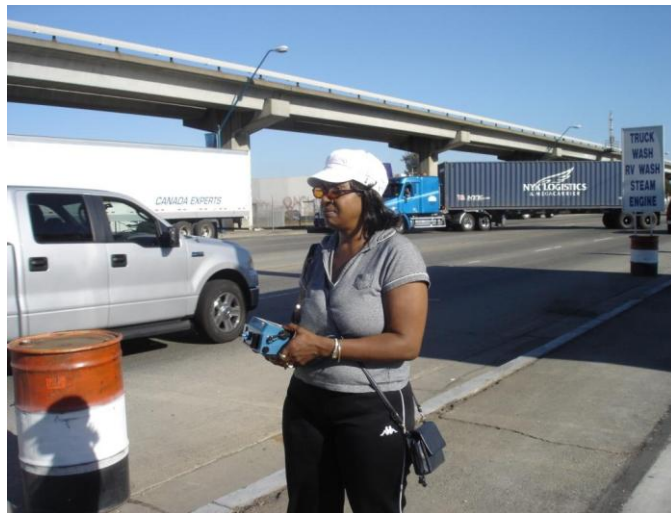


# East Oakland Particulate Matter 2.5 Community-based Air Monitoring Research Report



Communities for a Better Environment  
September 2010  
[www.cbecal.org](http://www.cbecal.org)

## **Acknowledgements**

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The air monitoring study and data analysis was made possible by our academic partners – Bill Jesdale, Rachel Morello-Frosch, Manuel Pastor and James Sadd and equipment borrowed from the California Air Resources Board. CBE is responsible for all findings and conclusions of the report.

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## Introduction

East Oakland has a childhood asthma hospitalization rate 150 to 200% higher than Alameda County as a whole, and life expectancy in East Oakland for the years 2000 to 2003 was 72.0 years, which was 6.9 years lower than Alameda County as a whole<sup>1</sup>. Air pollution from busy roadways, which is made up of many compounds and chemicals, including particulate matter, are linked both to increased childhood asthma, impaired lung function, allergies, heart disease and mortality<sup>2</sup>. East Oakland residents have been shown to be heavily impacted by industrial stationary and mobile sources of air pollution located near homes, schools, recreation centers, and churches<sup>3</sup>.

PM can come from diesel emissions and industrial facilities directly and from chemical reactions in the atmosphere due to the influence of the sun. PM is a mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small that they can only be detected with a microscope. Black soot, dust and smoke are particles that we can see with our eyes. People who live near busy roadways will often see black soot on the sides of their homes and on window sills. There are smaller particles as well, such as Particulate Matter 2.5 microns and smaller (PM 2.5), that can go deep into a person's lungs.

In 2008, CBE conducted a community-based air monitoring project in East Oakland of PM 2.5 to see the air quality impacts of diesel truck emissions and industrial activities nearby and in residential areas. The study was done in partnership with Rachel Morello-Frosch and Bill Jesdale.

### What we did



In fall 2008, we used TSI DustTrak 8520 Aerosol Particulate Monitors<sup>4</sup> – handheld air monitors borrowed from the California Air Resources Board – and handheld GPS units to measure concentrations of PM 2.5 in the air. The units of measurement of PM 2.5 were mg/ m<sup>3</sup>.

The DustTrak, in the picture to the left, is a rectangular, battery-operated machine that can be carried around on the shoulder while it takes measurements of the air. It gives a real-time digital readout with a built-in data logger. A pump draws the air sample through the inlet (black nozzle), which we fitted with a 2.5 micron filter to capture particles of that size. Inside the DustTrak, the sample enters an optics chamber where PM 2.5 is measured using a laser

<sup>1</sup> Alameda County Public Health Department. October 2005. Community Information Book Update: East Oakland.

<sup>2</sup> Krewski, D; et al. June 2009. *Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality*. Health Effects Institute.

<sup>3</sup> Lee, Anna Y. September 2008. Cumulative Impacts in East Oakland: Findings from a community-based mapping study. Communities for a Better Environment. Available for download at: [http://www.cbecal.org/pdf/cumulative\\_impacts\\_finalFULL.pdf](http://www.cbecal.org/pdf/cumulative_impacts_finalFULL.pdf)

<sup>4</sup> Information on DustTraks can be found online at: [http://www.raeco.com/products/particulate/tsi\\_dusttrak.html](http://www.raeco.com/products/particulate/tsi_dusttrak.html)

photometer and the data is stored internally. It is reliable and requires little maintenance. The person taking the measurement only has to record the date, time and location separately.

CBE staff and members and community members received a full-day of training from our academic partners, Rachel Morello-Frosch and Bill Jesdale (UC Berkeley School of Public Health), on particulate matter, health impacts, study methods and how to use the equipment. CBE staff members were involved in the design of the project, co-created materials, organized participants, formed and coordinated groups, created schedules, and handled day-to-day operational oversight. CBE staff and members, East Oakland residents and Merritt College students were involved in PM 2.5 monitoring. Our academic partners downloaded and analyzed the data from DustTrak monitors.



