# SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
## MONITORING AND ANALYSIS

Rule 1158 Follow-Up Study #6

Sampling Conducted
May 2002 – June 2002

Program Monitoring Conducted By
RES Environmental, Inc.
865 Via Lata, Colton, CA, 92324

Sample Analysis By
Steven Barbosa, Principal Air Quality Chemist
Sandra Hom, Senior Air Quality Chemist
Roger Bond, Air Quality Chemist
Jorge Diez, Laboratory Technician

Report Prepared By
Jeremy C. O'Kelly, Air Quality Chemist
March 2003

Reviewed By
Henry Hogo
Assistant DEO, Science and Technology Advancement

Report # MA 2003-04

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## EXECUTIVE SUMMARY

### Purpose

In June 1999, Rule 1158 affecting storage, handling and shipment of petroleum coke, coal, and sulfur was amended to further reduce particulate emissions from these sources. This study is one of an ongoing series, examining targeted compounds contained in the inhalable particulate fraction ($PM_{10}$) in the greater Long Beach/Wilmington area. This series of studies consists of $PM_{10}$ sampling in the spring/summer and fall/winter, observing trends in ambient $PM_{10}$ concentration and the elemental carbon content of collected samples.

### Sampling

Sampling was conducted coincident with the AQMD $PM_{10}$ monitoring network one-in-six day schedule between May 8, 2002 and June 19, 2002. Sampling locations were identical to those utilized for the previous Rule 1158 Follow-Up studies. It is intended that these sites be used throughout the entire series of studies. Field operations were contracted to RES Environmental, Inc. (Colton, CA), while all laboratory operations and data analysis were performed by AQMD personnel. Twenty-four samples were collected over seven non-consecutive sampling days.

### Key Findings

1. Study (three-site) average $PM_{10}$ values showed expected seasonal variation, with study averages consistently within the range of $PM_{10}$ results observed among the Basin comparison sites during the current study.

2. Study sites continue to exceed $PM_{10}$ results collected at the Long Beach network station, singly or in groups. The Hudson School site continues to produce higher results than the Edison School and Wilmington Childcare sites. Both of these conditions have been noted in the previous Long Beach studies.

3. The Long Beach studies have shown a significant decline in ambient elemental carbon (EC) since Rule 1158 amendment (July 1999). Results through fall/winter 2000 showed a steady decline in EC, while more recent studies have shown modest fluctuation in EC concentration. The magnitude of this fluctuation is not inconsistent with expected seasonal variation.

4. Amended Rule 1158 targets specific sources of ambient EC. Initial implementation of the controls prescribed by the Rule was expected to produce immediate, measurable decreases in ambient EC, such as has been observed in previous studies in this series. As the Rule becomes fully implemented, reductions in EC may be less evident, approaching the point where it may be difficult to differentiate between changes due to seasonal variation and changes due to Rule compliance.

## 1.0 INTRODUCTION

Over the course of several years prior to 1997, residents of Long Beach and Wilmington area neighborhoods lodged several complaints of black, oily airborne dust with the AQMD. Surveys of the area noted that there were numerous coal and petroleum coke production, storage, and shipment facilities. These included open stockpiles of green coke, enclosed "coke barns", refinery kilns producing petroleum coke, and a variety coke and coal carrying trains and trucks. Other industrial processes including sulfur distribution facilities, heavy traffic patterns, and general construction activities were also noted in the area.

In August of 1996, the District attended a public meeting in San Pedro, which focused on public concern over the levels of particulate matter in the region. Subsequently, the AQMD coordinated with various public action groups to select several sites for particulate monitoring, including sites located at specific areas of community concern.

Two studies were conducted at these sites, one in May 1997[1] and one in fall/winter 1998[2]. These studies were designed to characterize local micrometeorological parameters, and to microscopically and chemically characterize airborne particulate collected in the area. The most pronounced findings of these studies were the elevated levels of elemental carbon and inhalable particulate matter at some study sites, including a monitoring site adjacent to Elizabeth Hudson Elementary School in Long Beach.

In June 1999 the AQMD amended of Rule 1158 affected storage, handling and shipment practices for petroleum coke, coal, and sulfur. Subsequent California State legislation HSC 40459 (AB 1775 – Lowenthal) requires that the AQMD, in conjunction with CARB, prepare an annual study for the California State Legislature examining the frequency and severity of violations related to AQMD Rule 1158. To monitor the efficacy of the rule and provide supporting data for the Legislative Report, the AQMD initiated a series of *Rule 1158 Follow-up Studies.* These studies are conducted twice annually on an ongoing basis; once each spring/summer and fall/winter.

Removal and enclosure of open coke storage piles, and modification to equipment and work practices to comply with Rule 1158 requirements is ongoing. The Rule 1158 compliance schedule mandates implementation of the majority of control measures by August 1999, with full implementation of all measures by June 2004. Compliance field staff have documented a high rate of compliance with the initial rule implementation requirements, including covered transport, truck washing, prompt roadway/spill clean-up and the removal of several large open coke piles that has resulted in the reduction of fugitive coke emissions from storage, handling, and shipping operations. It is anticipated

[1] South Coast Air Quality Management District. (September 1997) *Micrometeorological and Ambient Air Quality Monitoring Conducted Simultaneously in the Vicinity of the Los Angeles and Long Beach Harbors.* Diamond Bar, CA.

[2] South Coast Air Quality Management District. (March 1999) *Micrometeorological and Ambient Air Quality Monitoring Conducted Simultaneously in the Vicinity of the Los Angeles and Long Beach Harbors.* Diamond Bar, CA.

that full implementation of Rule 1158 will contribute to a decrease in ambient $PM_{10}$ concentrations in the local area.

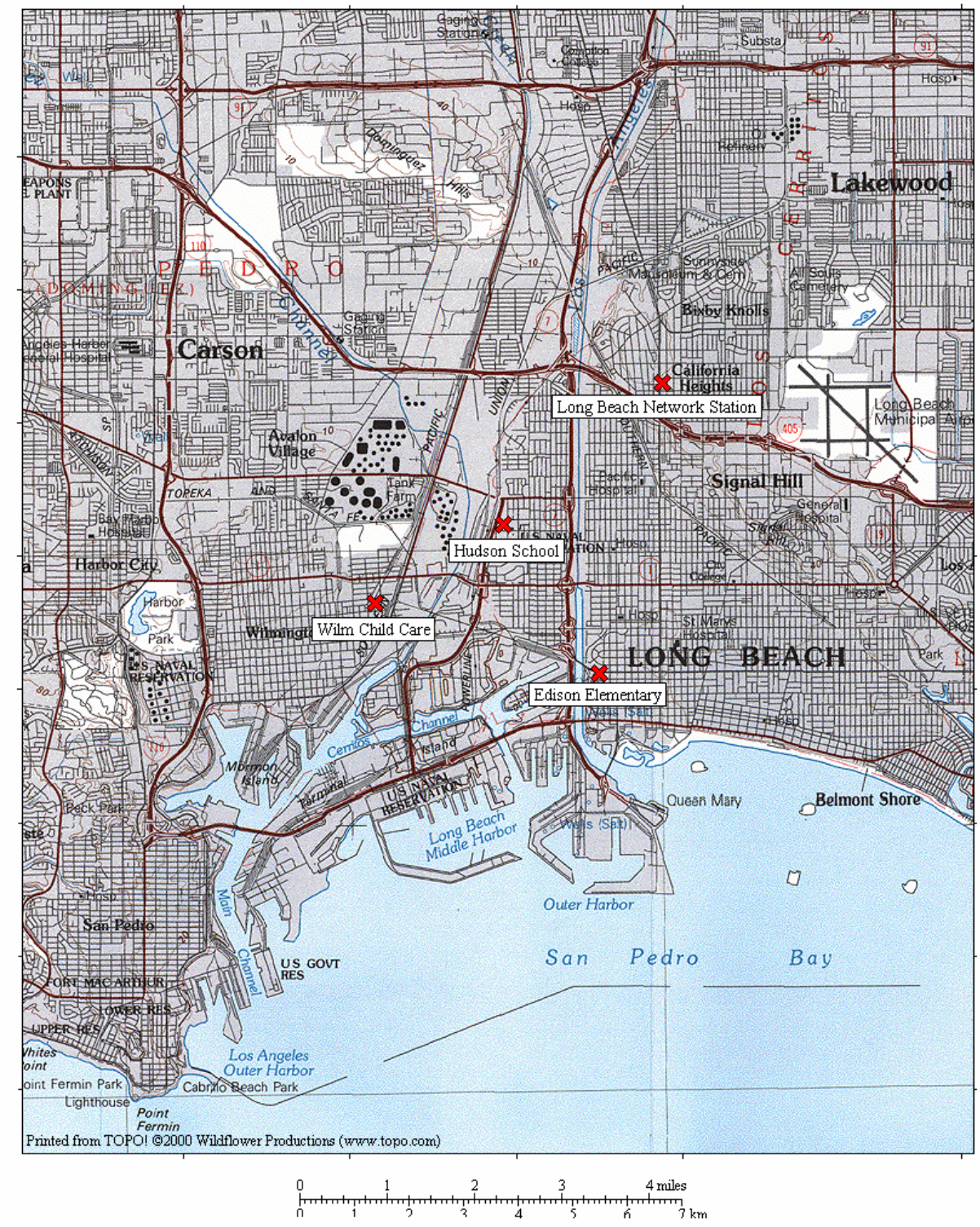



Figure 1 – Study Sampling Sites

## 2.0 PROJECT DISCUSSION

From May 8, 2002 to June 19, 2002, $PM_{10}$ monitoring was conducted at three locations in the cities of Long Beach (two sites) and Wilmington (one site). This study constituted the sixth in a series of follow-up studies evaluating improvements in local air quality precipitated by implementation of Rule 1158, as amended on June 11, 1999. The next sampling event began in November 2002.

