49.1		2.0	53.9	109.5	39.1	67.5	99.8	61.8	126.1	78.1	124.0	53.9	109.5
	24	7	10/1	We	AM	AR	Low	53.1	-52.9		53.1		112.9	106.0	159.1	45.1	111.0	70.9	102.8	143.5	102.2	166.0	106.0	159.1

Note: commute #14 was raining

Appendix M
Field Operations Manual for Main Study

RESEARCH TRIANGLE INSTITUTE

RTI

September 5, 1997

FIELD OPERATIONS MANUAL
MAIN STUDY
MEASURING CONCENTRATIONS OF SELECTED AIR POLLUTANTS INSIDE CALIFORNIA VEHICLES

ARB Contract 95-339
RTI Task 93U-6786-001

prepared by

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Main Study

Field Operations Manual

MEASURING CONCENTRATIONS OF SELECTED AIR POLLUTANTS INSIDE CALIFORNIA VEHICLES

Table of Contents

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Charles Rodes, RTI	919-541-6749	Sac. motel	919-541-6936	charlesr@rti.org
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Randy Newsome, RTI	919-541-6715	Sac. motel	919-541-7208	na
Tyson Mew	919-541-8042	LA motel		
Frank DiGenova, SR	916-444-6666 916-444-6667	916-753-7567 756-7268	916-444-8373	fjdigenova@ sierraresearch.com
(driver), SR	916-444-6666	na		na
(navigator - may be Frank DiGenova), SR	916-444-6666	na		na
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na - not applicable; [a] after-hour resources - Linda for technical/study design - Phil for LAS-X, weighing, computer operations/data logging

Addresses:

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ARB IN-VEHICLE MAIN STUDY					SACRAMENTO	9/5/97	page 1
Date	DOW	TIME	Type	Vent	Event	Comments	
8/29/97	Fr				Ship backseat rack separately	DONE	
8/30	Sa						
8/31	Su						
9/1	Mo				HOLIDAY		
9/2	Tu				Quality-check all study filters		
9/3	We				Ship equip/supplies from RTI to SR (FedEx 2 day)		
9/4	Th				Last-chance ship day		
9/5	Fr				Equip/supplies arrives at SR		
					Leased Aethalometer arrives at SR		
					SR obtains leased Sedan 2		
					SR tests for exhaust/fuel leaks in Caprice & Sedan 2		
					SR installs backseat rack, LAS-X and Aethalometer in Caprice		
9/6	Sa	PM			CR travels from RTP to Sacramento		
					CR picks up rental sedan & cell phone		
		PM			CR sets up microbalance and tests performance		
9/7	Su	AM			CR pre-weighs Sacramento filters		
		PM			DW and RN travel from RTP to Sacramento		
					DW pics up rental sedan & cell phone		
		PM	(2:00)		CR, DW, & RN meet FD at SR to transfer equip/supplies		
					CR, DW, & RN unpack equipment and check		
					Place rechargeable batteries on charge (CO and formaldehde)		
					Calibrate CO monitors		
					Dump lab data logger after weighings		
9/8	Mo	AM			Caprice and Sedan 2 arrives at motel (8:00 AM)		
					Manifold and outside line installed in Caprice		
					Manifold and outside line installed in Sedan 2		
					Test line losses for Caprice and Sedan 2		
					Install stakes at 2 Roadside sites		
					Install tripod at Ambient site		
					Test drive Caprice with LAS-X and Aethalometer functioning		
					Collect background VOC canister in Caprice and Sedan 2		
		PM			All hands coordination/training meeting (4:00 to 6:00 PM)		
					Synchronize all study clocks		
					Load new batteries in all particle samplers		
9/9	Tu	AM			Reset all particle data loggers	Immediately prior to AM commute	
		AM	FNRH	Hi	*Sampling Day 1 - Sacramento*		
		PM	FNRH	Hi			
9/10	We	AM	FRH	Hi	*Sampling Day 2 - Sacramento*		
		PM	FRH	Hi	Change particle pump batteries	After PM commute	
					Dump all data loggers (include car)		
9/11	Th	AM	FRH	Lo	*Sampling Day 3 - Sacramento*		
		PM	FRH	Lo	CR returns to RTP		
9/12	Fr	AM	AR	Hi	*Sampling Day 4 - Sacramento*		
		PM	AR	Hi			
					Change particle pump batteries	After PM commute	
					Dump all data loggers (include car)		
9/13	Sa	AM	R	Hi	*Sampling Day 5 - Sacramento*		
					1 commute only; Sedan 2 driver not needed	No roadside sites	
					Conduct AER measurement on Caprice & Sedan 2	After commute	
9/14	Su				Day Off		
9/15	Mo	AM	AR	Lo	*Sampling Day 6 - Sacramento*		
		PM	AR	Lo		No roadside sites	
					Check battery voltages	Change if <5.5 vdc	
9/16	Tu	AM	SB	Hi	*Sampling Day 7 - Sacramento*		
		PM	SB	Hi	Bus and driver arrive (6:00 AM)		
					SR checks bus for exhaust/fuel leaks	No roadside sites	
					Collect VOC background canister in bus		
					Install manifold and samplers inside bus		
					Review route and bus driving protocol		
					Dump all data loggers (include car)		
9/17	We				RN post-weigh Sacramento filters		
		AM			Pack equipment supplies		
					Transfer all data files to backup disks		
		PM			Ship Exposed Canisters to RTP (FedEx 1 day)		
					Transfer packed equipment to SR for storage		
					Dump lab data logger after weighings		
9/18	Th				DW & RN travel from Sacramento to RTP		
					DW & RN return rental sedans and cell phones		
					Laptop computer and data files returned to CR at RTP for archival		
					RN brings Mettler balance back to RTP		
					Balance printer forwarded to LA motel		
					Formaldehyde and filter samples handcarried to RTP		
9/19	Fr				VOC & formaldhyde samples archived/analyes initiated by DW		
					Filter samples returned to CR for archival		

ARB IN-VEHICLE MAIN STUDY					LOS ANGELES	9/5/97	Page 2
Date	DOW	TIME	Type	Vent	Event	Comments	
9/22	Mo	PM			TM travels from RTP to LA with Mettler balance & study laptop		
					TM picks up rental sedan and cell phone		
					TM sets up microbalance and tests performance		
					VOC Canisters arrive in LA from RTP		
					SR obtains SUV (in Sac.)		
					SR pre-tests SUV for exhaust/fuel leaks		
9/23	Tu				TM pre-weighs LA filters		
					SR staff, Caprice & SUV travel from Sacramento to LA		
9/24	We	AM			DW travels from RTP to LA		
					DW picks up rental sedan and cell phone		
					Equipment/Supplies unpacked		
		PM			Manifold installed in SUV		
					Collect VOC background canister in SUV		
					Install stakes at 2 Roadside sites		
					Install tripod at Ambient site		
					All hands coordination/training meeting (5:00 to 6:00 PM)		
					Load new batteries in all particle samplers		
		AM			Reset all data loggers prior to commute		
9/25	Th	AM	FNRH	Hi	*Sampling Day 1 - LA*		
		PM	FNRH	Hi		No Roadside sampling	
9/26	Fr	AM	FRH	Hi	*Sampling Day 2 - LA*		
		PM	FRH	Hi			
					Load new batteries in all particle samplers		
		AM			Reset all data loggers prior to commute		
9/27	Sa	AM	ANR	Hi	*Sampling Day 3 - LA*	No Roadside sampling	
					Conduct AER measurement on SUV		
9/28	Su	AM	ARN	Hi	*Sampling Day 4 - LA*	No Roadside sampling	
					Pope visits sites/blesses study		
9/29	Mo	AM	FRH	Lo	*Sampling Day 5 - LA*		
		PM	FRH	Lo			
					Load new batteries in all particle samplers		
		AM			Reset all data loggers prior to commute		
9/30	Tu	AM	AR	Hi	*Sampling Day 6 - LA*		
		PM	AR	Hi			
10/1	We	AM	AR	Lo	*Sampling Day 7 - LA*		
		PM	AR	Lo			
					Load new batteries in all particle samplers		
		AM			Reset all data loggers prior to commute		
10/2	Th	AM	FRC	Hi	*Sampling Day 8 - LA*		
		PM	FRC	Hi			
10/3	Fr	AM	MC	Hi	*Sampling Day 9 - LA*	No Roadside sampling	
		PM	MC	Hi		No SUV	
10/4	Sa				TM post-weighs Sacramento filters		
					Pack equipment supplies		
					Transfer all data files to backup disks		
					Ship Exposed Canisters to RTP		
					Dump lab data logger after weighings		
					Caprice returns to Sacramento		
					SUV rental returned		
10/5	Su				DW & TM travel from LA to RTP		
					Formaldehyde and filter samples handcarried to RTP		
10/6	Mo				Laptop computer and data files returned to CR at RTP for archival		
					CR ship filter samples to DRI for XRF metals analyses		
					VOC & formaldhyde samples analyes initiated by DW		
					SR begins summary/analysis of Caprice data		

9/5/97

SACRAMENTO

ARB In-Vehicle Main Study

FILTERS

					Sedan 1					Sedan 2 or Bus			Roadside		Ambient		Field	Lab		FILTER
Samp.					Inside				Outside	Inside		Outside					Blanks	Blanks		TOTALS
Day	DOW	Period	Type	Vent	PM2.5	PM2.5 DUP	PM10	PM10 DUP	PM2.5	PM2.5	PM10	PM2.5	PM2.5	PM10	PM2.5	PM10				
1	Tu	AM	FNRH	Hi	1		1		1	1	1	1	2	2	1	1	1			13
		PM	FNRH	Hi	1	1	1		1	1	1	1	2	2	1	1				13
2	We	AM	FRH	Hi	1		1		1	1	1	1	2	2	1	1	1			13
		PM	FRH	Hi	1		1	1	1	1	1	1	2	2	1	1				13
3	Th	AM	FRH	Lo	1		1		1	1	1	1	2	2	1	1	1			13
		PM	FRH	Lo	1	1	1		1	1	1	1	2	2	1	1				13
4	Fr	AM	AR	Hi	1		1		1	1	1	1	2	2	1	1	1			13
		PM	AR	Hi	1		1	1	1	1	1	1	2	2	1	1				13
5	Sa	midday	R	Hi	1		1		1	1	1	1	2	2			1			11
6	Mo	AM	AR	Lo	1		1		1	1	1	1			1	1	1			9
		PM	AR	Lo	1	1	1		1	1	1	1			1	1				9
7	Tu	AM	SB	Hi	1	1	1		1	1	1	1			1	1	1			10
		PM	SB	Hi	1		1	1	1	1	1	1			1	1				9
																			Total	
			Sub-totals:		13	4	13	3	13	13	13	13	18	18	12	12	7	4	ilters:	156