Rachel Morello-Frosch at community training.

CBE members agreed to prioritize four general areas to monitor in East Oakland (See Figures 1 and 2):

- San Leandro Street between 81<sup>st</sup> and 85<sup>th</sup> Avenues, 94621 where diesel trucks park and American Brass & Iron Foundry (red push pins to the West).
- Grass Valley Elementary School in the Oakland Hills (4720 Dunkirk Avenue, 94605) (also in red push pins, but situated east of I-580) to compare to the flatland locations;
- Around 77<sup>th</sup> Ave and Hawley Ave, 94621 where industry is right next to residences “Rakha Autobody/ residential” (yellow push pins);
- Tassafaronga Recreation Center (975 – 85<sup>th</sup> Ave, 94621) (green push pins), and
- ACORN Woodland Elementary and EnCompass Academy (1025 - 81<sup>st</sup> Ave, 94621), Allen Temple Baptist Church (8501 International Blvd, 94621), Rise Community School and New Highland Academy (8521 A Street, 94621) (orange push pins).



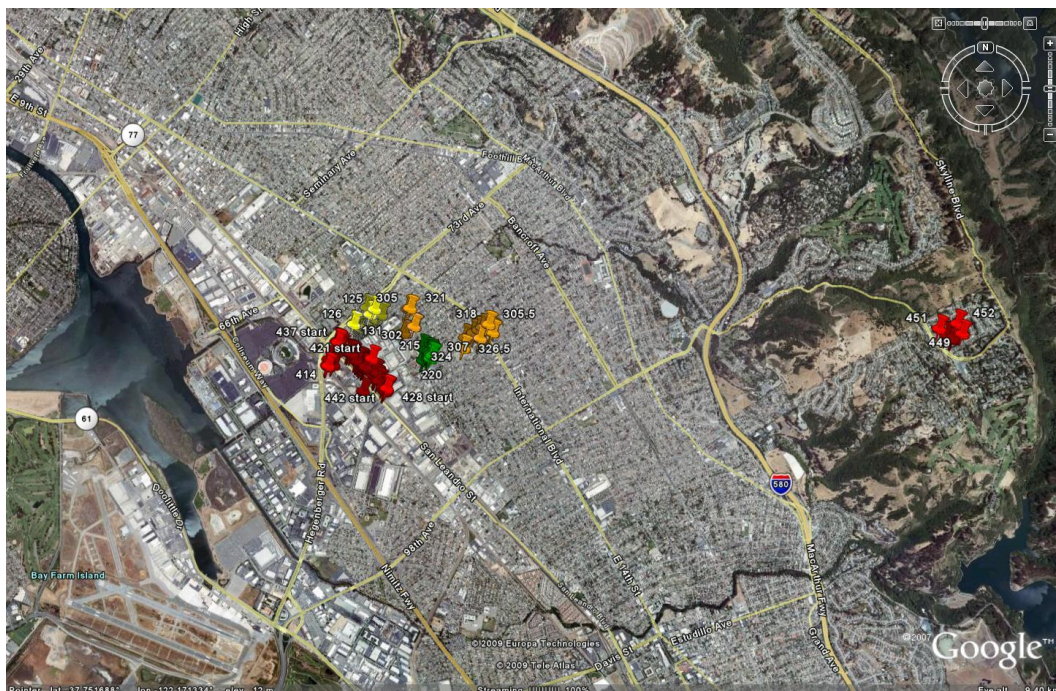


Figure 1. Map of East Oakland PM 2.5 air monitoring sites including Grass Valley Elementary. The yellow push pins mark Rakha Autobody/ residential. The green push pins show Tassafaronga Recreation Center. The orange push pins are where Allen Temple Baptist Church, New Highland Academy, Rise Community School, Acorn Woodland Elementary and Encompass Academy are located; and finally, the red push pins show San Leandro Street and American Brass & Iron Foundry.