This study builds on a base of knowledge established by several previous studies: two prior to Rule amendment and five follow-up studies. Together they constitute a set of four spring/summer studies (1997, 2000, 2001, and 2002)[3,4] and four fall/winter studies (1998, 1999, 2000, and 2001)[5,6]. The primary objectives of the current study were to collect data suitable for the evaluation of:

> Current inhalable particulate ($PM_{10}$) ambient concentration trends for the study area.
>
> Speciation of the carbonaceous component of the collected particulate samples for elemental and organic carbon content.
>
> Comparison of 2002 $PM_{10}$ mass and carbon data with that obtained during the earlier Rule 1158 studies.

The prevailing winds in the study area place portions of the community downwind of coal and coke production and/or storage facilities, and fugitive dust from these activities has been a longstanding community concern. This fugitive dust contributes to increases in the $PM_{10}$ particulate concentration. Mobile sources such as diesel trucks, trains and ships in the area also contribute to the overall ambient particulate matter concentrations.

Site selection and the sampling calendar were influenced by several factors. Sampling dates were scheduled to repeat as closely as possible the sampling dates of the previous studies, while coinciding with the EPA one-in-six monitoring schedule utilized by the AQMD in its $PM_{10}$ monitoring network. Samples were scheduled for collection on May 8, 14, 20, 26 and June 1, 7, 13 and 19, 2002, producing a data set consisting of twenty-four samples.

The three current monitoring sites were chosen from seven sites used in the fall/winter 1998 study, *Micrometeorological and Ambient Air Quality Monitoring Conducted Simultaneously in the Vicinity of the Los Angeles and Long Beach Harbors* (March 1999); the sites have remained constant during the course of the *Rule 1158 Follow-Up*

[3] South Coast Air Quality Management District. (September 1997)
[4] South Coast Air Quality Management District. *Rule 1158 Follow-Up Study #2, #4 and #6.* Diamond Bar, CA.
[5] South Coast Air Quality Management District. (March 1999)
[6] South Coast Air Quality Management District. *Rule 1158 Follow-Up Study #1, #3, and #5.* Diamond Bar, CA.

series of studies (Figure 1.) Site selection criteria included site locations relative to coal and coke facilities with respect to the local prevailing wind patterns, and their importance as locations containing student populations (the sites include two schools and a child care center). In addition, of the seven sites included in the 1998 study, the two school sites had exhibited the highest levels of ambient $PM_{10}$ and elemental carbon. Detailed site maps can be found in Appendix A-2.

## 2.1 SITE DESCRIPTIONS

RES Environmental, Inc. (RES), was contracted by the AQMD to perform field operations for the current study. The consultant described the sampling locations as follows[7]:

**Site 1:** School Building Services Facilities/Hudson School (HUD)
2401 Webster Avenue
Long Beach, California

The monitoring site is located at the Long Beach School Building Services facility (maintenance yard), adjacent to the Hudson Middle School. The $PM_{10}$ sampler was installed on top of two adjoining steel containers. Meteorological exposures were composed of (1), Henry Ford Freeway, which runs parallel to the monitoring site to the west and (2), maintenance yard to the north, east and south of the monitoring site. The maintenance yard consists of repairs and fabrication of materials, including welding.

**Site 2:** Edison Elementary School (EDI)
625 Maine Avenue
Long Beach, California

Site #2 was located at the Edison Elementary School in Long Beach. The $PM_{10}$ sampler was located on a steel container at the western side of the school and playground. The sampler was also installed on a five-foot platform to clear the school building to the east. The meteorological exposure consists of (1), a main street artery ($16^{th}$ Street) which carries heavy vehicle traffic, is located to the north (2), school buildings to the east and south and (3), a small bus terminal to the west of the monitoring site.

[7] RES Environmental, Inc. (February 2000) *The South Coast Air Quality Management District –Rule 1158 Follow-up Study.* Colton, CA.

**Site 3:** Wilmington Childcare Center (WIL)
1419 Young Street
Wilmington, California

The monitoring site was installed on the roof of the Childcare Center, near a elementary and middle school in the City of Wilmington. The meteorological exposure consists of (1), a residential area to the north (2), commercial/industrial development to the east (3), school to the south and (4) parking area/residential area to the west of the monitoring site.

## 2.2 SAMPLING AND ANALYSIS METHODOLOGY

The AQMD maintains a $PM_{10}$ monitoring network throughout the South Coast Air Basin (the Basin). The Federal Reference Method (FRM) SSI $PM_{10}$ samplers utilized in the $PM_{10}$ network and standard AQMD analytical procedures are summarized here:

The SSI sampler used in this study is the EPA's FRM sampler found in 40CFR50 Appendix J. It is used to monitor PM less than 10 microns in size ($PM_{10}$). For the purposes of this study, the SSI samplers are used to collect $PM_{10}$ samples, which were also used for the determination of organic carbon (OC), elemental carbon and total carbon.

The SSI sampler contains a pump controlled by a programmable timer. An elapsed time accumulator, linked in parallel with the pump, records total pump-operation time in hours. During operation, a known quantity of air is drawn through a particle size separator, which achieves particle separation, by impaction. The correct flow rate through the inlet is critical to collection of the correct particle size so that after impaction, only particles 10 microns in size or less remain suspended in the airstream. The flow of air then passes through a quartz filter medium, upon which the particles are collected. A programmable timer automatically turns the pump off at the end of the 24-hour sampling period.

Once a sample has been collected it is returned to the laboratory, following chain-of-custody protocols, where both $PM_{10}$ mass and carbon content are determined. Ambient $PM_{10}$ mass is determined by subtracting the weight of the clean unsampled filter (measured in the laboratory prior to sampling) from the weight of the sampled filter containing the collected $PM_{10}$, to yield the mass of the $PM_{10}$ collected on the filter. This mass is then divided by the amount of air drawn through the filter to give the ambient concentration, expressed as mass per cubic meter ($\mu g/m^3$).

Ambient carbon levels are determined by taking a small portion of the $PM_{10}$ filter and putting it into a carbon analyzer. The analyzer consists of a computer-controlled programmable oven, computer controlled gas flows, a laser, and a flame ionization detector (FID). The sample is first heated in the oven in increasing amounts of oxygen. As the temperature rises, first organic carbon and then elemental carbon are evolved from

the filter. The laser beam passes through the filter, and the transmitted intensity increases at the detector as the light-absorbing carbon leaves the filter, causing the filter to become less black. The evolved carbon is swept from the oven by gas flow, and is transported to the FID where it is detected (in the form of methane) throughout the heating process. The computer that controls these processes collects data on the oven temperature profile, laser light absorption, and FID response to determine the OC and EC content of the filter. This information, combined with the volume of air sampled, provides the OC and EC concentration in the ambient air.

## 3.0 DATA ANALYSIS

Data from the current study were compared with data obtained in previous Long Beach/Wilmington area studies.

### 3.1 $PM_{10}$ AMBIENT CONCENTRATION ANALYSIS

Table 1: Spring/Summer 2002 $PM_{10}$ Concentrations ($\mu g/m^3$) at Sampling Sites

| | Date | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Location** | **5/8/02** | **5/14/02** | **5/20/02** | **5/26/02** | **6/1/02** | **6/7/02** | **6/13/02** | **6/19/02** |
| **HUD** | 50 | 58 | 22 | 22 | 28 | 20 | 55 | 32 |
| **EDI** | 40 | 56 | 18 | 21 | 31 | 18 | 50 | 32 |
| **WIL** | 37 | 54 | 47 | 19 | 21 | 17 | 41 | 31 |
| **Long Beach** | * | * | 16 | 27 | 24 | 21 | 34 | 30 |

* No sample

Table 1 presents the $PM_{10}$ ambient concentrations observed during the study. Complete data tabulations can be found in Appendix A-1. Long Beach values are provided for comparison. Twenty-four hour ambient $PM_{10}$ concentrations during the study period ranged from a maximum of 58 $\mu g/m^3$ at HUD on May 14$^{th}$, to a minimum of 17 $\mu g/m^3$ obtained at the WIL site on June 7$^{th}$. The average $PM_{10}$ concentration for the three study sites was 34 $\mu g/m^3$.

The State of California has established 50 $\mu g/m^3$ as the $PM_{10}$ 24-hour standard. Four of the twenty-four (17%) samples collected during the course of the study exceeded this standard. The Federal $PM_{10}$ 24-hour standard (150 $\mu g/m^3$) was not exceeded by any of the samples in the current study. The highest site average (36 $\mu g/m^3$) over the course of the study occurred at the HUD site. This continues the trend observed in previous studies, where HUD ranked highest for $PM_{10}$.

For all studies except the fall/winter 2000 study, the HUD site has exhibited the highest study $PM_{10}$ average. It should also be noted that on several occasions in the previous studies the HUD site produced $PM_{10}$ samples significantly higher than those observed at EDI and WIL. Taken together, these trends suggest that HUD consistently experiences higher $PM_{10}$ concentrations than elsewhere in the study area. Such elevated samples may be the result of local sources or meteorological conditions influencing the immediate area adjacent to the sampler, and underscore the complexity and variety of particulate sources that contribute to ambient $PM_{10}$.

While less pronounced than in several previous studies, the three study sites produced average $PM_{10}$ values higher than those observed at the Long Beach $PM_{10}$ network station. While absent during the fall/winter 2000 and spring/summer 2001 studies, this trend was common in earlier studies.