Notes: Types:

- FRH - freeway rush, heavy duty influence
- FNRH - freeway non-rush, heavy duty influence
- AR - arterial rush
- ANR - arterial non-rush
- FRC - freeway rush, carpool lane
- R - rural
- SB - school bus
- MC - max. concentration scentios

Expected Sacramento Sampling Start Date: 9/9/97 (Tuesday)

Expected Sacramento Sampling End Date: 9/16/97 (Tuesday)

rush commute times:	AM	6:30 to 8:30
	PM	4:00 to 6:00
non-rush commute times:	AM	8:30 to 10:30
	PM	2:00 to 4:00
Bus commute times:	AM	6:30 to 8:30
	PM	2:00 to 4:00

9/[illegible]/97

ARB In-Vehicle Main Study

LOS ANGELES

FILTERS

					Sedan 1					Van/SUV			Roadside		Ambient		Field	Lab		FILTER
Samp.					Inside				Outside	Inside		Outside					Blanks	Blanks		TOTALS
Day	DOW	Period	Type	Vent	PM2.5	PM2.5 DUP	PM10	PM10 DUP	PM2.5	PM2.5	PM10	PM2.5	PM2.5	PM10	PM2.5	PM10				
1	Th	AM	FNRH	Hi	1		1		1	1	1	1			1	1	1			9
		PM	FNRH	Hi	1	1	1		1	1	1	1			1	1				9
2	Fr	AM	FRH	Hi	1		1		1	1	1	1	2	2	1	1	1			13
		PM	FRH	Hi	1		1	1	1	1	1	1	2	2	1	1				13
3	Sa	AM	ANR	Hi	1		1		1	1	1	1			1	1	1			9
4	Su	PM	ANR	Hi	1	1	1		1	1	1	1			1	1	1			10
5	Mo	AM	FRH	Low	1		1		1	1	1	1	2	2	1	1				12
		PM	FRH	Low	1	1	1		1	1	1	1	2	2	1	1	1			14
6	Tu	AM	AR	Hi	1		1		1	1	1	1	2	2	1	1				12
		PM	AR	Hi	1		1	1	1	1	1	1	2	2	1	1	1			14
7	We	AM	AR	Low	1		1		1	1	1	1	2	2	1	1				12
		PM	AR	Low	1	1	1		1	1	1	1	2	2	1	1	1			14
8	Th	AM	FRC	Hi	1		1		1	1	1	1	2	2	1	1				12
		PM	FRC	Hi	1		1	1	1	1	1	1	2	2	1	1	1			14
9	Fr	AM	MC	Hi	1		1		1						1	1				5
		PM	MC	Hi	1	1	1		1						1	1	1			7
																			Total	
			Sub-totals:		16	5	16	3	16	14	14	14	20	20	16	16	9	4	Filters:	183
SAC. and LA Composite:					29	9	29	6	29	27	27	27	38	38	28	28	16			339

Notes: Types:
- FRH - freeway rush, heavy duty influence
- FNRH - freeway non-rush, heavy duty influence
- AR - arterial rush
- ANR - arterial non-rush
- FRC - freeway rush, carpool lane
- R - rural
- SB - school bus
- MC - max. concentration scentios

rush commute times: AM 6:30 to 8:30; PM 4:00 to 6:00

non-rush commute times: AM 8:30 to 10:30; PM 2:00 to 4:00

Expected LA Sampling Start Date: 9/25/97 (Thursday)

Expected LA Sampling End Date: 10/3/97 (Friday)

8/28/97

ARB In-Vehicle Exposure Study Micro-Balance Transport and Setup

1. Balance System Transport

The Mettler AT-20 microbalance will be hand-carried by Charles Rodes on the plane to Sacramento, in the special Mettler shipping box. It will be repacked in the shipping box by Randy Newsome after the Sacramento sampling for Sierra Research personnel to transport to Los Angeles. The laptop computer and printer will also be transported. As a back-up in case the computer is damaged in shipment, the hand-carried Study Toshiba laptop will also be loaded with the balance operations software.

2. Balance/Computer Set-Up

Filter pre- and post-weighings will be made in a motel room rented for use as an equipment storage/staging area for study operations. Although this is not the historically ideal location for air pollution filter weighing, some concessions have been made due to the field pilot study nature of this phase of the project. This is <u>not</u> expected to result in any loss of precision or accuracy described in the proposal, as necessary to meet the goals of this project.

The important factors that potentially affect precision and accuracy have been addressed and accommodated for this Pilot Study. These are:

(1) the temperature environment around the balance,
(2) draft control around the balance,
(3) humidity control for the filters,
(4) filter static charge removal, and
(5) tilt control for the balance, and
(6) air jet cleaning of the balance pan prior to initiation of weighing.

<u>Temperature</u> - The Mettler AT20 balance is electronically temperature controlled, and temperature is not noted by Mettler as being of concern, as long as normal laboratory temperatures (15 to 25 °C) are maintained. The temperature environment of the balance has been shown in our labs to have a slight influence on the minimum detection level of the balance, since it can affect the zero drift during the period of a single weigh. Apparently the separation distance between the balance temperature sensor and weighing chamber is sufficient to provide a slight time lag in drafty conditions if the filters are weighed faster than the sensing system can make the correction. Without addressing this lag, the minimum detectable is ~2 $\mu g/m^3$, while eliminating the lag reduces the minimum detectable to nearly 1 $\mu g/m^3$. Although 2 $\mu g/m^3$ is acceptable for this study, obviously an improvement is desirable if it can be obtained with reasonable effort.

Since a highly controlled temperature environment was not readily available for in-the-field weighing, two steps were taken:
(1) The balance will be positioned in the room to avoid drafts from both the HVAC system and from persons (other than the individual weighing the filter) moving about in the room during pre- and post-weighing, and
(2) The balance control software was modified to have the balance automatically re-check the balance zero after each weighing to determine if a detectable change (>10 µg) had occurred. If

change has occurred (may also be caused a balance tilt shift) and the change is less than 10 µm, the previous tare is corrected, if the change is >=10 µg, the last weighing must be repeated.

The combination of these two steps should satisfactorily address temperature environment concerns. The determination of the precision at the start of each weighing session by repeated weighings of both a Class S3 0.1 gram standard weight and a designated reference blank filter will demonstrate the precision level, which incorporates the influence of balance zero shift. Additionally, the computer system automatically records the temperature during the weighing session.

Draft - The Mettler AT20 is somewhat sensitive to drafts due to the potential for slight temperature gradients to appear around the balance and due to pressure waves inside the weighing chamber that may affect the pan movement. As previously noted, the balance will be positioned in the room to avoid drafts from both the HVAC system and from persons (other than the individual weighing the filter) moving about in the room during pre- and post-weighing. Additionally, the weighing pan is shielded from drafts by the inverted static shield can place over the pan and filter during each weighing. These two steps should virtually eliminate the influence of drafts.

Humidity - The influence of humidity on air pollution filter weighing has been addressed for many years, although there is almost no information in the published literature quantifying the problem and defining control measures. The moisture uptake of selected filter materials has been reported (especially for glass and quartz fibers) and shown to be of sufficient magnitude to require that a controlled humidity chamber be used for weighing these materials. Testing in our labs has shown that the Gelman 3.0 µm porosity Teflo® filter material selected for use in this Pilot Study are virtually hydrophobic. The attached graph weighing 2 randomly elected filters in a controlled chamber [although for a smaller 25 mm diameter size and using a 5-place rather than a 6-place balance] clearly illustrates that within the measurement error, there is no detectable uptake of moisture on this material within the range of 20 to 80 % relative humidity.

Since high humidity conditions may occur on rainy days in which the HVAC system is not operating adequately to remove moisture, we will monitor the humidity routinely as part of the balance computer control system operation, and not conduct weighings if the humidity is outside the range of 30 to 70 % Rh. The repeated weighings of a designated Gelman Teflo® reference filter will demonstrate consistency between the pre- and post-weighing periods. Although it would be desirable to have stringent humidity control to remove the potential for humidity influence, this degree of control for the Pilot Study has been determined to be adequate, within the resources available.

Static Charge - As described clearly in the proposal, static charge can have one of the most pronounced influences on the precision of filter weighing. We will accommodate this by the combination of dual Polonium static charge neutralizers and the pan shield used to drain static charge from the pan area.

Balance Tilt - The Mettler AT20 balance is a state-of-the-art weighing system that incorporates a very effective vibration damping system, minimizing the need for screening low frequency vibrations. The balance zero, however, is very tilt-sensitive, influencing both the precision and accuracy of the weighing process. Two steps will be taken to minimize the influence of tilt:

(1) The balance location will important by (a) selecting a room on a first floor concrete slab, (b) placing the balance on a solid table or desk that is supported on four points (legs) beneath the balance, and (c) making sure that these support points are minimally influenced by the room carpeting.
(2) Modifying the balance control software to require that the balance re-zero after each weighing will determine whether the balance tilted during the weighing.

Weighing Software/Balance Operation Procedures

Unpacking and Balance Setup:

The balance case contains the balance, balance pans, reference weight and reference filter, computer cable, bar code reader, tweezers, Smart Reader, and Mettler book. The balance should be removed from the case and set on the balance table. Adjust the feet at the rear of the balance for leveling the bubble. Once levelled, press down on the table surface to see whether the bubble can be made to shift. If it shifts, the table should be reinforced or another location found.

Place the stainless steel wing plate in the balance, put the lower part of the draft shield on the wing plate, and put the balance pan (with three posts) in the socket. Turn on the balance. Once it is on, put the upper pan on the balance and the tin can electrostatic shield in place. Close the balance doors. For operation, the upper part of the glass should not move. It was connected to the doors for shipping.

Computer setup:

This setup assumes the Toshiba 110CS will be used. The keyboard and light pen must be plugged together and plugged into the small DIN port on the back of the computer. The external keyboard is needed to force the computer to recognize the bar code reader. Once the computer as been booted, the keyboard could be unplugged and the barcode reader will still work.