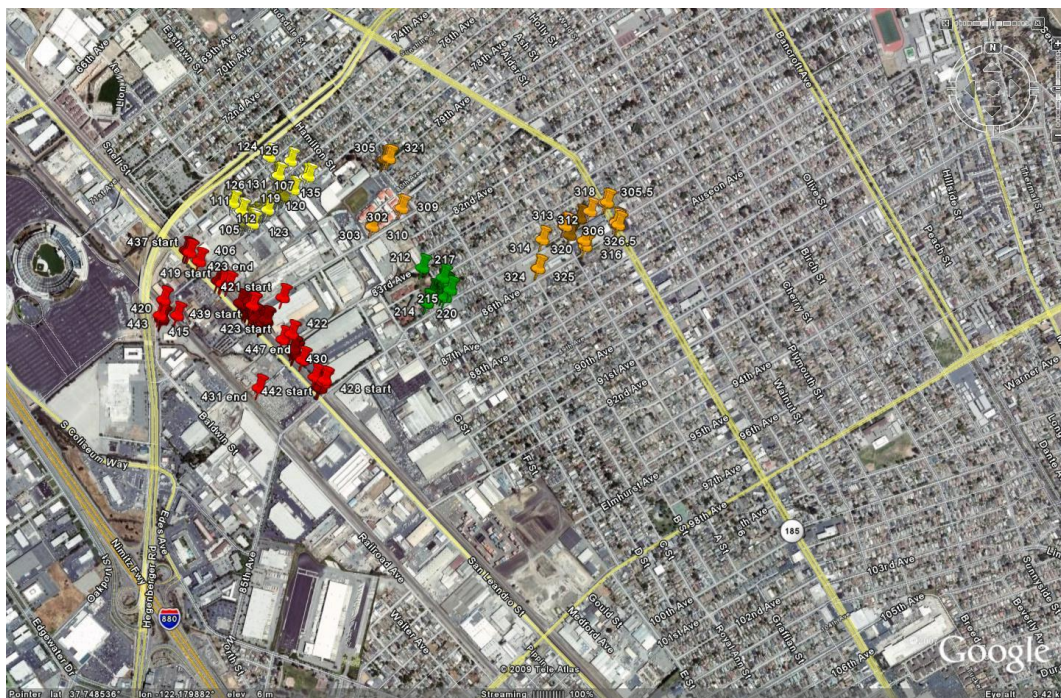


Figure 2. Map of East Oakland PM 2.5 monitoring sites excluding Grass Valley Elementary. Push pins are the same locations as in Figure 1.



Each group of about 3 to 4 people monitored one location over 3 weeks with samples on weekday mornings, afternoons and on the weekends. Ideally, each site was sampled for 10 minutes, 3 times per visit. Each site received 3 visits per time of day on weekdays, and one weekend visit to compare to non-business hours (See Appendix). Time commitments ranged with people's availability, but most people committed about 10 hours of time over the course of the training and data collection. Planning and conducting the study took approximately 3 months. PM measurements are affected by humidity, so the timing of measurements was critical. All measurements were taken early October - early November to avoid the effects of the rainy season. And in fact, no rain occurred during monitoring.



One group of CBE members and Merritt students practicing to use DustTrak air monitor and GPS device.

## **What We Found**

The results showed extremely high levels of PM 2.5 in East Oakland, higher than state and federal standards, highlighting the need for stricter regulations to protect the health of communities most impacted by poor air quality. (See Appendix).