**Figure 2: 2002 $PM_{10}$ Study Average vs. Long Beach Network Station**

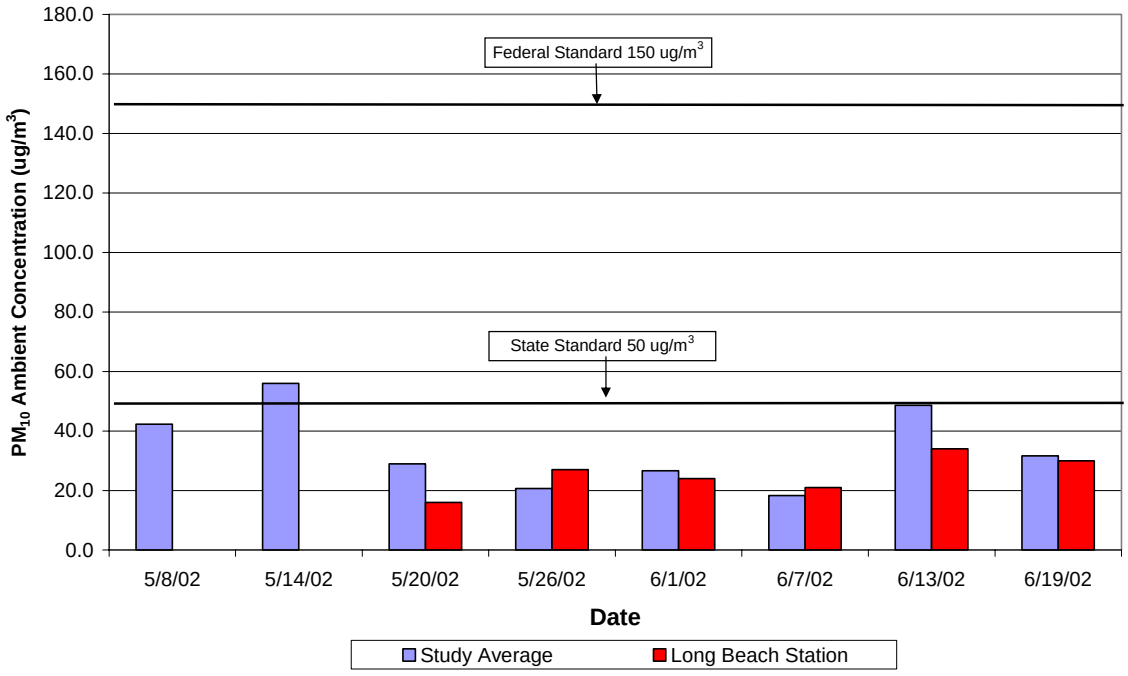


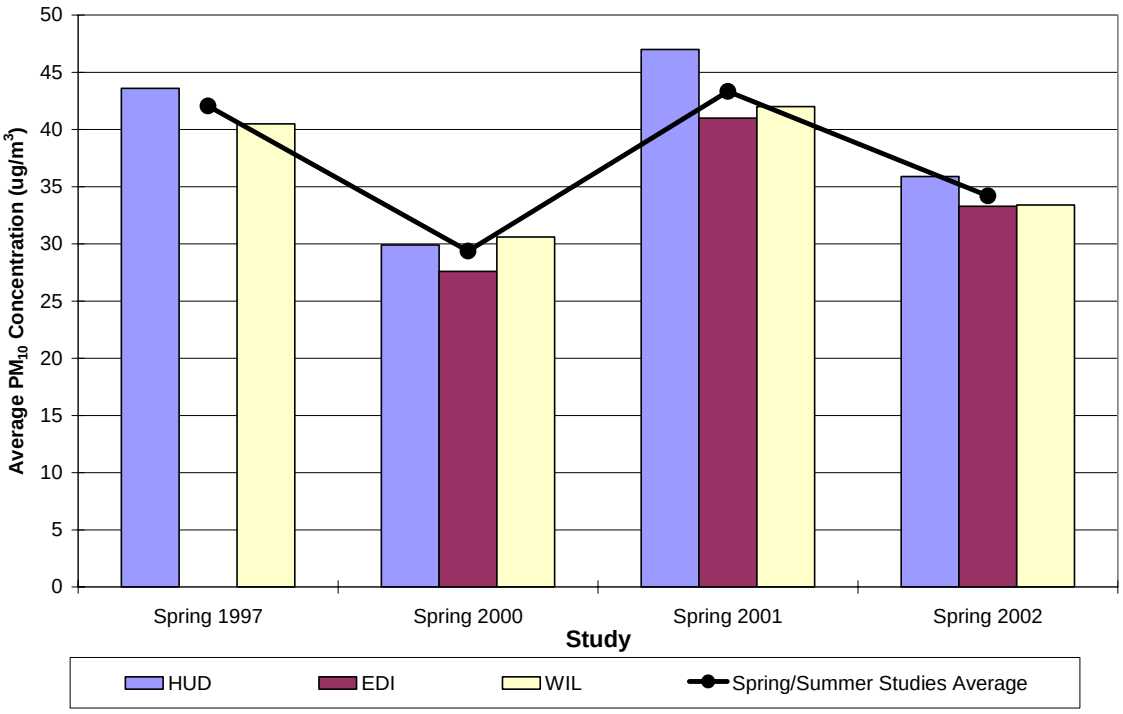

Figure 2 compares the average value for the three study sites with the Long Beach network station on each day of the 2002 study. Samples for the May 8th and 14th dates were not available for the Long Beach Station. When looking at these results, it must be kept in mind that $PM_{10}$ consists of a variety of chemical species.[8] These include carbonaceous components (EC and OC), crustal materials and wind-blown soils, sulfate and nitrate formed by precursor SOx and NOx emissions primarily as a result of combustion, and sodium chloride particulate resulting in part from wind-carried sea salt. Increases in $PM_{10}$ observed at study sites may be the result of contributions from one or several of these sources. Particle formation is also highly influenced by meteorological conditions, which vary seasonally and from year to year.

For all dates other than May 20th and June 13th, the study average and the Long Beach station yield very similar values. On June 13th $PM_{10}$ results at study sites were significantly higher than the result at the Long Beach Network station. On May 20th, the $PM_{10}$ result at WIL was significantly higher than at HUD and EDI, and the Long Beach

[6] Kim. B.M., Teffera, S., Zeldin, M.D. Characterization of $PM_{2.5}$ and $PM_{10}$ in the South Coast Air Basin of Southern California: Part 1 – Spatial Variations. *J. Air and Waste Manage. Assoc.* **2000** 50:2034-2044.

station. An independent localized source near WIL may account for the elevation of the study average on that date.

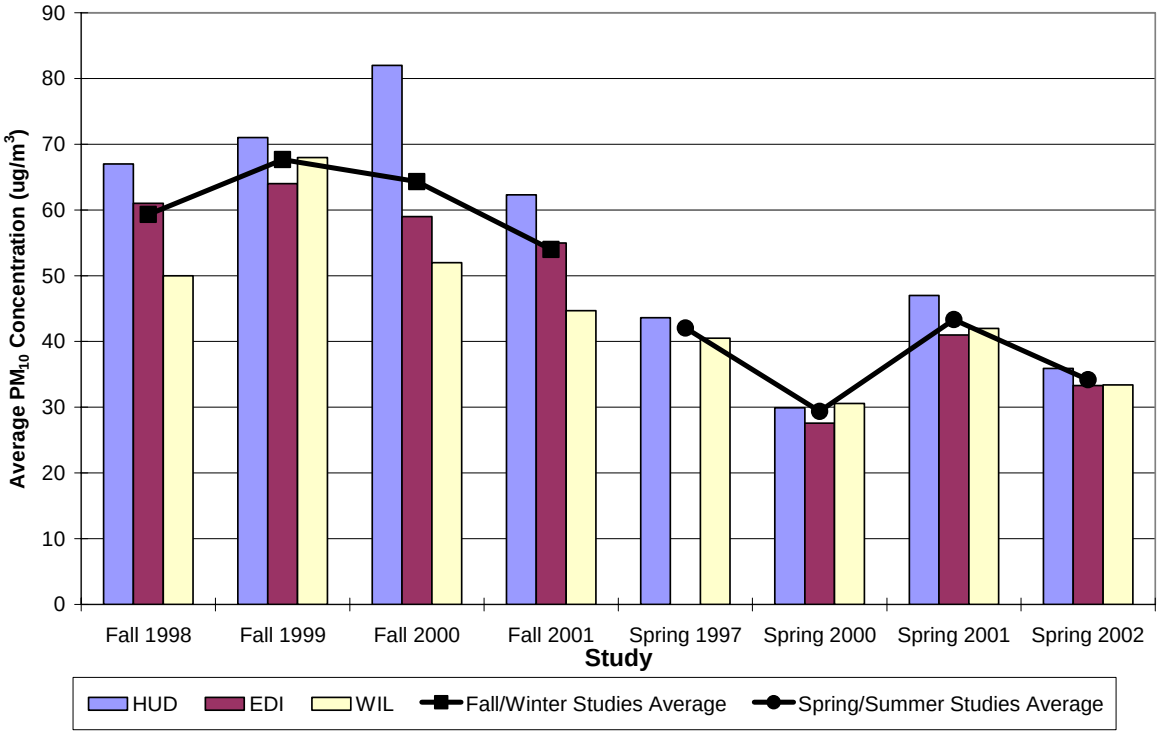
**Figure 3: Ambient $PM_{10}$ Concentrations by Site and Year**




## 3.2 $PM_{10}$ TREND ANALYSIS

Figure 3 summarizes the ambient $PM_{10}$ concentrations observed over the course of the four spring/summer studies. The black line represents the three-site study average for each study. The data show a varying three-site seasonal $PM_{10}$ average centered on 37μg/m$^3$, with a standard deviation of approximately ±12 μg/m$^3$ (or about 32%.) compared to a fall 61μg/m$^3$, with a standard deviation of approximately ±6 μg/m$^3$ (or about 10%.)