The printer cable should be plugged into the printer port and the printer turned on before the weighing program is started. The weighing should have a printer to produce a paper record of the filter weights. *If no printer is available, the printer portion of the program must be shut off from DOS. To do this enter the following line at the DOS prompt:*

set equip=2,1,3,0,2000,50,1

Then, the program can be run. If a printer later becomes available, either reboot the computer or type the line:

set equip=

with no spaces or any other characters after the "=".

The data cable from the balance should be plugged into the serial port on the back of the computer.
(This assumes that the room temperature and humidity have been downloaded from the Smart Reader before beginning the weighing. The Smart Reader and the balance both need to use the serial port, but only one at a time can.)

Weighing:

Enter "weigh" from the command line. The batch file transfers into the c:\weigh subdirectory an starts the program METTLER.EXE.

For almost every occasion, ignore the Program Mode menu item and proceed to Session Setup. Proceed down the list of choices: Link to Balance, Bar Code Test, skip Smart Reader Test, correct the date and time if needed, Operator ID (initials), Temperature, and Humidity (taken from Smart Reader printout.) Return to Main Menu.

Perform the Balance Audit. This interrogates the balance and performs an internal calibration. It can be performed again later, if needed.

Go to the Weigh Session. Three steps should be performed: weighing the standard weight, weighing the reference filter, and performing the precision test with the reference filter.

1. Standard weight - select Weigh Sample and enter the letter "S" plus the date for the sample number, e.g. "S021497". Place the standard weight on the pan when requested to. The value obtained after weighing and rezeroing should be

   $$0.100002 \pm 0.000002 \text{ g}$$

   Any value outside this range should be considered suspect. Reweigh or perform the balance audit again.
2. Reference weight - select Weigh Sample and enter the letter "R" plus the date for the sample number, e.g. "R021497". Place the reference filter on the pan when requested to. The v e obtained after weighing and rezeroing should be

   $$0.110808 \pm 0.000010 \text{ g}$$

   The reference weight will be used to track long term changes in the filter weight.
3. Precision Test - select Precision Test and perform the test with the reference filter. This is a test of operator skill. After five good weights, the standard deviation should be 0.000006 g or less. An experienced operator should be able to achieve 0.000002 g on most occasions.

Preweighing:

1. Lay out enough filters for a set of samplers in open petri dishes in the conditioning cabinets. The petri dishes should not be labelled at this time. (An unlabelled dish with a filter is assumed to be an unweighed filter.)
2. Paste a label on the petri dish just prior to weighing the filter. The label is scanned with the bar code reader to enter the sample number.
3. Weigh the filter and return it to its petri dish. Close the dish. (No more than one filter should be out of its closed dish at a time, to avoid possible confusion.)
4. At the end of the weighing session, or after 20 filters, which ever comes first, reweigh the first of the group of twenty, giving the original sample number plus "a", "b", or other designator, e.g. "S021497a". If the reweight is within 6 μg of the original weight, proceed to

other things. If not, reweigh again. Now if the reweight is not within 12 μg of the original weight, all the filters need to be reweighed. This will require leaving the program, entering the subdirectory "c:\weigh\dat" and deleting the sample files that need to be reweighed.

Data Backing up:

1. After each weighing session, place the printed pages in the weighing notebook with glue. Copy the entire c:\weigh\dat subdirectory onto a floppy disk, rotating two different floppy disks between copies. (Make a \dat subdirectory on A:. Copy c:\weigh\dat*.* A:\dat.)

Postweighing:

1. Remove all petri dishes from the conditioning chamber and close their lids. Take one at a time to the balance, scan in the sample code. The computer should indicate that the sample has been **preweighed**. If it does not, there is a problem of identification that needs to be resolved immediately.
2. Weigh the sample. If the postweight is low (within 10 μg of the original weight) or high (above 1000 μg over the original weight) you will be queried as to its appropriateness. A large negative weight probably means that the preweight was taken from a different filter. Resolve the matter before accepting the results.

Data Backing up:

1. After each weighing session, place the printed pages in the weighing notebook with glue. Copy the entire c:\weigh\dat subdirectory onto a floppy disk, rotating two different floppy disks between copies. (Make a \dat subdirectory on A:, if needed. Copy c:\weigh\dat*.* A:\dat.)

Packing up:

1. Put tweezers, pan lid, pan, draft shield bottom, standard weight, Smart Reader, and reference weight in the box. Put the box in the large middle compartment. Put the wing plate and tin can enclosure in the same compartment. Couple the glass top to the doors and open the doors. Turn off the balance. Coil the power connector into the power supply and place the smaller middle compartment, with power cord in the adjacent compartment. Put the bar code reader in the same compartment.
2. Place the balance in the bottom of the carrying case. Lower the top carefully onto the bottom and snap shut.

8/28/97

August 28, 1997

ARB In-Vehicle Exposure Study
STEPWISE PROCEDURES FOR $PM_{2.5}$ AND PM_{10} AEROSOL COLLECTION

by

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1.0 GENERAL

The mass concentration quantitation limits for the $PM_{2.5}$ and PM_{10} samplers are a function of a) the total integration interval, b) the sampling flow rate, c) the repeatability (standard deviation) of the weighing process used to perform mass measurements, and d) the allowable coefficient of variation. Using a) a total sampling window integration interval of **2 hours (120 min)**, b) a sampling flow rates of **4.0 liters per minute (lpm)**, and c) a weighing limit of three times the 2 μg precision limit for a 6-place analytical balance, produces an expected sample volume of 0.48 m^3 and an expected **MQL of 12.5 μg/m^3** (MDL of 4.2 μg/m^3) aerosol provides a lower bound for aerosol detection limits.

Another factor in affecting the minimum quantifiable aerosol concentration is the potential **contamination** of filters during preparation, loading into the impactors, and weighing before and after sampling. Small mass increases may result from contamination by particles, fibers or by grease from impactor surfaces. The potential for mass increases from contamination will be assessed using field blanks (filters that are loaded into impactors, carried to homes, returned and weighed). Changes in the filter tare weight with time will be assessed by monitoring the weight of unexposed filters kept in the lab.

2.0 SAMPLE COLLECTION

2.1 Laboratory Sampler Set-up/Checkout

This procedure applies to the in-vehicle sampler or the outdoor pole-mounted sampler. This phase of sampler set-up is to be performed in the laboratory, prior to arriving at the participant's residence.

2.1.1 Sampler Attachment to Stick

This procedure will be followed when first assembling an indoor/outdoor sampling system or when replacing a failed unit. Once indoor/outdoor samplers have been assembled, they will remain in use and require no further assembly.

1. Install 4 AA batteries for indoor sampling. NOTE: Battery life using 4 LPM pumps is expected to be six (6) 2-hour commutes. The number of commutes per battery set <u>must</u> be recorded such that new batteries can be installed.
2. Fasten a Velcro strap around the blue box and batteries.
3. Lay pump and data logger boxes into the rabbets on the alignment stick. The battery strap goes into the deepest rabbet.
4. Attach a Velcro strap around each box to hold the units firmly to the stick.

2.1.2 Opening Bluff Body Forms

1. Remove the 2 screws holding the top; remove the top.
2. Using finger holes, remove the top insulation layer.

2.1.3 Pump Battery Replacement

1. Open form and partially remove pump box/data logger assembly from the container. <u>Do not</u> disconnect the tubing from the barbed hose connector unless absolutely necessary to avoid damaging components.
2. Undo the Velcro strip from the battery pack and remove the old batteries. Place orange pressure sensitive dot tabs on each used battery to prevent confusion with new batteries. Replace the old batteries with 4 fresh AA alkaline ProCell batteries and re-wrap the battery pack with the Velcro strip to hold them in place.

3. Old batteries are to be stored for later return and recycling by manufacturer or will be disposed of properly.

2.1.4 <u>Pump Operation Test</u>

1. Remove the **unshorted** plug (if installed) and insert a **shorted** (on flow check device) plug into the phono jack on the blue box. See Figure 6 to identify plug types. This places the pump into the **CONTINUOUS** mode. Verify (by ear or touch) that the pump is running continuously. If not, check to see that the plug is properly connected, that no external wires are obviously broken and that the new batteries are really new.
2. Reset the pump to **CONTINUOUS** mode by inserting a **shorted** plug.
3. Connect a **Test Inlet** (loaded with a dummy filter) to the sampler to apply a pressure drop.
4. As a leak test, cover a Test Inlet opening with the palm of the hand for a few seconds (3 - 5) to determine if the pump motor stalls. If OK, prepare to check the flow rate setting. If the pump does not stall, determine if all of the tubing connections are sound. NOTE: Use special Leak Test pump that is limited to 12 inches of vacuum.

2.1.5 <u>Flow rate Setting</u>

1. Connect the flow calibration adapter to the proper Magnehelic gauge.
2. With the Magnehelic gauge standing (or hanging) vertically, make sure that the gauge is set to zero with no flow. If not, use a small screwdriver to adjust the screw at the lower center of the face.
3. Place the calibration adapter on the face of the inlet.
4. Allow the Magnehelic reading to stabilize for 30 seconds and read the Magnehelic gauge to the nearest 0.05 inches of water.
5. Referring to interpolated calibration table for the flow check orifice, determine the <u>actual</u> flow rate in liters/minute (lpm) and enter this value on the checklist.

- If the flow rate is **3.90 to 4.10 lpm** the pump flow is within acceptable limits and no adjustments are necessary.

  If not, use a small screwdriver (alignment tool) to slowly reset the **Pump Flow Adjustment** on the side of the Data Logger box.

6. Allow the reset flow to stabilize for 20 seconds, and if the flow is still within limits, the flow setting is acceptable.

2.1.6 Data Logger Tests

2.1.6.1 Laptop Computer Connection/Operation

The computer reader program is installed on the study laptop computer. It is accessed using the Reader icon from Windows.

1. Plug in the data cable to connect the COM1 port on the laptop computer to the data port on the end of any blue Data Logger box.
2. From the WINDOWS menu, double click on the "READER" icon. (The program will run from the DOS prompt but should be started from within WINDOWS.) If the cable connection is OK, the display will show the opening **Main Menu** screen with the last data logger ID# (XXXXX) and pump ID# (1XX) on the upper left of the screen. If the cable is not connected to the laptop, the computer will beep 10 times before displaying the **Main Menu** - Check the cable connections.