## PM<sub>2.5</sub> measurements from 5 East Oakland sites, Oct 7 - Nov 8, 2008

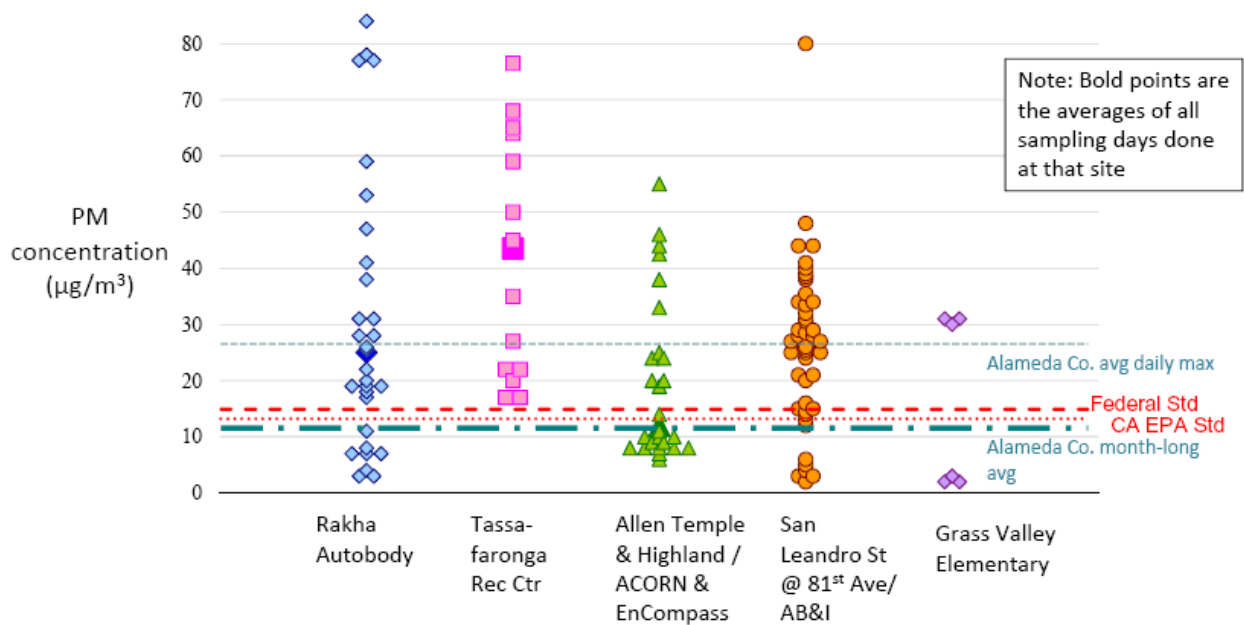


Figure 3. PM<sub>2.5</sub> measurements from 5 East Oakland sites, October 7-November 8, 2008. Each site is represented by a colored shape (left to right, x-axis): Rakha Auto Repair shop/ residential (blue diamond); Tassafaronga Recreation Center (pink squares); Allen Temple Baptist Church/ Highland Elementary/ ACORN Woodland Elementary/ Encompass Academy/ (green triangle); San Leandro street/ AB&I (orange circle); and Grass Valley Elementary (purple diamond). Each emblem indicates the average concentration measured on a day of measurement. The average concentration of particulate matter per day increases with placement on the graph vertically (y-axis). The horizontal lines represent the Alameda County average daily maximum (higher blue dashed line, 27  $\mu\text{g}/\text{m}^3$ ) and the month-long average (blue line, 11  $\mu\text{g}/\text{m}^3$ ); the U. S. EPA (EPA, 15  $\mu\text{g}/\text{m}^3$ ) and the California EPA annual standard (red line, 12  $\mu\text{g}/\text{m}^3$ ).

The highest points represent the highest PM<sub>2.5</sub> measurements at that East Oakland site (See Figure 3). Compared to the Alameda County average daily maximum (higher blue dashed line, 27  $\mu\text{g}/\text{m}^3$ ) during that time period, East Oakland had significantly higher PM<sub>2.5</sub> measurements (see highest points for each colored shape). Rakha/ residential reached the highest measurements (84  $\mu\text{g}/\text{m}^3$ ), followed by San Leandro St (80  $\mu\text{g}/\text{m}^3$ ); Tassafaronga Recreation Center (77  $\mu\text{g}/\text{m}^3$ ); and Allen Temple/ Highland/ Acorn and Encompass (55  $\mu\text{g}/\text{m}^3$ ). Grass Valley Elementary (purple dots) had significantly lower measurements for PM<sub>2.5</sub> than the other East Oakland sites (2 to 31  $\mu\text{g}/\text{m}^3$ ), but reached slightly above the Alameda County daily maximum.

The averages at each site over the 3-4 weeks of monitoring are the bold points for each different colored shape. The sites had average PM<sub>2.5</sub> measurements higher than the Alameda County monthly average (thick, dashed blue line, 11  $\mu\text{g}/\text{m}^3$ ). The highest average was for Tassafaronga Recreation Center (44  $\mu\text{g}/\text{m}^3$ ), followed by San Leandro St/ AB&I (27  $\mu\text{g}/\text{m}^3$ ); then Rakha/ residential (25  $\mu\text{g}/\text{m}^3$ ); Grass Valley elementary (17  $\mu\text{g}/\text{m}^3$ ); and slightly higher for Allen Temple/ Highland/ Acorn-Encompass (12  $\mu\text{g}/\text{m}^3$ ).

# PM<sub>2.5</sub> weekday measurements from 5 East Oakland sites, Oct 7 - Nov 8, 2008

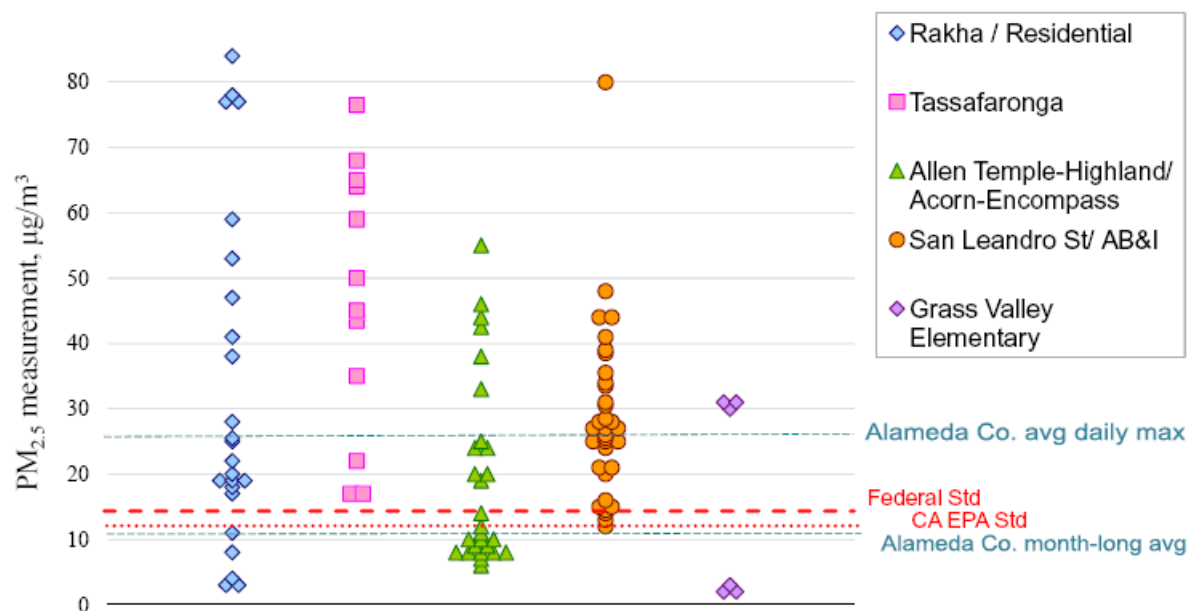


Figure 4. PM 2.5 *weekday-only* measurements from 5 East Oakland sites, October 7-November 8, 2008.