**Figure 4: Ambient $PM_{10}$ Concentrations During Long Beach Study Series**

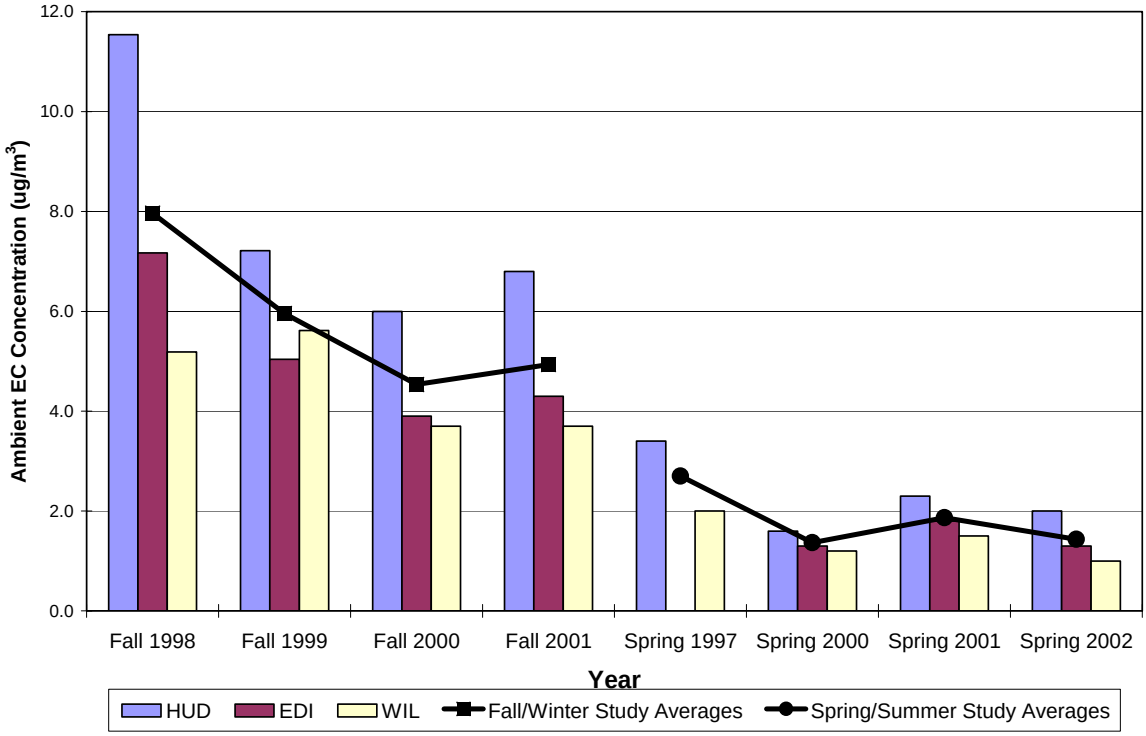



Displaying the fall/winter data alongside spring/summer data, Fig. 4 further illustrates these seasonal and year to year variations. $PM_{10}$ concentrations in the Basin have been observed to be highest in the fall/winter season, when the air mass over the Basin is particularly prone to stagnation due to high pressures in inland and desert areas. Similarly, Santa Ana wind conditions, resulting from even higher inland pressures, also occur during the fall/winter timeframe and contribute to higher $PM_{10}$ values. As winter gives way to spring, lower $PM_{10}$ concentrations are observed, gradually increasing throughout summer and fall. In the figure above, spring/summer study $PM_{10}$ concentrations are lower than fall/winter concentrations, in agreement with historical trends in the basin.

Study average $PM_{10}$ values (the average value for all three sites during a given study) are illustrated by the black lines in Fig. 4. Year-to-year fall/winter study results are characterized by a moderately varying study average ($61 \pm 6$ μg/m$^3$), while the three monitoring locations have considerably differing $PM_{10}$ concentrations during a single year. In contrast, spring/summer studies are characterized by a larger variation in year-to-year study average ($37 \pm 12$ μg/m$^3$), while the three monitoring locations observe similar $PM_{10}$ concentrations during a single year.

## 3.3 ELEMENTAL CARBON TREND ANALYSIS

**Figure 5: Average EC by Site and Year**



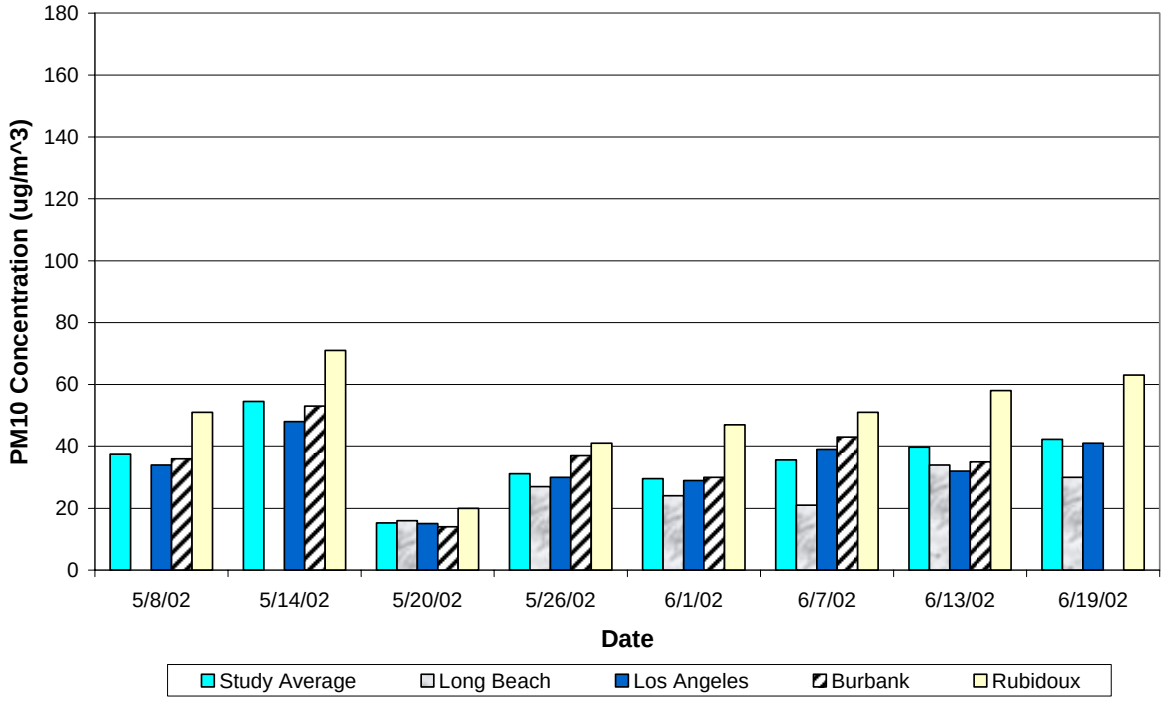

Elemental carbon is of particular interest in this study, as it arises in part from coke and coal storage as well as from transportation including diesel emissions from trucks, trains and ships. Elemental carbon concentrations were averaged for the three study sites over the duration of each study, and results are represented in Fig. 5 above. Complete data tabulations can be found in Appendix A-1. The results obtained in the current study were lower than those observed in spring 2001, but slightly higher than those observed in spring 2000.

In the previous section it was noted that there are no consistent trends for study average $PM_{10}$ concentrations or for individual site averages. Examining both Fig. 4 and Fig. 5, it should be noted that the changes in EC concentrations occur without direct correlation to ambient $PM_{10}$ fluctuations during the fall/winter studies. During the spring/summer studies, EC concentrations changed in a pattern similar to the ambient $PM_{10}$ fluctuations. As the changes from year to year become smaller, as is illustrated particularly in the 2000-2002 spring studies, it may be difficult to differentiate between changes due to seasonal variation, experimental error, and changes due to Rule compliance.

## 3.2 BASIN-WIDE $PM_{10}$ COMPARISON

In order to place the study results in context, the study maximum $PM_{10}$ value for each day was compared to results obtained concurrently at several other $PM_{10}$ network sites within the Basin (Figure 6). The sites chosen for comparison are representative of the spectrum of conditions encountered in the Basin. In general, Rubidoux is among the highest $PM_{10}$ sites in the Basin, with particulate high in nitrate and crustal materials; it is representative of the southeastern portion of the Basin. Los Angeles reflects conditions within the urban core, with particulate higher in sulfate and carbonaceous compounds than Rubidoux, resulting from a higher contribution to ambient particulate by vehicle emissions.