2.1.6.2 Data Logger Connection

1. Move the cursor to "**Test Logger**" and hit ENTER to initialize the data access. The logger ID# should appear on the status line near the top of the screen. If the logger ID# or the pump ID# don't match ID#'s on sides of the blue and gray boxes, correct the file entry.
2. Note that the display updates (numbers blink faintly) every 8 seconds as the data logger reads the system sensors. If the numbers are not updating, Exit to the **Main Menu**, move the cursor to "**Test Logger**" again and hit ENTER. If the numbers are still not updating the logger is not functioning and must be replaced.

2.1.6.3 Sensor Parameter Tests

1. With the logger stationary and the pump still set in the **CONTINUOUS** mode (shorted plug inserted), note the readings of the Movement, Battery Voltage and Pump Pressure (last column to the right).
   - If the Movement number is **50 to 200** with the logger stationary, it is OK.
   - If the Ambient Temperature is within ± **5 degrees F** of the room thermometer, it is OK.
   - If the Battery Voltage is 5.00 to 6.50 with the pump running, the sensor is OK and the batteries are fresh. If the voltage reading is low, replace with a new set of batteries and retry. Mark the batteries that are removed as "USED".
   - If the Pump Pressure is **0.5 to 6.5 inches H_2O** with the test inlet attached and pump running, it is OK.

   The display also provides "OK" indicators for these parameters, but some of them require more testing.
2. The Movement reading should change substantially, but become no higher than 255. While the pump is running, the battery voltage and pressure should read **OK**; when the pump cycles off, the battery voltage and pressure should read **OFF**.

   If any of the channels, except internal temperature, are not functioning within limits, the data logger should not be used. Replace the data logger with another unit, mark the defective unit as "**DEFECTIVE**" and return it to RTI/RTP for repair.

2.1.6.4 Updating/Presetting Sampler and Participant Data

1. To correct the data logger ID# or pump ID#, return to the **Main Menu** and move the cursor to "**File Data**" and hit ENTER.
2. Move the cursor to the "**Logger Serial No.**" or "**Pump Serial No.**" position, as required, and edit the number as necessary.

3. If the information is available, enter the "**Sample**"" (from back of aerosol inlet), "**Participant.**" and "**Description.**", as required. "**Sample**"" will usually be entered at the participant's location to avoid having to match the Sample ID with the sampler at that location.
4. Check that Channels active is "1111-", 8 second multiplier is "10", and pump duty cycle agrees with pump setting.
5. Exit this screen to the **Main Menu** to automatically update the new data into memory.
6. Remove the Test Inlet from the quick connect.
7. Remove the **shorted plug** and insert an **unshorted plug** to put the sampler into standby mode for transportation.
8. Place pump/logger sampling unit into a locator slot in insulating foam on bottom inside of form.
9. Exit the READER program, if no more data loggers are to be interrogated.

The samplers are ready to take to the participant's residence.

2.2 Field Deployment

Preface: These set-up/check-out procedures are to be conducted at the participant's residence. Again, all the tests are similar for the personal, indoor, and outdoor samplers. The height of the outdoor sampler will require that it is temporarily attached to a stand for the indoor sampler and tested indoors, before deployment outdoors.

2.2.1 Siting Guidance and Deployment (Outdoor Sampler)

The order may vary with site. The outdoor sampler is mounted on a stake driven into the ground if located in the yard, or on a collapsible tripod if located on a balcony or other hard surface.

1. Locate the outdoor sampler within 20 ft of the roadway, but preferably no closer than 10 ft .
2. Locate the stand so that the inlet is facing toward the road.

3. Try not to locate the inlet closer than 3 feet to a wall, tree or similar obstruction.
4. Avoid placing the sampler within 10 feet of a combustion source (e.g. incinerator).
5. Assess the need for security and relocate the sampler, if necessary.
6. Drive the outdoor stake into the ground (or align the stand).
7. Deploy the outdoor sampler form with pump(s) functioning (see following sections.)

2.2.2 System Performance Testing

Performance testing of the flow system on-site must be done with the aerosol inlet selected and attached. These checks ensure the integrity of the sampling system and filter together.

2.2.3.1 Accessing Prepared Loggers

1. Open the personal or indoor/outdoor samplers enough to plug the data cable into the logger RS232 port.
2. Move the cursor to "**Test Logger**" and hit ENTER to initialize the data access. If the logger ID# or the pump ID# are incorrect (don't match ID#'s on sides of the blue and gray boxes), correct the entry as described in 2.1.1.4.3.
3. If not already on the "**File Data**" screen, from the **Main Menu** proceed to the "**File Data**" screen.
4. Update the "**Logger Serial No.**" and "**Pump Serial No.**" if necessary.

2.2.3.2 Aerosol Inlet Attachment

1. Remove and store the shipping clip from the inlet and attach the aerosol inlet to the quick connect corresponding to the sampling unit under test.
2. Exit this screen back to the **Main Menu** to automatically update the file. Do not exit the "READER" program yet.
3. Attach the inlet to the outside of the form using the thumb nut corresponding to the internal position of the sampler under test.

2.2.3.3 Flow rate Check

1. Connect the flow calibration adapter to the proper Magnehelic gauge. See Figure 7.
2. With the Magnehelic gauge standing (or hanging) vertically, make sure that the gauge is set to zero with no flow. If not, use a small screwdriver to adjust the screw at the lower center of the face.
3. Place the calibration adapter on the face of the inlet.
4. Place the pump into **CONTINUOUS** mode (switches ON).
5. Allow the Magnehelic reading to stabilize for 30 seconds and read the Magnehelic gauge to the nearest 0.05 inches of water.
6. Referring to the interpolated calibration table for the flow check system, determine the actual flow rate in liters/minute (lpm) and enter this value on the spreadsheet if this is the **Stop** reading.
7. If this is the **Start** flow rate, and it is **3.90 to 4.10 lpm,** the pump flow controller is within acceptable limits.
8. If not acceptable, use a small screwdriver to reset the **Pump Flow Rate Adjustment** on the side of the blue Data Logger box. (Not the Balance Adjustment on the other side of the box.)
9. If the flow is reset, allow the flow to stabilize for 20 seconds, and if still within acceptable limits, record the Magnehelic reading and associated actual flow (lpm).
10. Remove the flow check adapter from the inlet.

2.2.3.4 Data Logger Reset

1. Move the cursor to "**Reset Logger**" and hit ENTER, if you are ready for the 6 day sampling period to begin. Answer "Y" to the question "Reset anyway?". Wait for the cursor to return to the main menu. This **MUST** be accomplished to establish the start of the sampling period.

2. Place the pump into the **TIMED CYCLE** mode (remove the shorted plug, insert unshorted plug) and unplug the RS-232 plug from the blue box.
3. If no other samplers are to be set up, exit to the **Main Menu** screen and exit the READER program.

2.3 Retrieval

Conduct these procedures to retrieve the inlet and logger data from the sampler

2.3.1 Final Flow rate Check

Final flow rate checks of the personal sampler are performed at the end of the sampling period with the sampler removed from the participant. Make sure that the **correct** inlet is being tested **(check** the inlet ID#) before entering the **Stop** reading in the spreadsheet.

1. Connect the flow calibration adapter to the proper Magnehelic gauge.
2. With the Magnehelic gauge standing (or hanging) vertically, make sure that the gauge is set to zero with no flow. If not, use a small screwdriver to adjust the screw at the lower center of the face.
3. Place the calibration adapter on the face of the inlet.
4. Set the pump to **CONTINUOUS** mode.
5. Allow the Magnehelic reading to stabilize for 30 seconds and read the Magnehelic gauge to the nearest 0.05 inches of water.
6. Referring to the interpolated calibration table for the flow check system, determine the actual flow rate in liters/minute (lpm) and enter on the data sheet.
7. Remove the flow check adapter from the inlet.
8. Turn **OFF** the pump (insert unshorted plug).

2.3.2 Logger Data Retrieval

1. Plug in the data cable to connect the COM1 port on the laptop computer with the RS-232 data port located on the end of the blue box.
2. Move the cursor to "**Test Logger**" and hit ENTER to initialize the data access. If the sample ID# is incorrect (doesn't match ID#'s on back of aerosol inlet), make sure the correct RS-232 socket has been connected.
3. Place a formatted floppy data disk in the laptop drive. One floppy disk will hold up to 40 logger dumps. There should easily be enough space on one floppy disk to handle all the data retrieved in one day.
4. Move cursor to **Dump Logger** and hit **ENTER** to start data transfer. Transfer will require ~ 1 minute.
5. Screen display will indicate the transfer by showing "XXX out of YYY done" as the transfer proceeds. At completion, XXX will equal YYY.
6. A data check will take less than a minute. It will summarize the mean, minimum, and maximum value for each channel (temperature, movement, battery voltage, and pressure drop), plus the number of points considered to be "Bad" for a few seconds. The time-block averages will be displayed. (If you miss the display of the summary, you can see it later under "**View Data**"; if you miss the time-block averages, you can see them again under "**Review Blocks**."
7. If 2 or more channels show more than 15 to 20 data points as "Bad", the data dump was questionable, and should be repeated. Check the time-blocks for reasonable, continuous values.
8. Review the blocks, looking for the following characteristics in the block averages:
   - Internal temperatures should not display.
   - External temperatures should typically be between 50 and 90 °F; higher during the day and lower at night. Very steady temperatures or very high or low temperatures should trigger questions about the wearer's environment.
   - Battery voltage should decline gradually from **6.1 volts** to **5.0 volts** over the test period.

- Pressure should change no more than **3-5 inches** over the test period (it is somewhat temperature sensitive.) If the pressure rises above 7-10 inches, the filter may have plugged.

9. Return to the **Main Menu**, move the cursor to "**Store to Floppy**" and hit **ENTER**. Answer the drive? question with "A". Floppy drive light should indicate the data transfer. (If for some reason the floppy storage fails, the data should be retrievable from the laptop at a later date. However, it is best to carry a second formatted disk in case of failure and to try the second disk before giving up on the storage.)
10. If no other loggers are to be dumped, when control returns to the **Main Menu,** exit the **READER** program.

2.3.3 Aerosol Inlet Retrieval

The aerosol inlet must be handled carefully after sampling to avoid dislodging material from either the filter or the internal surfaces of the inlet. The foam-lined shipping case should be taken to the residence for the retrieval to protect the collected samples during transport.

1. Detach the aerosol inlet(s) from the quick disconnect; remove the screw holding the inlet(s) to the form.
2. *$PM_{2.5}$ and PM_{10}:* Place the inlets in a Ziplok bag; no shipping clip is used.
3. Place the bagged inlet into the shipping case for transport.