As in Figure 3, each site is represented by a colored shape. Compared to the Alameda County average daily maximum (higher blue dashed line, 27  $\mu\text{g}/\text{m}^3$ ) during that time period, East Oakland had significantly higher PM 2.5 measurements for weekday monitoring (see the highest points for each different colored shape in Figure 4). Rakha/ residential had the highest measurements reaching 84  $\mu\text{g}/\text{m}^3$ ; followed by San Leandro St at 80  $\mu\text{g}/\text{m}^3$ ; then Tassafaronga Recreation Center at 77  $\mu\text{g}/\text{m}^3$ ; and Allen Temple & Highland Elementary at 55  $\mu\text{g}/\text{m}^3$ . Grass Valley Elementary had significantly lower measurements for PM 2.5 than the other East Oakland sites (highest measured at 31  $\mu\text{g}/\text{m}^3$ ), but was above the Alameda County daily maximum.



## PM<sub>2.5</sub> weekend measurements from 5 East Oakland sites, Oct 7 - Nov 8, 2008

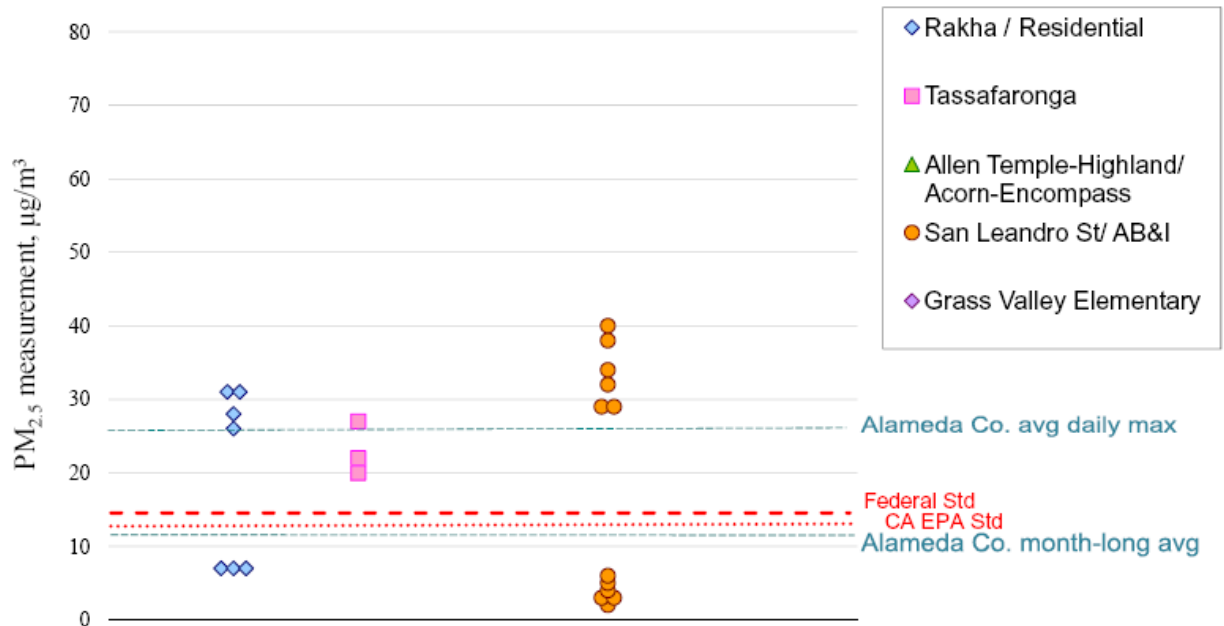


Figure 5. PM 2.5 *weekend-only* measurements from 5 East Oakland sites, October 7-November 8, 2008.

As with Figures 3 and 4, each site is represented by a different colored shape in Figure 5 (left to right, x-axis). However, Allen Temple Baptist Church/ Highland Elementary/ ACORN Woodland Elementary/ Encompass Academy and Grass Valley Elementary are omitted. These sites have measurements that exceed the Alameda County average daily maximum (higher blue dashed line, 27 µg/m<sup>3</sup>) during that time period and the Federal and CA EPA standards (15 and 12 µg/m<sup>3</sup>, respectively). San Leandro St/AB & I reached the highest measurements for PM 2.5 (40 µg/m<sup>3</sup>), followed by Rakha/ residential (31 µg/m<sup>3</sup>); then Tassafaronga Recreation Center (27 µg/m<sup>3</sup>). The three sites have ranges of PM 2.5 measurements close in range to each other on the weekend. The averages all exceeded the Alameda Co. month-long average. Rakha/ residential had the highest average (26 µg/m<sup>3</sup>, n=7); then Tassafaronga Recreation Center (22 µg/m<sup>3</sup>, n=3); and San Leandro St/AB & I (18 µg/m<sup>3</sup>, n=12).