**Figure 6: 2002 Study $PM_{10}$ Average vs. $PM_{10}$ Network Sites**

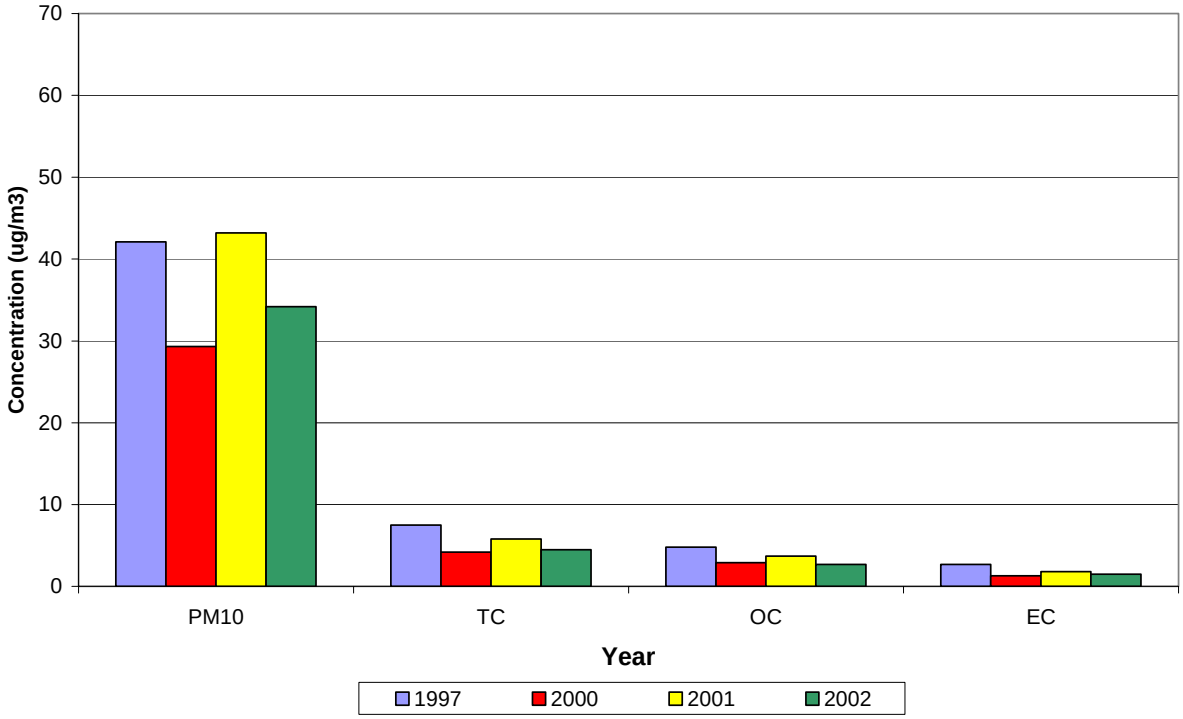


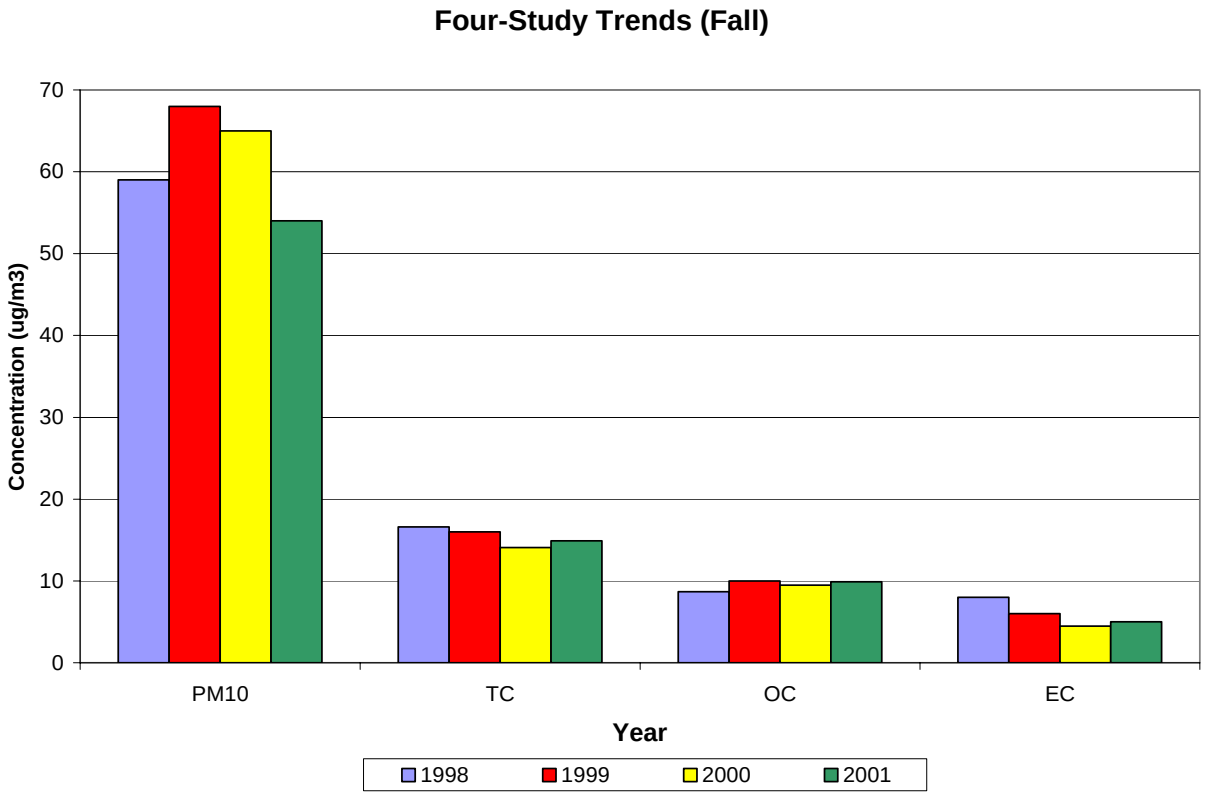

On all study dates the maximum $PM_{10}$ concentration was measured at Rubidoux. As in the spring/summer 2000 and 2001 studies, the study maximum value varied within the range of values observed at $PM_{10}$ network sites, while remaining considerably lower than the Basin maximum concentrations observed at Rubidoux.

Figure 7 summarizes trends observed over the entire course of studies. The primary indicator of ambient coke and coal dust is EC; notably, EC concentrations observed after Rule 1158 amendment (June 1999) have consistently remained lower than EC

concentrations observed prior to amendment. EC is the only species monitored to exhibit such a trend.

**Figure 7: Four-Study Trends (Spring)**






## 4.0 CONCLUSIONS

Study (three-site) average $PM_{10}$ values showed expected seasonal variation. The study $PM_{10}$ average did not exceed Basin-wide observations, a result consistent with the prior spring/summer studies. However, the three study sites recorded higher ambient $PM_{10}$ than the Long Beach network station, as has been observed in previous studies.

For seven of eight sampling days, HUD collected higher $PM_{10}$ than EDI, WIL, or the Long Beach station. Earlier studies in the series have also routinely produced higher results at the HUD site than at other study locations. This indicates that localized sources or meteorological conditions may disproportionately impact the HUD site.

Ambient EC remains well below concentrations observed in studies prior to Rule 1158 amendment (June 1999). From 1998 – 2000, ambient elemental carbon concentrations had decreased steadily over the series of fall/winter studies, but fluctuated in fall 2001 and during the spring/summer studies from 1997-2002.

As discussed earlier, elemental carbon arises in part from coke and coal storage as well as from transportation including diesel emissions from trucks, trains and ships. Changes in EC may be attributable to changes in the contributions from one or more of these sources, or from seasonal and meteorological atmospheric changes.

# APPENDIX A-1 LONG BEACH $PM_{10}$ MONITORING DATA

**2002 Spring/Summer $PM_{10}$ Ambient Concentration Results**

| Location | 5/8/02 | 5/14/02 | 5/20/02 | 5/26/02 | 6/1/02 | 6/7/02 | 6/13/02 | 6/19/02 | Average |
|---|---|---|---|---|---|---|---|---|---|
| HUD | 50 | 58 | 22 | 22 | 28 | 20 | 55 | 32 | 36 |
| EDI | 40 | 56 | 18 | 21 | 31 | 18 | 50 | 32 | 33 |
| WIL | 37 | 54 | 47 | 19 | 21 | 17 | 41 | 31 | 33 |
| LB Station | NS | NS | 16 | 27 | 24 | 21 | 34 | 30 | 25 |

**2001 Spring/Summer Organic Carbon Ambient Concentration Results**

| Location | 5/8/02 | 5/14/02 | 5/20/02 | 5/26/02 | 6/1/02 | 6/7/02 | 6/13/02 | 6/19/02 | Average |
|---|---|---|---|---|---|---|---|---|---|
| HUD | 5.4 | 4.8 | 3.3 | 2.1 | 1.8 | 2.4 | 5.0 | 2.4 | 3.4 |
| EDI | 3.4 | 4.5 | 3.1 | 2.3 | 2.6 | 2.0 | 3.5 | 2.8 | 3.0 |
| WIL | 2.8 | 4.5 | 2.2 | 1.9 | 2.0 | 2.4 | 3.2 | 2.6 | 2.7 |

**2001 Spring/Summer Elemental Carbon Ambient Concentration Results**

| Location | 5/8/02 | 5/14/02 | 5/20/02 | 5/26/02 | 6/1/02 | 6/7/02 | 6/13/02 | 6/19/02 | Average |
|---|---|---|---|---|---|---|---|---|---|
| HUD | 3.5 | 2.2 | 2.6 | 0.9 | 1.0 | 1.2 | 3.5 | 1.0 | 2.0 |
| EDI | 1.5 | 2.0 | 1.7 | 1.1 | 0.8 | 0.9 | 1.7 | 0.9 | 1.3 |
| WIL | 1.1 | 1.8 | 0.7 | 0.8 | 0.5 | 1.1 | 1.3 | 1.1 | 1.0 |

**2001 Spring/Summer Total Carbon Ambient Concentration Results**

| Location | 5/8/02 | 5/14/02 | 5/20/02 | 5/26/02 | 6/1/02 | 6/7/02 | 6/13/02 | 6/19/02 | Average |
|---|---|---|---|---|---|---|---|---|---|
| HUD | 8.9 | 7.1 | 5.9 | 3.1 | 2.8 | 3.6 | 8.5 | 3.4 | 5.4 |
| EDI | 4.9 | 6.5 | 4.9 | 3.4 | 3.4 | 3.0 | 5.2 | 3.7 | 4.4 |
| WIL | 3.8 | 6.3 | 2.9 | 2.7 | 2.5 | 3.5 | 4.5 | 3.7 | 3.7 |

**2001 Spring/Summer $PM_{10}$ Ambient Concentration Results**

| Location | 5/25/01 | 5/31/01 | 6/6/01 | 6/12/01 | 6/18/01 | 6/24/01 | 6/30/01 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 39 | 70 | 47 | 34 | 63 | 36 | 38 | 47 |
| EDI | 31 | 67 | 41 | 32 | 49 | 36 | 33 | 41 |
| WIL | 39 | 56 | 43 | 36 | 47 | 35 | 35 | 42 |
| LB Station | 30 | 48 | 45 | 29 | 43 | 32 | 37 | 38 |

**2001 Spring/Summer Organic Carbon Ambient Concentration Results**

| Location | 5/25/01 | 5/31/01 | 6/6/01 | 6/12/01 | 6/18/01 | 6/24/01 | 6/30/01 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 3.6 | 6.6 | 4.6 | 3.1 | 6.1 | 3.2 | 3.4 | 4.4 |
| EDI | 3.4 | 5.1 | 4.9 | 2.5 | 4.9 | 3.4 | 3.3 | 3.9 |
| WIL | 4.1 | 3.7 | 4.0 | 3.2 | 4.8 | 3.1 | 3.1 | 3.7 |

**2001 Spring/Summer Elemental Carbon Ambient Concentration Results**

| Location | 5/25/01 | 5/31/01 | 6/6/01 | 6/12/01 | 6/18/01 | 6/24/01 | 6/30/01 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 1.7 | 3.9 | 2.0 | 1.1 | 3.5 | 1.3 | 2.2 | 2.3 |
| EDI | 1.0 | 2.9 | 1.6 | 1.1 | 3.0 | 1.2 | 1.5 | 1.8 |
| WIL | 2.3 | 1.2 | 1.8 | 1.1 | 2.1 | 1.1 | 0.9 | 1.5 |