$PM_{2.5}$ or PM_{10} MSP Inlet Leak Test

8/11/97

1. Applicability

This procedure applies to the 2.0 or 4.0 LPM series 200 MSP, Inc. aerosol inlets having either $PM_{2.5}$ or PM_{10} cutpoints. The cutpoint and flowrate are stamped on the inside of the inlet cap. The MSP Clamping Fixture <u>must</u> be used with these inlets after the filter is loaded to assure that the inlet components are aligned properly and the screws tightened consistently.

2. Background

The MSP, Inc. 200 series inlets have 2 or 3 internal sealing surfaces, depending on whether the inlet is equipped with a scalping stage. One of these sealing surfaces is the outer plastic ring of the Gelman Teflo® filter. The other surfaces are flat silicone ring seals that seal against either the inlet cap or the scalper cap. If any of these seals is not uniformly seated against the mating surface, the pump flow will not properly be directed through the impactor (to obtain the desired cutpoint) or through the filter (to remove the particles).

3. Procedure

<u>Inlet Loading</u>

1. Inspect the silicone ring seals to make certain that they are flat and not contorted.
2. Load the filter into the inlet, making certain that the filter and components are properly centered.
3. Assemble the inlet components in the MSP Clamping Fixture, insert the screws, and uniformly tighten the screws.

<u>Leak Testing</u>

1. Attach the leak test pump to the inlet using the quick connects.
2. Start the pump using the special current-limiting plug that restricts the pressure drop to approximately 12 inches of H_2O.
3. Place the face of the inlet against the silicone rubber pad and press firmly.
4. If the inlet is properly sealed, the pump motor will immediately stop (no noise), such that no flow is occurring. Remove the inlet from the clamp and record the filter number and the inlet number of the study data form.
5. If the inlet is improperly sealed, the pump motor will continue to revolve slowly. If this occurs the inlet fails the test and must be disassembled and re-loaded.

4. Hardware Requirements

1. Inlet to be tested, with attached male quick disconnect.
2. Leak-test pump with attached inlet tubing, ending in a female quick disconnect.
3. Special current limiting plug that replaces the standard looped shorting plug to start the pump motor in continuous operation.

3. A clean, flat silicone rubber pad, slightly larger than the Inlet cap against which to seal the inlet ports.

5. Documentation Requirements

None specifically. This is a pass/fail test. Inlets to be used for sampling must pass this test. Inlets not passing must be reloaded and re-tested. If the inlet passes the test, the filter number and inlet number are recorded on the log sheet.

C. Rodes, Research Triangle Institute, 8/11/97

Revised 8/24/97

MSP Particle Impactor Loading/Unloading

Impactor preparation:

1. Using the AirJet spray, flush the inlet impactor screen with a 2 second burst to remove any potential residual particles and fibers.
2. Oil the impactor surface with 2 drops of silicone oil, spread evenly across the surface and carefully blotted with a Kimwipe to remove the excess. Make certain that no excess oil is on any other surface. Oiling is expected to be required only once in Sacramento and once in Los Angeles. Between runs, simply wipe the impactor surface lightly with a Kimwipe.
3. With a cleaned and oiled impactor, take one pre-weighed filter, look up its sample number on the sheet of unused labels, and place the same sample number on one impactor back. Open the petri dish and place the filter in position. Close the petri dish and loosely assembling the impactor with the security screws. (Only one open petri dish at a time.) Confirm the agreement of impactor label with petri dish label before putting away the petri dish.
4. Using the appropriate press for either $PM_{2.5}$ or PM_{10} inlets, tighten the press, centered on the inlet cap, and uniformly tighter the security screw 1/4 turn past contact. DO NOT OVER-TIGHTEN !!!

Impactor disassembly:

1. Place the impactor on the lab paper in the disassembly area. Match its sample number to an empty petri dish number. Remove the filter from the impactor, use the AirJet to provide a 1 second blast of the inside of the petri dish, and place the filter in the empty petri dish. Close the dish. (Only one open impactor or petri dish at a time.)
2. Loosen the lid of the petri dish and place it in the conditioning chamber.
3. Place a sample number from the label sheet in the weighing notebook and note any usual aspects of the filter by the label (color, visible particles or debris, tears, holes, stuck to backing, etc.) If holes are noted, estimate whether they would have affected the flow.

Driving Protocol for the ARB Pilot Study

This protocol applies to all commutes, except (1) bus, (2) carpool, and (3) maximum exposure commutes

The protocol for "freeway-congested-heavy duty diesel influence" is as follows:

1) follow the pre-selected route and position behind a target (heavy duty diesel - truck preferred, city bus second) whenever possible;

2) record the target type on the Caprice switchbox

3) drive in the slow (truck) lane, except when changing lanes to follow or acquire a target;

4) break off target pursuit if target turns off route, can't be followed, drives erratically or unsafely, or appears to modify behavior due to following;

5) change targets if a dirtier-appearing target becomes available;

6) drive with normal following distances (like other nearby cars) but not further than about 100 feet behind targets

7) record the Level of Congestion continuously on the Caprice switchbox

The protocol for "arterial" and "rural" driving will be:

(1) drive at about the posted speed limit and simply note any targets that happen to occur. No attempt will be made to either acquire or avoid targets.

C. Rodes/Frank DiGenova, 8/28/97

LASX Setup and Operating Procedures

Physical setup:

1. The connection to the inlet nozzle is with a 1/8" Swagelok fitting. When tightening or changing fittings, be sure to hold the LASX inlet assembly with a wrench to avoid rotating the inlet. The red dot on the inlet should not be allowed to move because it will affect the calibration of the instrument.

2. The RS232 cable for the computer should be plugged into the relay control adapter, which in turn is plugged into the back of the LASX. If the cable should fail, replace it with a modem cable with female DB-9 to male DB-25. Do not replace it with a printer cable.

3. Connect the relay terminal block to the battery using the fused power leads provided.

4. Position the red LED indicator light where the operators can easily see it when looking forward.

Initial settings:

1. The LASX should be set for Probe Range on "3", Int. Multi. on "15", and Rest Period on "Sec". This will allow the counter to print every 15 seconds. The Printer switch should be "Off" and the Run/Hold switch in the "run" position.

Starting the LASX:

1. The first thing to do after several seconds warm-up is to set the clock. Adjust the hour digits for the proper hour by pushing the "Set" button below the hour indicator. Adjust the minute digits for the desired starting minute using the "Set" button below the minute indicator. Seconds are not adjustable, but the "Start" button should be pushed when the master clock indicates 0 seconds.

2. Set the Sample flow to "1", as closely as possible, for a 1 cm^3/s sample. The sheath flow should be set to 20, but is not critical.

3. Turn the printer on and allow two or three cycles to print. Save the printed tape for the notebook, as an indication of proper operation. Turn the printer off.

Starting the LASX program:

1. With the LASX running and the computer connected to it via the serial port, start the program by entering the command "LASX filename" where the file name has no extension. The suggested filenames consist of 6 digits to represent the date with "a" or "p" to designate a morning or afternoon run, such as "021997a".

2. The program runs in the \LASX subdirectory and stores the data in the \LASX\DATA subdirectory. The actual program name is LASXGET.EXE, but the command "LASX" is a batch file.

3. When the program first starts, the solenoids should be activated to pull an outside air sample. Every minute thereafter, the solenoids should be switched to the other condition. The red LED is lit when sampling the outside air and off when sampling the inside air.

4. Other indications that the program is running properly are:
   The subsample number (1 to 4) should change every 15 seconds.
   The time in seconds should update regularly.
   On the top line, the value 0 just before "Cnt/s" should flicker unless the LASX printer light is on, whereupon the value should count up to 162 and return to 0.

5. If the program seems to be stuck, press the <Esc> key to exit the program. Restart the program using the same file name as before. (The up arrow key may be used to recall the previous commands that had been entered.)

6. If the value just before "Cnt/s" holds at some other number than 0 when the LASX is not printing, try pressing the letter "f" one time to clear it to zero. If the key press does not work, restart the program.

Stopping the program and LASX:

1. Press <Esc> to stop the program. Turn off the LASX.

Backing up the data:

1.. Copy the data files in the c:\LASX\DATA subdirectory to a floppy disk.

ARB In-Vehicle Main Study
Aethalometer Setup and Operating Procedures

Physical setup:

1. The connection to the inlet nozzle is with a 1/4" Swagelok fitting. The Aethalometer should be connected to the adjacent manifold connection as the LAS-X.

2. Make certain a formatted diskette (marked Aethalometer Data) is in the disc drive.

3. Connect the power plug to the 120 vac power strip, if not already connected.

Initial settings:

1. Open the door of the unit and make certain a tape cartridge is installed. Check that there is no slack in the tape.

Starting the Aethalometer:

1. Turn on the power switch; the data system will boot automatically and the system will start.

2. After 2 minutes, check the display panel and enter the desired clock time (Don Whitaker's watch time).

Stopping the Aethalometer:

1. Switch unit OFF.

2. Remove floppy disk.

Backing up the data:

1.. Copy the data files from the diskette to the hard drive of the laptop.

Operating questions for the Aethalometer can be referred to: Tony Hansen, McGee Scientific, phone (510) 845-2801

CARBON MONOXIDE DATA COLLECTION PROTOCOL

Carbon monoxide (CO) data are collected using Draeger Model 190 CO dataloggers. Monitors are calibrated at least once a week or more often if deemed necessary. Zero and span points are checked and recorded prior to and after each daily sampling period. At the completion of each day's sampling period the data are downloaded to a personal computer using a software package provided by National Draeger, Inc.

Monitor Operation

The following is a brief description of the operation procedure for the Draeger 190 CO monitor. For additional details refer to the operating manual provided.

The alarm feature has been adjusted to approximately 150 ppm CO instead of the factory setting of 35 ppm in order to minimize chances of classroom disturbances in the event of a high CO spike. Operation of the monitor is simple and is outlined in this paragraph. "Keys" are used to turn the monitor on and off, place the monitor in the concentration only mode and to reset the datalogger. These keys are color coded red and blue. The blue key resets the datalogger and also puts the monitor in a power conserving "sleep" mode. The red key is used to place the monitor in a concentration only mode which is used for zeroing and spanning the monitor and to reset the datalogger. With no key inserted, the monitor is in its normal operating/logging mode. Do not insert any keys until the data have been successfully downloaded to the personal computer. To do so will reset the datalogger and collected data will be lost.