## PM<sub>2.5</sub> weekday morning measurements from 5 East Oakland sites, Oct 7 - Nov 8, 2008



Figure 6. PM 2.5 *weekday morning* measurements from 5 East Oakland sites, October 7- November 8, 2008.

As with Figures 3-5, each site is represented by a different colored shape in Figure 6. These sites have measurements for PM 2.5 that exceed the Alameda County average daily maximum (27  $\mu\text{g}/\text{m}^3$ ) during that time period and the Federal and CA EPA standards (15 and 12  $\mu\text{g}/\text{m}^3$ , respectively). San Leandro St/AB & I reached the highest measurements (80  $\mu\text{g}/\text{m}^3$ ), followed by Tassafaronga Recreation Center (77  $\mu\text{g}/\text{m}^3$ ); then Rakha Autobody/ residential (77  $\mu\text{g}/\text{m}^3$ ); then Allen Temple/ Highland/ Acorn/Encompass (55  $\mu\text{g}/\text{m}^3$ ); and Grass Valley (3  $\mu\text{g}/\text{m}^3$ ). The averages all exceeded the Alameda Co. month-long average except Grass Valley. Tassafaronga Recreation Center had the highest weekday morning average (57  $\mu\text{g}/\text{m}^3$ , n=6); then Allen Temple/ Highland/ Acorn/ Encompass (43  $\mu\text{g}/\text{m}^3$ , n=7); then San Leandro St/AB & I (34  $\mu\text{g}/\text{m}^3$ , n=13); then Rakha/ residential (33  $\mu\text{g}/\text{m}^3$ , n=14); and Grass Valley (2; n=3).

## PM<sub>2.5</sub> weekday afternoon measurements from 5 East Oakland sites, Oct 7 - Nov 8, 2008

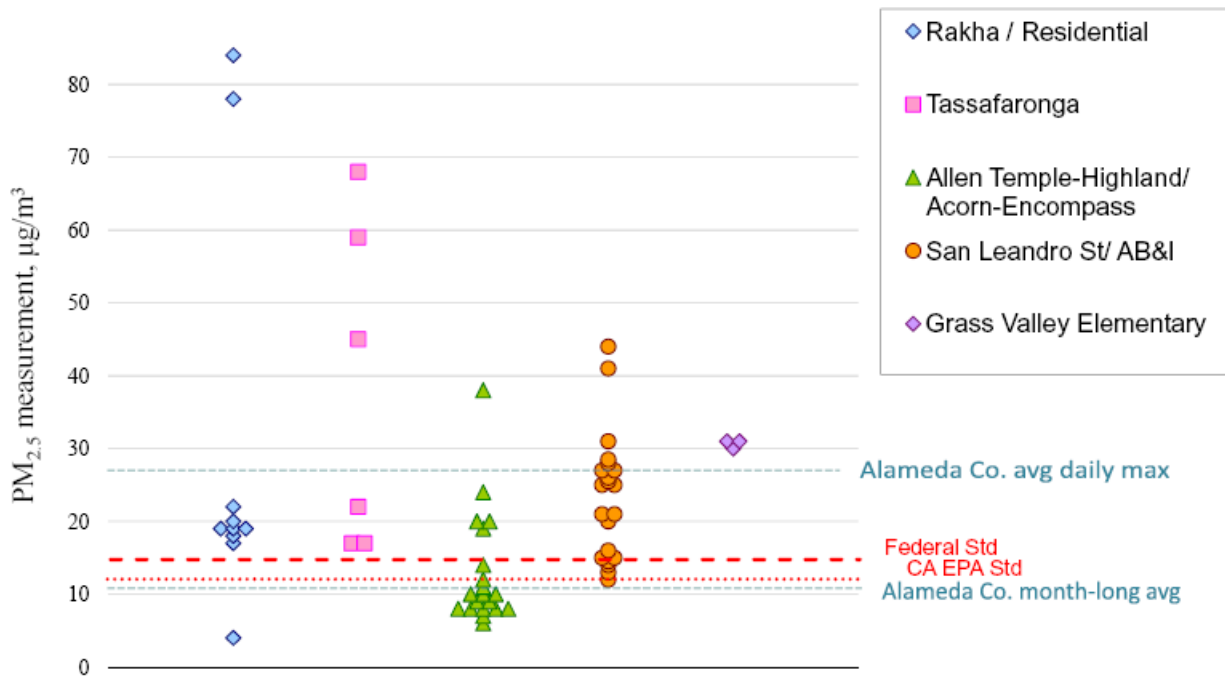


Figure 7. PM<sub>2.5</sub> weekday afternoon measurements from 5 East Oakland sites, October 7-November 8, 2008.