**2001 Spring/Summer Total Carbon Ambient Concentration Results**

| Location | 5/25/01 | 5/31/01 | 6/6/01 | 6/12/01 | 6/18/01 | 6/24/01 | 6/30/01 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 5.3 | 10.5 | 6.6 | 4.2 | 9.6 | 4.6 | 5.6 | 6.6 |
| EDI | 4.4 | 8.0 | 6.5 | 3.6 | 7.9 | 4.7 | 4.8 | 5.7 |
| WIL | 6.4 | 4.9 | 5.8 | 4.3 | 6.9 | 4.2 | 4.0 | 5.2 |

**2000 Spring/Summer $PM_{10}$ Ambient Concentration Results**

| Location | 5/24/00 | 5/30/00 | 6/5/00 | 6/11/00 | 6/17/00 | 6/23/00 | 6/29/01 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 27 | 31 | 40 | 32 | 18 | 19 | 42 | 30 |
| EDI | 20 | 28 | 37 | 31 | 25 | 17 | 35 | 28 |
| WIL | 22 | 38 | 41 | 33 | 19 | 24 | 37 | 31 |
| LB Statior | * | * | 32 | 30 | 17 | 19 | 34 | 26 |

* No Sample

**2000 Spring/Summer Organic Carbon Ambient Concentration Results**

| Location | 5/24/00 | 5/30/00 | 6/5/00 | 6/11/00 | 6/17/00 | 6/23/00 | 6/29/01 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 2.9 | 2.6 | 3.8 | 3.0 | 2.3 | 2.0 | 3.7 | 2.9 |
| EDI | 2.5 | 2.6 | 3.6 | 2.8 | 2.6 | 2.1 | 3.1 | 2.8 |
| WIL | 2.5 | 2.9 | 3.7 | 3.0 | 2.4 | 2.9 | 3.3 | 3.0 |

**2000 Spring/Summer Elemental Carbon Ambient Concentration Results**

| Location | 5/24/00 | 5/30/00 | 6/5/00 | 6/11/00 | 6/17/00 | 6/23/00 | 6/29/01 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 1.7 | 1.2 | 2.6 | 1.4 | 0.7 | 0.8 | 2.5 | 1.6 |
| EDI | 1.2 | 1.2 | 1.7 | 1.4 | 0.8 | 0.6 | 1.3 | 1.3 |
| WIL | 1.3 | 1.2 | 1.8 | 1.1 | 0.9 | 1.0 | 1.6 | 1.2 |

**2000 Spring/Summer Total Carbon Ambient Concentration Results**

| Location | 5/24/00 | 5/30/00 | 6/5/00 | 6/11/00 | 6/17/00 | 6/23/00 | 6/29/01 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 4.6 | 3.7 | 6.4 | 4.4 | 3 | 2.8 | 6.2 | 4.4 |
| EDI | 3.7 | 3.8 | 5.3 | 4.2 | 3.4 | 2.7 | 4.4 | 3.9 |
| WIL | 3.8 | 4.1 | 5.5 | 4.1 | 3.3 | 3.9 | 4.9 | 4.2 |

**1997 Spring/Summer $PM_{10}$ Ambient Concentration Results**

| Location | 5/4/97 | 5/8/97 | 5/12/97 | 5/14/97 | 5/20/97 | 5/22/97 | 5/27/97 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 48 | 50 | 36 | * | 32 | 39 | 58 | 44 |
| EDI | * | * | * | * | * | * | * | * |
| WIL | 43 | 50 | 35 | 42 | 30 | 36 | 48 | 41 |

LB Station

* No Sample

**1997 Spring/Summer Organic Carbon Ambient Concentration Results**

| Location | 5/20/97 | 5/22/97 | 5/27/97 | Average |
|---|---|---|---|---|
| HUD | 3.6 | 4.3 | 6.9 | 4.9 |
| EDI | * | * | * | * |
| WIL | 4.1 | 4.2 | 5.8 | 4.7 |

**1997 Spring/Summer Elemental Carbon Ambient Concentration Results**

| Location | 5/20/97 | 5/22/97 | 5/27/97 | Average |
|---|---|---|---|---|
| HUD | 2.3 | 2.4 | 5.4 | 3.4 |
| EDI | * | * | * | |
| WIL | 1.2 | 1.6 | 3.3 | 2.0 |

**1997 Spring/Summer Total Carbon Ambient Concentration Results**

| Location | 5/20/97 | 5/22/97 | 5/27/97 | Average |
|---|---|---|---|---|
| HUD | 5.9 | 6.7 | 12.3 | 8.3 |
| EDI | * | * | * | |
| WIL | 5.3 | 5.8 | 9.1 | 6.7 |

# APPENDIX A-1 LONG BEACH $PM_{10}$ MONITORING DATA (CONTINUED)

**2001 Fall/Winter $PM_{10}$ Ambient Concentration Results**

| Location | 11/8/00 | 11/14/00 | 11/20/00 | 11/26/00 | 12/2/00 | 12/8/00 | 12/14/00 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 40 | 62 | 97 | 39 | 36 | 76 | 86 | 62 |
| EDI | 24 | * | 105 | 33 | 33 | 63 | 72 | 55 |
| WIL | 16 | 43 | 47 | 37 | 25 | 75 | 70 | 45 |
| LB Station | 25 | 14 | 24 | 30 | 24 | 56 | * | 29 |

* No Sample

**2001 Fall/Winter Organic Carbon Ambient Concentration Results**

| Location | 11/8/00 | 11/14/00 | 11/20/00 | 11/26/00 | 12/2/00 | 12/8/00 | 12/14/00 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 5.6 | 12.9 | 10.9 | 9.7 | 6.9 | 16 | 17.2 | 11.3 |
| EDI | 3.3 | * | 8.8 | 8.7 | 7 | 13.9 | 15.9 | 9.6 |
| WIL | 2.9 | 9.2 | 6.9 | 9.4 | 4.7 | 15.5 | 13.5 | 8.9 |

**2001 Fall/Winter Elemental Carbon Ambient Concentration Results**

| Location | 11/8/00 | 11/14/00 | 11/20/00 | 11/26/00 | 12/2/00 | 12/8/00 | 12/14/00 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 5.2 | 7.8 | 7.1 | 4.7 | 4.6 | 8.4 | 9.7 | 6.8 |
| EDI | 2.3 | * | 4.3 | 3.8 | 3.3 | 5.5 | 6.6 | 4.3 |
| WIL | 1.4 | 4.2 | 2.7 | 4.1 | 1.8 | 6.2 | 5.4 | 3.7 |

**2001 Fall/Winter Total Carbon Ambient Concentration Results**

| Location | 11/8/00 | 11/14/00 | 11/20/00 | 11/26/00 | 12/2/00 | 12/8/00 | 12/14/00 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 10.8 | 20.7 | 18 | 14.4 | 11.5 | 24.4 | 26.9 | 18.1 |
| EDI | 5.6 | * | 13.1 | 12.5 | 10.3 | 19.4 | 22.5 | 13.9 |
| WIL | 4.3 | 13.4 | 9.6 | 13.5 | 6.5 | 21.7 | 18.9 | 12.6 |

**2000 Fall/Winter $PM_{10}$ Ambient Concentration Results**

| Location | 11/8/00 | 11/14/00 | 11/20/00 | 11/26/00 | 12/2/00 | 12/8/00 | 12/14/00 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 134 | 56 | 143 | 73 | 100 | 28 | 43 | 82 |
| EDI | 52 | 48 | 78 | 73 | 105 | 18 | 37 | 59 |
| WIL | 56 | 45 | 55 | 65 | 93 | 16 | 37 | 52 |
| LB Station | 44 | 49 | 92 | * | 105 | 20 | 35 | 58 |

* No Sample

**2000 Fall/Winter Organic Carbon Ambient Concentration Results**

| Location | 11/8/00 | 11/14/00 | 11/20/00 | 11/26/00 | 12/2/00 | 12/8/00 | 12/14/00 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 17.1 | 10.6 | 22.6 | 9 | 9.2 | 4.6 | 8.7 | 11.7 |
| EDI | 8.9 | 9.7 | 15.4 | 7.6 | 10.2 | 2.8 | 7.8 | 8.9 |
| WIL | 10.5 | 9.7 | 10.9 | 7 | 8.1 | 2.9 | 7.2 | 8.0 |

**2000 Fall/Winter Elemental Carbon Ambient Concentration Results**

| Location | 11/8/00 | 11/14/00 | 11/20/00 | 11/26/00 | 12/2/00 | 12/8/00 | 12/14/00 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 7.6 | 6.4 | 11.6 | 4.8 | 4.6 | 3.7 | 3.6 | 6.0 |
| EDI | 3.8 | 4.1 | 7.4 | 4.3 | 3.3 | 2 | 2.1 | 3.9 |
| WIL | 4.6 | 4.1 | 5.1 | 3.8 | 3.6 | 1.7 | 2.9 | 3.7 |

**2000 Fall/Winter Total Carbon Ambient Concentration Results**

| Location | 11/8/00 | 11/14/00 | 11/20/00 | 11/26/00 | 12/2/00 | 12/8/00 | 12/14/00 | Average |
|---|---|---|---|---|---|---|---|---|
| HUD | 24.7 | 17 | 34.2 | 13.8 | 13.8 | 8.3 | 12.3 | 17.7 |
| EDI | 12.7 | 13.8 | 22.8 | 11.9 | 13.5 | 4.8 | 9.9 | 12.8 |
| WIL | 15.1 | 13.8 | 16 | 10.8 | 11.7 | 4.6 | 10.1 | 11.7 |

**1999 Fall/Winter $PM_{10}$ Ambient Concentration Results**

| Location | 11/2/99 | 11/8/99 | 11/14/99 | 11/20/99 | 11/26/99 | 12/2/99 | 12/8/99 | 12/14/99 | Average |
|---|---|---|---|---|---|---|---|---|---|
| HUD | 92 | 38 | 50 | 30 | 47 | 69 | 68 | 171 | 71 |
| EDI | 85 | 33 | 47 | 37 | 49 | 74 | 93 | 97 | 64 |
| WIL | 92 | 89 | 46 | 30 | 65 | 70 | * | 87 | 68 |
| LB Station | 77 | 22 | 38 | 27 | 38 | 50 | 55 | 59 | 46 |