Daily Operations

Each monitor should be zeroed and spanned at the beginning and end of each daily sampling period. Record the zero and span session using the instrument's datalogger and enter the required information on the CO Monitor Zero and Span Log (see attached copy of log). The procedures are outlined below.

Daily Zero and Span Procedure

1. Remove the blue key from the monitors and replace with the red key.

2. Press the black button at the top of the red key to place the monitor in the concentration only mode.

3. Attach the manifold to the 0 ppm CO in air cylinder and Adjust the rotameter to provide airflow through the manifold of approximately 1 to 1.2 LPM if all six ports are to be used or approximately 150 to 200 mL/min per port if fewer than six are to be used.

4. Attach the monitors to the manifold by inserting the sensor into the adapter.

5. Observe the concentration reading on each instrument. The readings should be 5 +/- 1 ppm. Allow 2-3 min for this reading to stabilize. Do not record this reading on the Zero and Span Log.

Note: A +5 ppm offset is used to compensate for negative drift due to temperature variations.

6. If the concentration reading needs adjustment, adjust the zero pot (marked with Z) using a small screwdriver. Adjust to 5 ppm. Do not record this reading on the Zero and Span Log.

7. Disconnect the manifold from the 0 ppm cylinder and attach to the span cylinder (11 ppm CO in air). Adjust the flow as described in

step 3 above.

8. Allow 2-3 min for this reading to stabilize. The concentration reading on each instrument should be 16 +/- 1 ppm.

9. If the concentration reading needs adjustment, adjust the span pot (marked with S) using a small screwdriver. Do not record this reading on the Zero and Span Log.

10. Reattach the manifold to the 0 ppm air and observe the monitor reading. If the reading is outside the 5 +/- 1 ppm repeat steps 6-10.

11. If the reading is within 5 +/- 1 ppm press the black button on top of the red key to return the monitor to the logging mode and then remove the red key to begin datalogging. Place keys in tool bag as they will not be reinserted at this time. Note this start time on the span log. Allow the monitor to record data for approximately 2 min. Record the concentration on the Zero and Span Log.

12. Attach the manifold to the span gas and allow the monitor to record for approximately 2 min. Record the concentration on the Zero and Span Log. Do not reinsert either the blue or red key at this time as the recorded data will be lost.

13. The monitors are now ready for deployment.

14. Deploy the monitors.

15. Collect the monitors at the specified time.

16. Before downloading the data from the monitors, check the zero and span of the monitors using the 0 ppm and 11 ppm CO gases.

17. Attach the monitors to the calibration manifold and attach the manifold to the 0 ppm air regulator\cylinder using the Tygon tubing supplied.

18. Observe the concentration reading on each monitor. Allow the monitor to record the concentrations for 2-3 minutes after

stabilization. Do not make any adjustments to the zero pot. Record the concentration in the "End of Day" section of the Zero and Span Form.

19. Attach the manifold to the 11 ppm CO gas source, observe the concentration reading on each monitor. Allow the monitor to record the concentrations for 2-3 minutes after stabilization. Do not make any adjustments to the span pot. Record the concentration on the Zero and Span Form.

20. The monitors are now ready to download. Refer to the section below on Retrieving and storing data from the datalogger.

Retrieving and Storing Data From Datalogger

Data are retrieved and stored from the Model 190 using a personal computer and Draeger's Enhanced Graphics Software (EGS). The following is the step by step procedure for accomplishing this. The procedure assumes that the CompuAdd 316NX notebook computer, set-up and provided by RTI will be used.

1. Turn the computer on and select "Draeger CO" from the menu.

2. Press ENTER to display the EGS menu.

3. Attach the adapter/converter box to the serial port on the computer and to the output jack of the monitor. Make sure the 9 volt battery is attached the the converter box.

Note: Do not insert the blue or red key into the output jack until data have been downloaded, verified and saved. To do so will reset the datalogger thus voiding all collected data.

4. Press 3 (Load from Logger) and turn the converter switch on. The computer screen will indicate "active". Once the data transmission is complete turn the converter box off.

5. Type the sample name. The name is composed of the school ID plus the location ID (example: 1234-21). Press ENTER.

6. Type the location (playground, classroom, cafeteria, etc.). Press ENTER.

7. Type the date. Press ENTER.

8. Type the start time (24 hr clock). Press ENTER.

Note: This is the time that the datalogger was turned on which should correspond with the SPAN time noted on the Zero and Span Log, not the deployment time.

9. Type any appropriate comments (problems during collection, etc.). Press ENTER.

10. Type 1 to indicate CO for the gas type. Press ENTER.

11. Type the three digit serial number for the CO monitor. Press ENTER.

12. Check the information as it is displayed, if information is incorrect, redownload the data from the datalogger by repeating steps 4-11.

13. Type command "5" to view the graph if desired. Press ENTER to return to menu.

14. If all information is correct, type command 4 to save the file.

15. Type the file name. The filename is the same as the already assigned sample name (step 5). Press ENTER.

16. Type command 0 to list the files for verification that the file has been saved. If not repeat download.

17. Repeat steps 3 - 16 for all remaining CO monitors.

18. Once all CO monitors have been downloaded, Type command 1 to exit to the main software menu.

19. Backup data files before turning CO monitors off. See instructions elsewhere for this procedure.

20. Once backup files are made, insert the blue key into the output jack to put monitors in the "sleep" mode for overnight.

Weekly Operations

Multi-point Calibration

Perform a four point calibration check on each unit at the beginning of each week. If problems occur with individual monitors perform an additional calibration on those units as soon as possible after the problem is observed. Calibration is performed using 0, 2, 11 and 20 ppm CO in air, certified cylinder gases. The procedure is described below.

1. Insert the red key and place the monitor in the concentration mode by pressing the black button on the top of the red key.

2. Individually attach the 0 ppm, 2 ppm, 11 ppm and 20 ppm CO gases to the manifold. Allow approximately 2 minutes for the monitor to stabilize and on the CO Calibration Log.

3. If concentration values are off on any point by +/- 2 ppm rezero and span the monitor and repeat the calibration.

CO CALIBRATION LOG

DATE ___/___/___

TECHNICIAN _______________

INITIAL CALIBRATION CHECK

START TIME ____:____

Monitor S/N	0 ppm Reading	___ ppm Reading	___ ppm Reading	___ ppm Reading
003				
010				
016				
039				
048				
057				
066				

RECALIBRATION (Perform only if adjustments are necessary)

Monitor S/N	0 ppm Reading	___ ppm Reading	___ ppm Reading	___ ppm Reading
003				
010				
016				
039				
048				
057				
066				

ARB In-Vehicle Main Study
Aethalometer Setup and Operating Procedures

Physical setup:

1. The connection to the inlet nozzle is with a 1/4" Swagelok fitting. The Aethalometer should be connected to the adjacent manifold connection as the LAS-X.

2. Make certain a formatted diskette (marked Aethalometer Data) is in the disc drive.

3. Connect the power plug to the 120 vac power strip, if not already connected.

Initial settings:

1. Open the door of the unit and make certain a tape cartridge is installed. Check that there is no slack in the tape.

Starting the Aethalometer:

1. Turn on the power switch; the data system will boot automatically and the system will start.

2. After 2 minutes, check the display panel and enter the desired clock time (Don Whitaker's watch time).

Stopping the Aethalometer:

1. Switch unit OFF.

2. Remove floppy disk.

Backing up the data:

1.. Copy the data files from the diskette to the hard drive of the laptop.

Operating questions for the Aethalometer can be referred to: Tony Hansen, McGee Scientific, phone (510) 845-2801

LASX Setup and Operating Procedures

Physical setup:

1. The connection to the inlet nozzle is with a 1/8" Swagelok fitting. When tightening or changing fittings, be sure to hold the LASX inlet assembly with a wrench to avoid rotating the inlet. The red dot on the inlet should not be allowed to move because it will affect the calibration of the instrument.

2. The RS232 cable for the computer should be plugged into the relay control adapter, which in turn is plugged into the back of the LASX. If the cable should fail, replace it with a modem cable with female DB-9 to male DB-25. Do not replace it with a printer cable.

3. Connect the relay terminal block to the battery using the fused power leads provided.

4. Position the red LED indicator light where the operators can easily see it when looking forward.

Initial settings:

1. The LASX should be set for Probe Range on "3", Int. Multi. on "15", and Rest Period on "Sec". This will allow the counter to print every 15 seconds. The Printer switch should be "Off" and the Run/Hold switch in the "run" position.

Starting the LASX:

1. The first thing to do after several seconds warmup is to set the clock. Adjust the hour digits for the proper hour by pushing the "Set" button below the hour indicator. Adjust the minute digits for the desired starting minute using the "Set" button below the minute indicator. Seconds are not adjustable, but the "Start" button should be pushed when the master clock indicates 0 seconds.

2. Set the Sample flow to "1", as closely as possible, for a 1 cm^3/s sample. The sheath flow should be set to 20, but is not critical.

3. Turn the printer on and allow two or three cycles to print. Save the printed tape for the notebook, as an indication of proper operation. Turn the printer off.

Starting the LASX program:

1. With the LASX running and the computer connected to it via the serial port, start the program by entering the command "LASX filename" where the file name has no extension. The suggested filenames consist of 6 digits to represent the date with "a" or "p" to designate a morning or afternoon run, such as "021997a".

2. The program runs in the \LASX subdirectory and stores the data in the \LASX\DATA subdirectory. The actual program name is LASXGET.EXE, but the command "LASX" is a batch file.

3. When the program first starts, the solenoids should be activated to pull an outside air sample. Every minute thereafter, the solenoids should be switched to the other condition. The red LED is lit when sampling the outside air and off when sampling the inside air.

4. Other indications that the program is running properly are:
The subsample number (1 to 4) should change every 15 seconds.
The time in seconds should update regularly.
On the top line, the value 0 just before "Cnt/s" should flicker unless the LASX printer light is on, whereupon the value should count up to 162 and return to 0.

5. If the program seems to be stuck, press the <Esc> key to exit the program. Restart the program using the same file name as before. (The up arrow key may be used to recall the previous commands that had been entered.)

6. If the value just before "Cnt/s" holds at some other number than 0 when the LASX is not printing, try pressing the letter "f" one time to clear it to zero. If the key press does not work, restart the program.