As with Figures 3-6, each site is represented by a different colored shape in Figure 7. All of these sites have weekday afternoon measurements that exceed the Alameda County average daily maximum (27 µg/m<sup>3</sup>) during that time period and the Federal and CA EPA standards (15 and 12 µg/m<sup>3</sup>, respectively). Rakha Autobody/ residential reached the highest measurement of PM<sub>2.5</sub> (84 µg/m<sup>3</sup>); then Tassafaronga Recreation Center (68 µg/m<sup>3</sup>); followed by San Leandro St/AB & I (44 µg/m<sup>3</sup>), then Allen Temple/ Highland/ Acorn/ Encompass (38 µg/m<sup>3</sup>); and Grass Valley (31 µg/m<sup>3</sup>). Most of the weekday afternoon averages exceeded the Alameda Co. month-long average except Rakha Autobody/ residential and Allen Temple/ Highland/ Acorn/ Encompass. Tassafaronga Recreation Center had the highest weekday afternoon average (34 µg/m<sup>3</sup>, n=6); then Grass Valley (31; n=3); then San Leandro St/AB & I (25 µg/m<sup>3</sup>, n=21); then Rakha/ residential (19 µg/m<sup>3</sup>, n=10); and Allen Temple/Highland/Acorn/Encompass (10 µg/m<sup>3</sup>, n=20).

### Personal Experiences While Monitoring

In our debriefing session with the study participants, people shared their personal experiences and talked about a many different environmental and public health issues they observed during



sampling. Some of the sites had buckets of illegal dumped oil on the street for over a week, trash, mattresses, even a scooter lying in the middle of the street. Some participants experienced burning eyes, a change in and difficulty breathing, sneezing, feeling light-headed and very tired after visits, and knowing they could not stay long. Participants conducting monitoring at Acorn Elementary School and Encompass Academy noted foul smells and illegal dumping near the monitoring site. People suspected illegal activities were occurring at the auto-body shops. Some were surprised to see that there are no buffers between the industrial businesses and residences. Someone was surprised to see children playing at Tassafaronga Recreation Center while diesel trucks passed by. We met some long-time residents in the community who carry a lot of history and have stories of being exposed to air pollutants their whole lives growing up in the community.



Homes across the street from industrial businesses near 77<sup>th</sup> Ave and Hawley.

## Conclusions

Local air monitoring in East Oakland shows high levels of PM 2.5 for people living close to and workers in industrial areas and high diesel truck traffic corridors. The DustTraks do not pinpoint the exact source of PM 2.5. The results also suggest that residents of the flatlands East Oakland may be exposed to higher levels of PM 2.5 than residents of Alameda County on average, and specifically to higher levels than residents in the Oakland Hills.

PM 2.5 measurements at all four East Oakland flatland sites reached levels two to three times higher than measurements from Alameda County air monitoring stations over a similar time period. The averages at three sites were up to four times the Alameda County average; one site was somewhat similar to the Alameda County average. All four sites in the Hegenberger

Corridor reached levels higher than the California EPA standard. The flatland sites reached levels 2.5 times higher than the school in the Oakland Hills.

Follow-up and long-term air monitoring and investigating high contributor sources should be conducted. Because asthma and premature death statistics for East Oakland suggest that these communities are already suffering the impacts of elevated PM levels, developing and implementing a plan to mitigate and reduce the high levels of PM in East Oakland should be done immediately, involving broad stakeholders with the most impacted community at the decision-making table.

## Appendix

The following figures detail the locations of air monitoring samples.

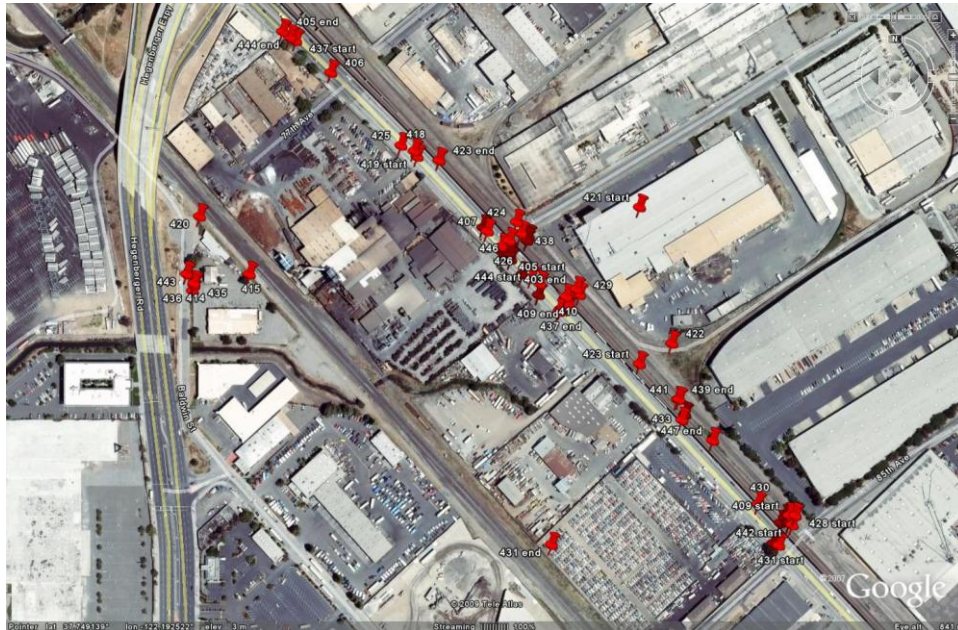


Figure 8. PM 2.5 monitoring locations near diesel trucks along San Leandro Street and around AB&I Foundry.