* No Sample

**1999 Fall/Winter Organic Carbon Ambient Concentration Results**

| Location | 11/2/99 | 11/8/99 | 11/14/99 | 11/20/99 | 11/26/99 | 12/2/99 | 12/8/99 | 12/14/99 | Average |
|---|---|---|---|---|---|---|---|---|---|
| HUD | 9.9 | 6 | 6 | 4.5 | 11 | 13.3 | 10.4 | 22.2 | 10.4 |
| EDI | 8.3 | 4.8 | 5.8 | 4.9 | 10.5 | 14.1 | 13.4 | 14.2 | 9.5 |
| WIL | 8.1 | 14.1 | 6.4 | 4.4 | 12.6 | 13.5 | * | 12.2 | 10.2 |

**1999 Fall/Winter Elemental Carbon Ambient Concentration Results**

| Location | 11/2/99 | 11/8/99 | 11/14/99 | 11/20/99 | 11/26/99 | 12/2/99 | 12/8/99 | 12/14/99 | Average |
|---|---|---|---|---|---|---|---|---|---|
| HUD | 7.9 | 4.1 | 4.8 | 2.7 | 5.9 | 7.9 | 6.6 | 17.8 | 7.2 |
| EDI | 5.7 | 2.6 | 4 | 2.7 | 4.6 | 6.1 | 6.1 | 8.5 | 5.0 |
| WIL | 6 | 6.7 | 4.1 | 2.4 | 7.4 | 5.5 | * | 7.2 | 5.6 |

**1999 Fall/Winter Total Carbon Ambient Concentration Results**

| Location | 11/2/99 | 11/8/99 | 11/14/99 | 11/20/99 | 11/26/99 | 12/2/99 | 12/8/99 | 12/14/99 | Average |
|---|---|---|---|---|---|---|---|---|---|
| HUD | 17.8 | 10.1 | 10.8 | 7.2 | 16.9 | 21.2 | 17 | 40 | 17.6 |
| EDI | 14 | 7.4 | 9.8 | 7.6 | 15.1 | 20.2 | 19.5 | 22.6 | 14.5 |
| WIL | 14.1 | 20.8 | 10.5 | 6.8 | 20 | 19 | * | 19.4 | 15.8 |

**1998 Fall/Winter $PM_{10}$ Ambient Concentration Results**

| Location | 11/1/98 | 11/7/98 | 11/13/98 | 11/19/98 | 11/25/98 | 12/13/98 | Average |
|---|---|---|---|---|---|---|---|
| HUD | 61 | 56 | 72 | 89 | * | 55 | 67 |
| EDI | 50 | 49 | 67 | 73 | 74 | 55 | 61 |
| WIL | 54 | 43 | 45 | 52 | 70 | 33 | 50 |
| LB Station | 43 | 31 | 39 | 54 | * | 27 | 39 |

* No Sample

**1998 Fall/Winter Organic Carbon Ambient Concentration Results**

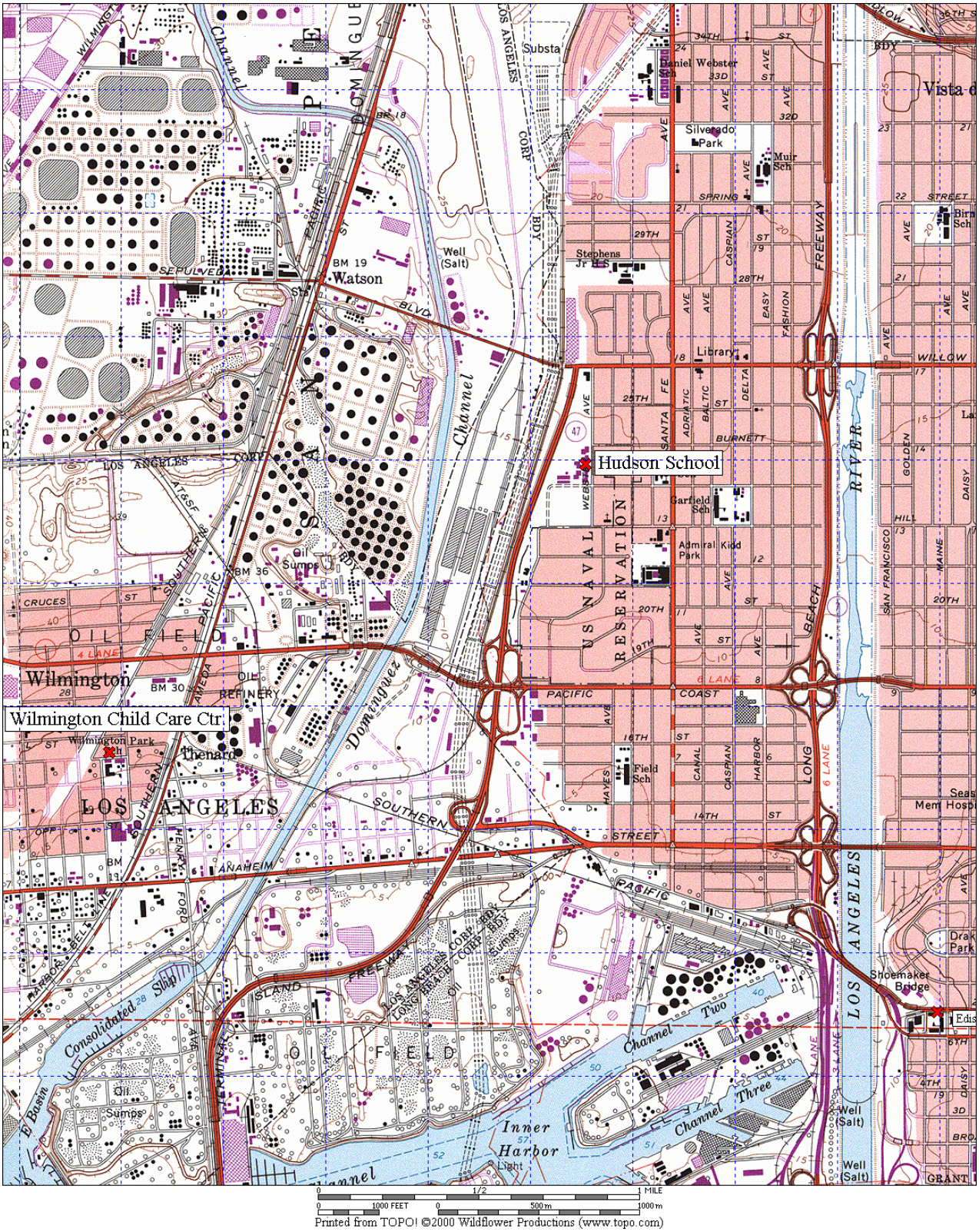
| Location | 11/1/98 | 11/7/98 | 11/13/98 | 11/19/98 | 11/25/98 | 12/13/98 | Average |
|---|---|---|---|---|---|---|---|
| HUD | 7.5 | 6.4 | 11.2 | 14.2 | * | 8.6 | 9.6 |
| EDI | 7 | 5.5 | 11.3 | 10.4 | 9.3 | 10.1 | 8.9 |
| WIL | 6.9 | 5.7 | 8.4 | 8.3 | 9.9 | 5.8 | 7.5 |

**1998 Fall/Winter Elemental Carbon Ambient Concentration Results**

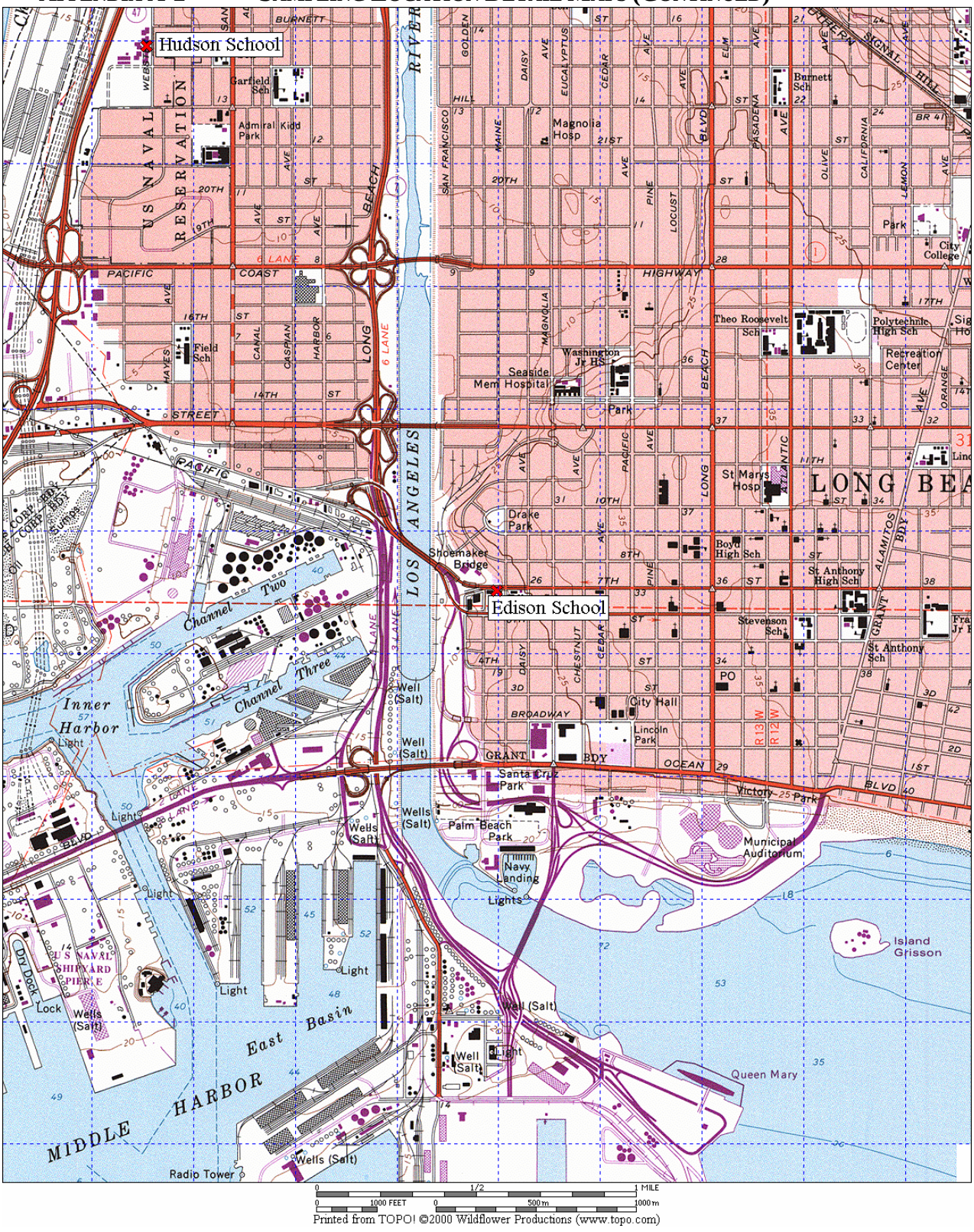
| Location | 11/1/98 | 11/7/98 | 11/13/98 | 11/19/98 | 11/25/98 | 12/13/98 | Average |
|---|---|---|---|---|---|---|---|
| HUD | 6.2 | 6.2 | 16.6 | 19.8 | * | 8.9 | 11.5 |
| EDI | 4.3 | 3.3 | 9.2 | 12.5 | 7.9 | 5.8 | 7.2 |
| WIL | 4.1 | 3.8 | 5.9 | 7.3 | 6.6 | 3.4 | 5.2 |