Stopping the program and LASX:

1. Press <Esc> to stop the program. Turn off the LASX.

Backing up the data:

1.. Copy the data files in the c:\LASX\DATA subdirectory to a floppy disk.

Air Exchange Rate (AER) Determination Protocol
for the ARB In-Vehicle Exposure Study

!. **When** - The AER measurements will be conducted using the Sierra test vehicle at some point on Saturday while in the "rural" area west of Sacramento to take advantage of the expected low CO background level.

2. **How** - The AER measurements will basically be determined from the exponential decay rate inside the vehicle using specified ventilation settings and proceeding at a specified vehicle speed. The specific steps are:

a) Drive the car for 5 minutes at the maximum AER setting (windows open) to purge the interior with the "clean" rural air,

b) Start the data collection with a calibrated CO monitor in 1 minute integration mode,

c) With the vehicle OFF, stationary, and the windows closed, release a measured amount of CO into the interior to provide (from computation) an equilibrium concentration representing a typical freeway commute level of 20 to 30 ppm),

d) Turn ON a small fan (not part of the vent system) to mix the air in the passenger compartment for 5 minutes,

e) Set the vehicle vent system controls to the desired settings, proceed to a rural route that can be driven at a selected speed for 12 to 15 minutes, with minimal stops, and record the CO concentrations,

f) Return the vehicle to the starting point, dump the CO data, and plot the results to determine the exponential decay rate (see Ott and Willits, 1981. for computational procedure).

total time per AER measurement is approximately 30 to 60 minutes.
The desired vent/driving scenarios include (1) low AER (driving): no outside air thru vent, fan off, windows closed, freeway speed (55 mph), (2) medium AER (driving): outside air thru vent, medium fan speed, windows closed, freeway speed (55 mph), (3) high AER (driving): outside air thru vent, medium fan speed, windows 1/3 open, and [optional if time permits] (4) medium AER (stationary): outside air thru vent, medium fan speed, windows closed, with vehicle at rest, preferably engine OFF.

Temperature/Humidity Data Logger Setup and Operating Procedures

Two Smart Reader 2 humidity/temperature loggers have been sent for monitoring humidity and temperature. One is for the weighing room and one is for the car (marked on the loggers.) The loggers operate continuously and do not need to be reset.

The data in the loggers is retrieved by using the program HUMID.EXE in the C:\WEIGH subdirectory. Do not use HUMID directly, however. The two loggers have different calibration data that must be called properly.

1. Make sure the printer is connected to the computer and turned on. Plug a Smart Reader cable into the serial port of the computer, and plug the cable into the Smart Reader.

2. To use the Lab logger, enter the command LABHUMID. To use the Car logger, enter the command CARHUMID.

3. The program will print a header and display a file name on the status line, of the form "H021997", the letter "H" plus the date. This name will be used to store the dumped logger data. If you dump more than once a day, the previous data will be overwritten. If you dump only once a day, new files will be created each time.

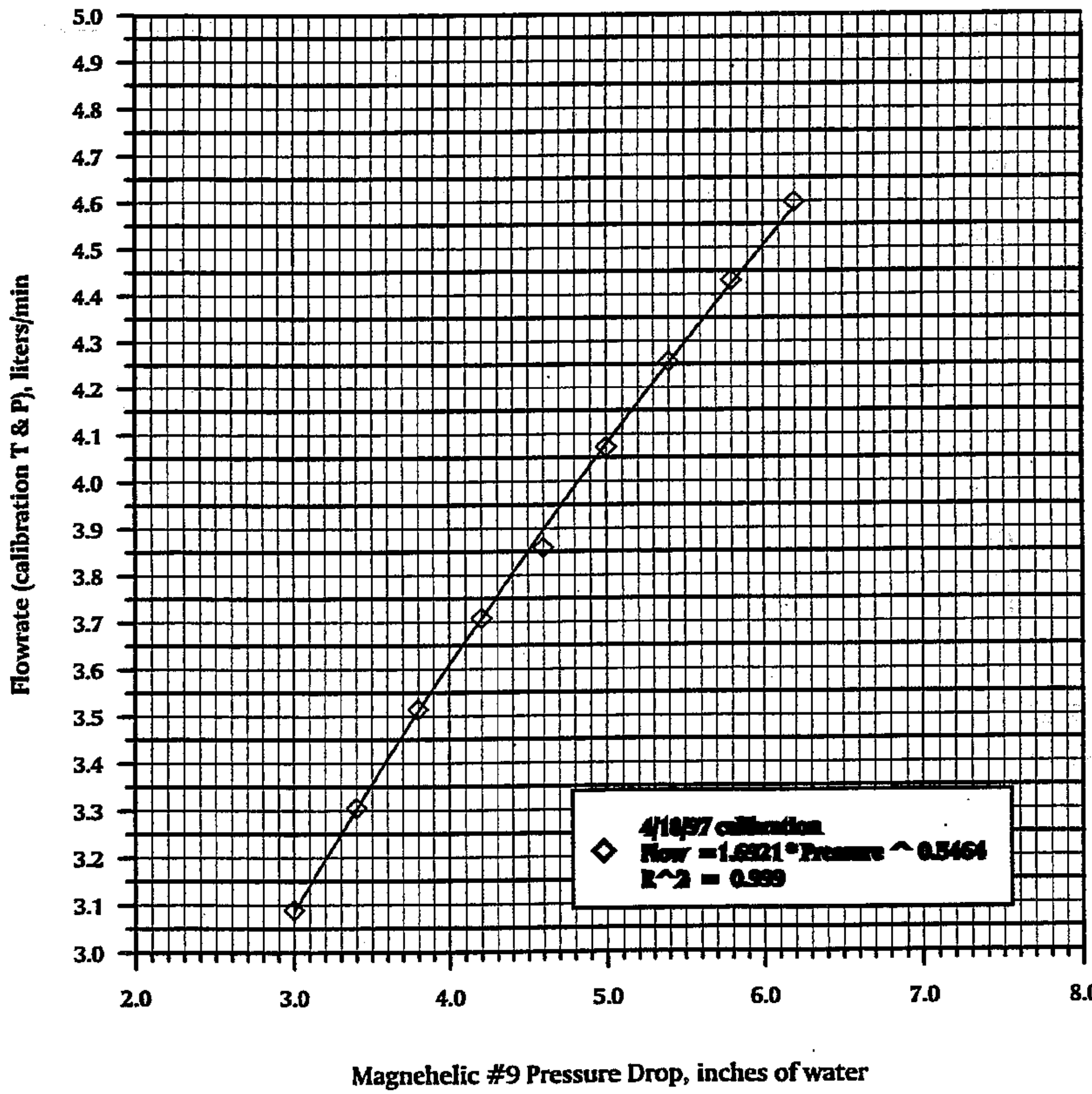
4. Use the Interrogate Logger option to dump the data. The printer will begin printing as the data dumps. Once the first screen full of results are shown, press any key to continue to the time list, which will also print.

5. Once the dump has been done, exit the program. Paste the printed results into the appropriate notebook. If weighing will then be done, use the current values for temperature and humidity in the weighing program setup.

***Warning*: The loggers have magnetic strips on their backs for mounting. Keep the loggers well separated from floppy disks that can be erased or damaged by the magnets.**

ARB Main Study
PM2.5 & PM10 4.0 LPM Particle Samplers
Flow Audit Orifice #9 Calibration

Pressure: 756.7 mm Hg
Temperature: 72.0 deg. F



ARB Main Study PEM Audit Orifice Calibration

File: pemorf09.xls

Orifice #:	9	Calibration date:	8 / 18 / 97
Magnehelic #:	9	Temperature, deg. F :	72
Bubble Flowmeter S/N #:	16709-5	Atm. Press., mm Hg:	757

4.00 lpm = 4.85 Inches of H2O

Magnehelic Reading, inches H2O	Flowrate, lpm	Magnehelic Reading, inches H2O	Flowrate, lpm
4.00	3.609	5.40	4.252
4.05	3.634	5.45	4.274
4.10	3.658	5.50	4.295
4.15	3.682	5.55	4.316
4.20	3.707	5.60	4.338
4.25	3.731	5.65	4.359
4.30	3.755	5.70	4.380
4.35	3.778	5.75	4.401
4.40	3.802	5.80	4.422
4.45	3.826	5.85	4.442
4.50	3.849	5.90	4.463
4.55	3.872	5.95	4.484
4.60	3.896	6.00	4.504
4.65	3.919	6.05	4.525
4.70	3.942	6.10	4.545
4.75	3.964	6.15	4.565
4.80	3.987	6.20	4.586
4.85	4.010	6.25	4.606
4.90	4.032	6.30	4.626
4.95	4.055	6.35	4.646
5.00	4.077	6.40	4.666
5.05	4.099	6.45	4.686
5.10	4.122	6.50	4.706
5.15	4.144	6.55	4.725
5.20	4.165	6.60	4.745
5.25	4.187	6.65	4.765
5.30	4.209	6.70	4.784
5.35	4.231	6.75	4.804

Factor **1.6921** Exponent **0.54642**

Flow (lpm) = Factor x Pressure Drop (inches H2O) ^ Exponent

Orifice response correction multiplying factors:

P correction = [Pseasonal / Pcal]^0.5 T correction = [Tcal / Tseasonal]^0.5

ARB Main Study CEET Shipping List 8/28/97

Item	Description	number	Ship/Take?	Status	Total Value, $
	Support Equipment				
	Study Toshiba laptop	1	RNT		$2,100
	Spare battery for Toshiba laptop	1	S		$120
	CER Toshiba laptop	1	CRT		$4,200
	CER HP660 inkjet printer	1	SM		$320
	Gilabrator, 6 lpm	1	S		$780
	Kodak digital camera (CEET.)	1	CRT		$450
	Field Operations Manual	1	S		$500
	Continuous Monitoring				
	LAS-X	1	S	shipped	$9,000
	Aethalometer	1	S	leased	$5,000
	PMS/LAS-X shipping crate	1	S	shipped	$120
	LAS-X operating manual	1	S	shipped	$20
	Aethalometer operating manuals	1	S	already at SR	$20
	Roadside Monitoring				
	Bluff bodies w/rainshields	3	S		$1,000
	Bluff body switch panels	3	S		$50
	Groundstakes w/standpoles	2	S		$150
	Tripod w/weight	1	S		$80
	Security cables & locks	2	?		$25
	Pole driver	1	S		$15
	In-Vehicle Monitoring				
	Backseat rack	1	S	Ship 8/29	$200
	Back window insert	1	S		$5
	Polyethlyene tubing, 3/8"	20 ft	S		$20
	Manifold switching system	1	S		$600
	Manifold system #2	1	S		$300
	Data logger w/humidity sensor	1	S		$800
	3/8" SS union	1	S		$25
	Wood PM sampler trays	2	S		$100
	Manifold #2 aux. pump	1	S		$400