**1998 Fall/Winter Total Carbon Ambient Concentration Results**

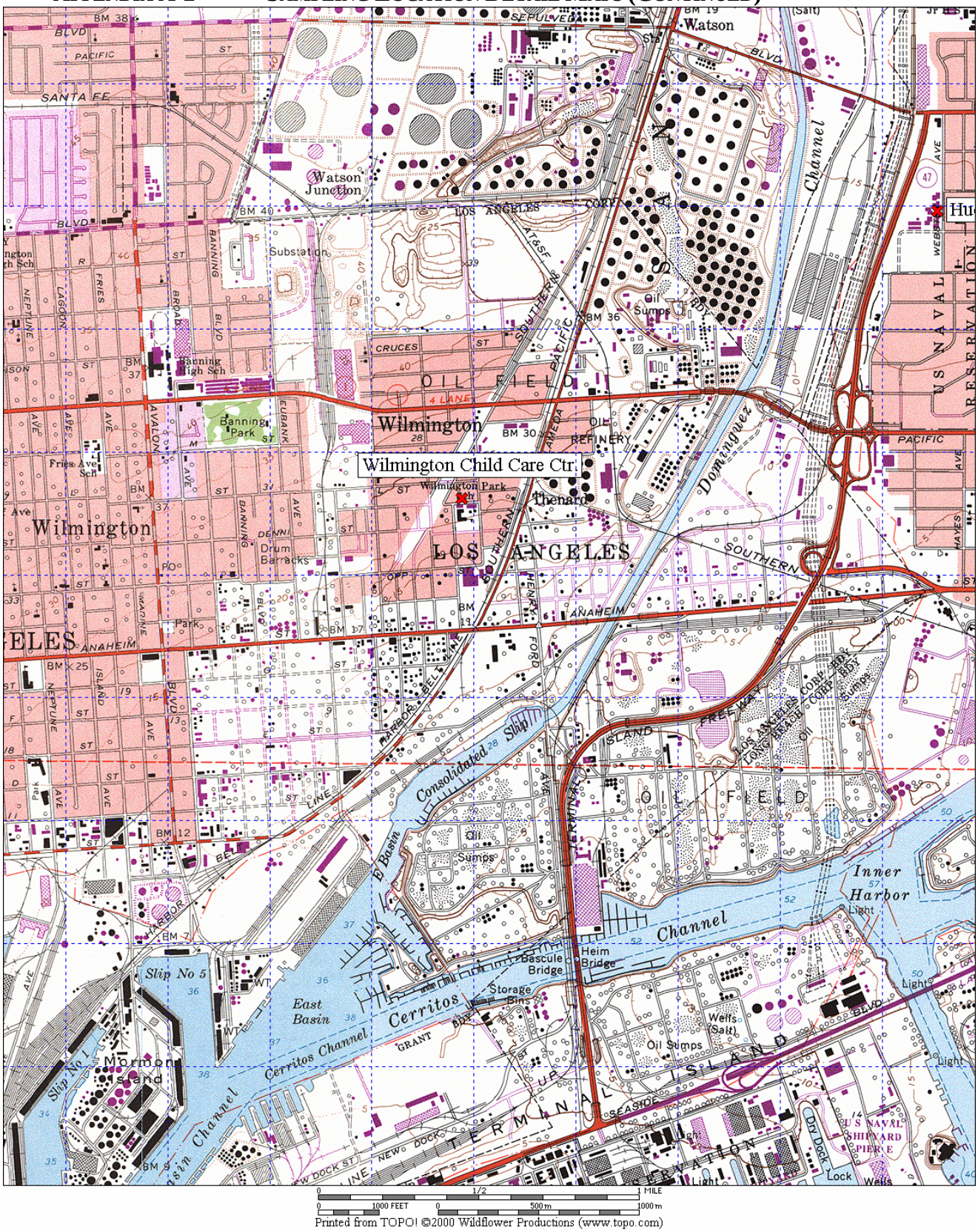
| Location | 11/1/98 | 11/7/98 | 11/13/98 | 11/19/98 | 11/25/98 | 12/13/98 | Average |
|---|---|---|---|---|---|---|---|
| HUD | 13.7 | 12.6 | 27.9 | 34 | * | 17.5 | 21.1 |
| EDI | 11.3 | 8.8 | 20.5 | 22.9 | 17.2 | 15.9 | 16.1 |
| WIL | 11 | 9.4 | 14.4 | 15.6 | 16.5 | 9.2 | 12.7 |



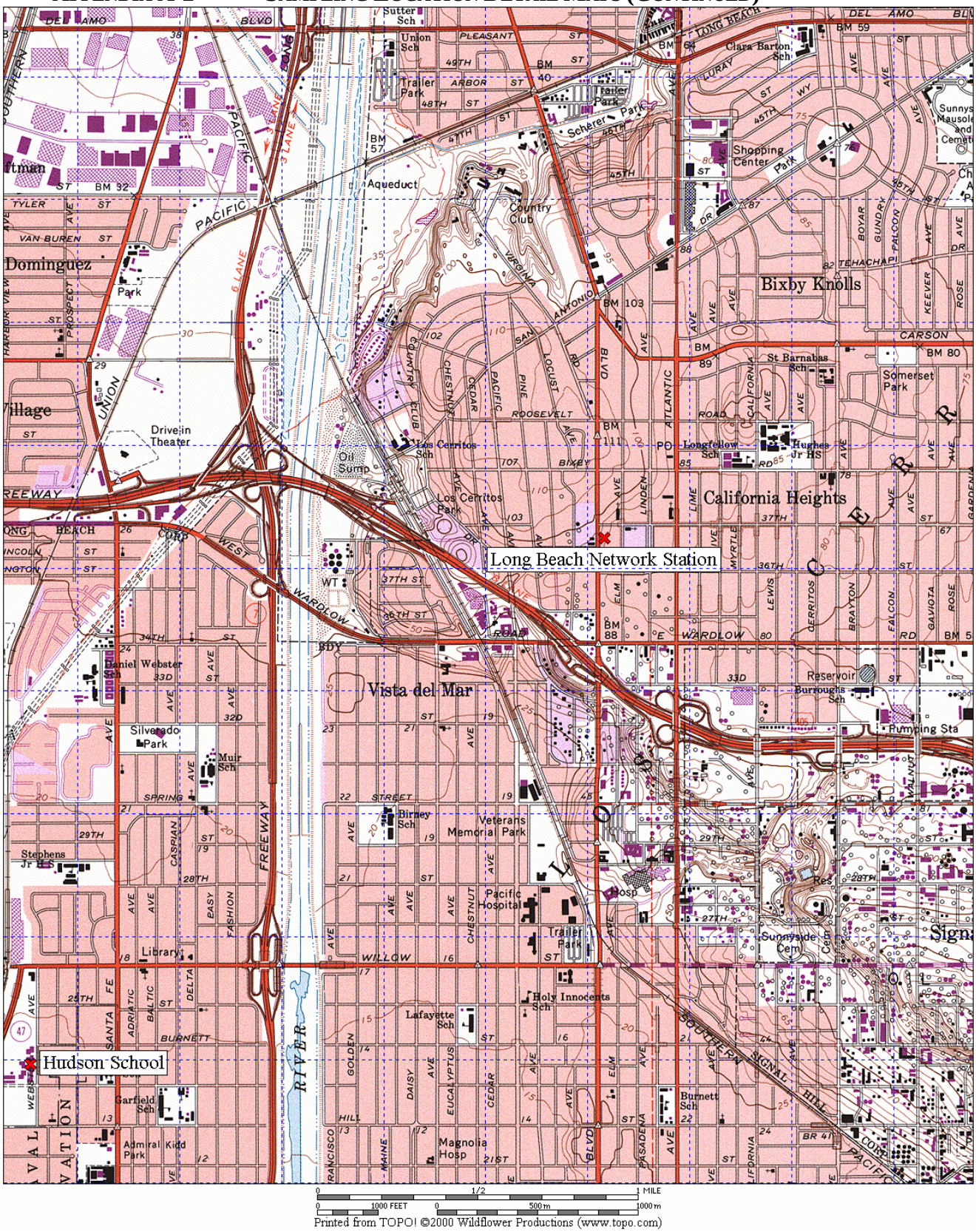

**Hudson School and Surrounding Area**




**Edison School and Surrounding Area**




**Wilmington Childcare Center and Surrounding Area**




**Long Beach Station and Surrounding Area**