S - ship to Sierra for Sunday pickup; SM - ship to motel; CRT/RNT - Charles/Randy take

Item	Description	number	Ship or Take?	Weight/Size
	Supplies			
	Duct tape	1 rolls	S	$10
	Masking tape	1 roll	S	
	Tools	asst	S	$125
	Lab bench paper	10 feet	S	
	Kimwipes	2 boxes	S	$5
	cable ties	50	S	$5
	cable tie gun	1	S	$50
	Tygon tubing (2 sizes)	20 ft	S	$10
	Inkjet printer paper	1 pkg	S	$2
	office supplies (various)	1	S	$10
	35mm slide film	1 roll		$5
	Data/Calibration Sheets			
	Particle sampling	10	S	$2
	LAS-X operating	10	S	$2
	Orifice/Magnehelic calibration table	1	S	$2
	Software			
	Filter weighing program	2	CRT	$150
	Pump logger software	2	RNT	$150
	Kodak camera	1	CRT	$100
	Filter Weighing			
	Mettler AT20	1	CRT	$8,000
	RS232 cable	1	CRT	$65
	Data logger w/humidity sensor	1	CRT	$800
	Gelman Teflo® filters	350	CRT	$1050
	Weighing log	1	SM	$10
	balance computer printer	1	SM	$200
	printer paper	1 roll	SM	$10
	printer ink cartridge	1	SM	$10
	printer cable	1	SM	$15
	static charge neutralizers	2	SM	$90
	filter equilibration cabinets	2	SM	$120
		1		

S - ship to Sierra for Sunday pickup; SM - ship to motel; CRT/RNT - Charles/Randy take

Item	Description	number	Ship or Take?	Weight/Size
	Particle Monitoring			
	4 LPM Pump/Data logger systems	14	S	$30,000
	spare ON/OFF plugs	4	S	$2
	RS232 dump cable	2	S	$45
	4 LPM MSP PM2.5 inlets w/scalpers	9	S	$3,600
	4 LPM MSP PM10 inlets	7	S	$2,800
	Silicone oil	1 pint	S	$12
	Gelman 3.0 µm filters	350	S	$1050
	Gelman petri dishes	350	S	$120
	Gelman filter tweezers	2	S	$30
	Spare MSP inlet screws	4	S	$1
	PM2.5/PM10 MSP inlet screw press	1	S	$400
	security screwdriver	2	S	$16
	Spare MSP inlet gaskets	6	S	$2
	Calibrated 4 LPM PEM orifice w/Magnehelic	1	S	$220
	Dust OFF spray cans	4	S	$16
	Clean room swabs	10	S	$20

S - ship to Sierra for Sunday pickup; CRT/RNT - Charles/Randy take

STATE OF CALIFORNIA · DEPARTMENT OF TRANSPORTATION

ENCROACHMENT PERMIT

TR-0120 (NEW 9/91)

Permit No.	0397-NSV0888
Dist/Co/Rte/PM	03-SAC-51-2.4/5.96 03-SAC-80-R11.55
Date	August 27, 1997
Fee Paid: $ EXEMPT	Deposit: $ N/A
Performance Bond Amount (1): $ N/A	Payment Bond Amount (2): $ N/A
Bond Company	
Bond Number (1)	Bond Number (2)

Compliance with (check one):

X Your application of AUGUST 27, 1997

___ Utility Notice No. _____ of _____

___ Agreement No. _____ of _____

___ R/W Contract No. _____ of _____

TO:

Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709-2194

ATTN: Charles E. Rodes, Ph.D.
PHONE: (919) 541-6749

Ref.: 6786-001

, PERMITTEE

and subject to the following, PERMISSION IS HEREBY GRANTED to:

Install four (4) temporary air monitoring stations, three (3) along State Highway 51 (Bus. 80) and one (1) on State Highway 80. Specific locations described on memo dated February 18, 1997.

MEMO ATTACHED

Permittee shall contact **State Inspector Tara McCann**, telephone (916) 227-7008, **two working days** prior to commencing work, to arrange a **pre-job meeting**, in accordance with **Provision 6** of the attached **General Provisions**. The 24 hour notification before restarting work, provided by Provision 6, shall be strictly adhered to. All work shall be conducted and completed to the satisfaction of Caltrans representative listed below. **Immediately following completion of the work permitted herein, the Permittee shall fill out and mail the Notice of Completion attached to this permit.**

The following attachments are also included as part of this permit. (Check applicable):

Yes	No	
X		General Provisions
	X	Utility Maintenance Provisions
X		Special Provisions TRAFFIC CONTROL
	X	A Cal-OSHA permit required prior to beginning work;
		# PLAN and MEMO ATTACHED

In addition to fee the permittee will be billed actual costs for:

Yes	No	
	X	Review
	X	Inspection
X		Field Work

(If any Caltrans effort expended)

___ Yes X No The information in the environmental documentation has been reviewed and considered prior to approval of this permit.

This permit is void unless the work is completed before OCTOBER 1, 1997

This permit is to be strictly construed and no other work other than specifically mentioned is hereby authorized.

No project work shall be commenced until all other necessary permits and environmental clearances have been obtained.

Tara McCann, Permits
5900 Folsom Boulevard
Sacramento, CA 95919
(916) 227-7008, Cellular 755-7371

c: Peter Azevedo, Sunrise Region
William Barker, Permits

APPROVED:

Irene T. Itamura, District Director

BY: Richard W Jones

Richard W. Jones, Chief - Office of Encroachment Permits

Figure 9
Illustrations of the U.S. DOT
Level of Service Classification Scheme

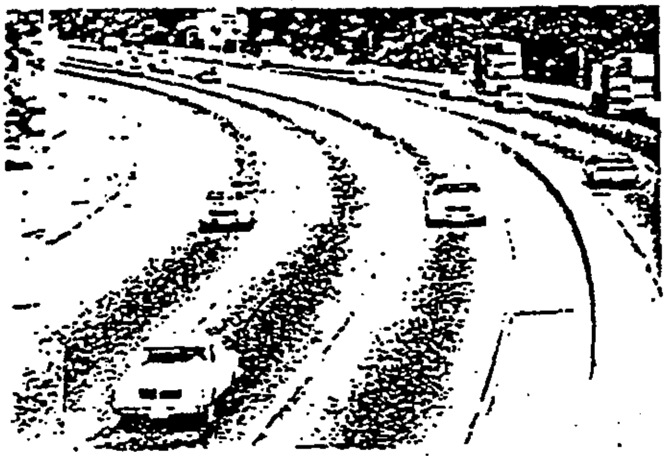


Illustration 3-5. Level-of-service A.

Level of Congestion 1

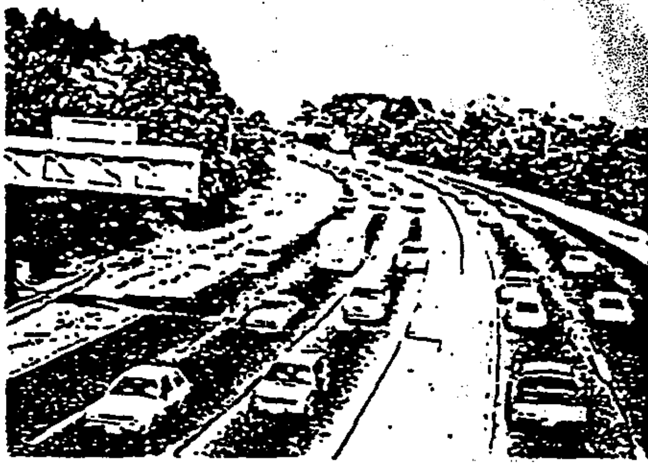


Illustration 3-8. Level-of-service D.

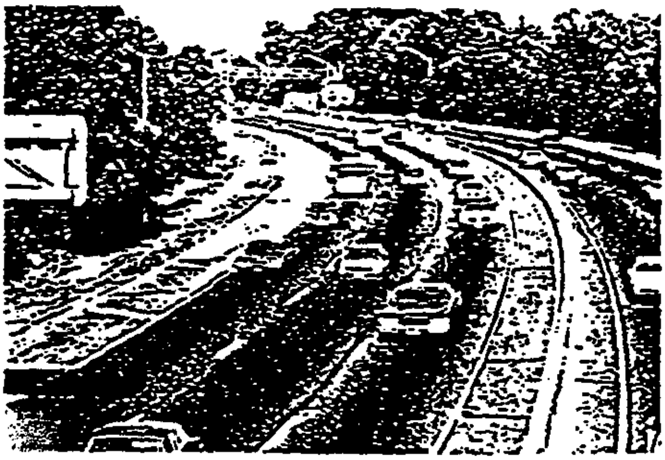


Illustration 3-6. Level-of-service B.

Illustration 3-9. Level-of-service E.

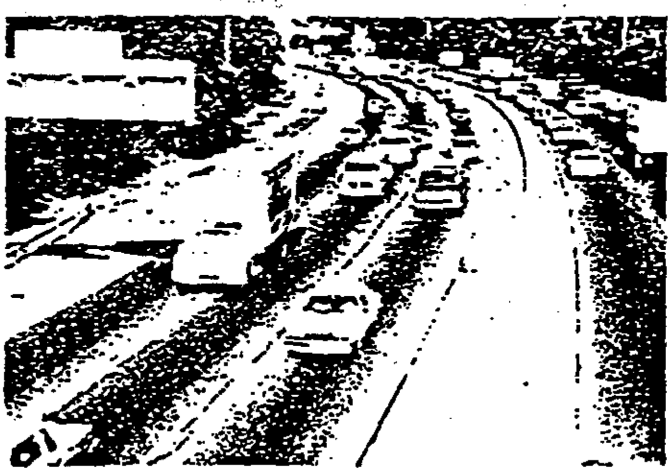


Illustration 3-7. Level-of-service C.

Illustration 3-10. Level-of-service F.

Level of Congestion 6

Sacramento and Los Angeles Commuting Route Maps

[not repeated here – see Appendix C]