Figure 9. PM 2.5 air monitoring locations around 77<sup>th</sup> and Hawley Streets – Rakha Autobody, Jefferson-Smurfit and nearby residences.



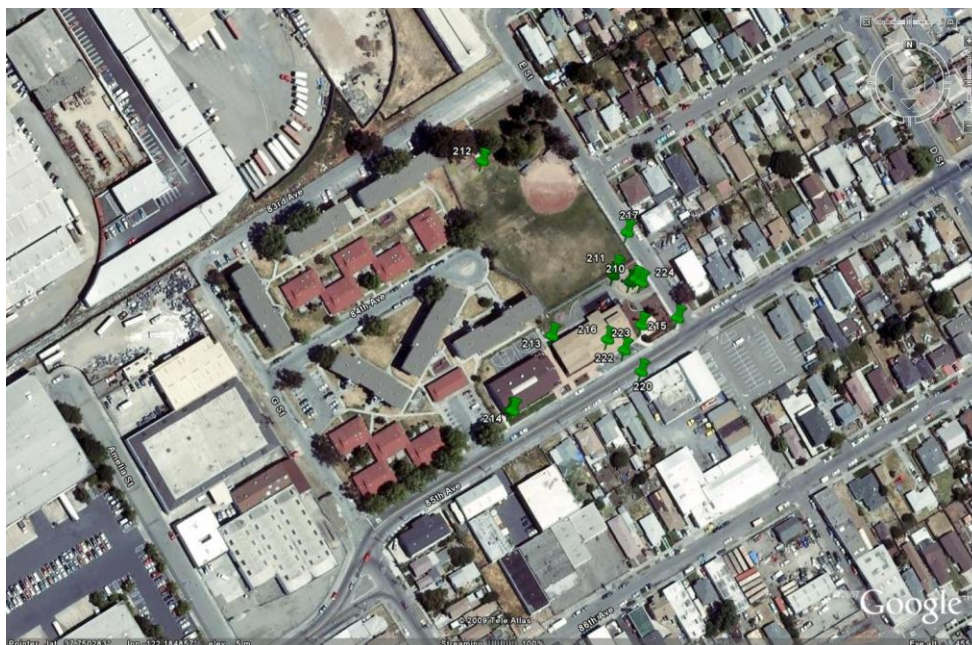


Figure 10. PM 2.5 air monitoring locations at Tassafaronga Recreation Center

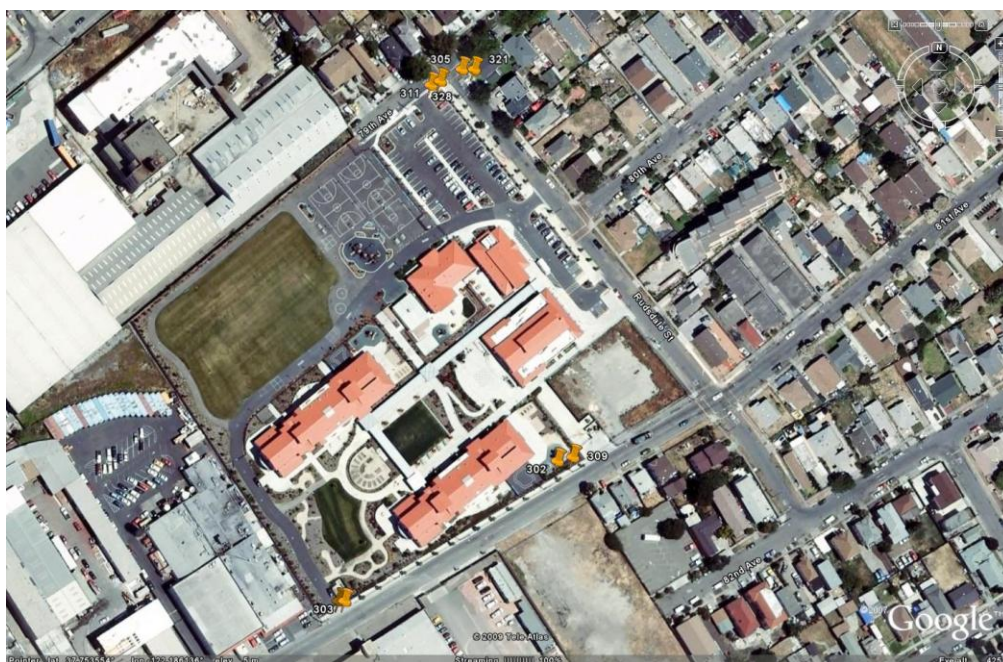


Figure 11. PM 2.5 air monitoring locations at ACORN Woodland Elementary School and EnCompass Academy.



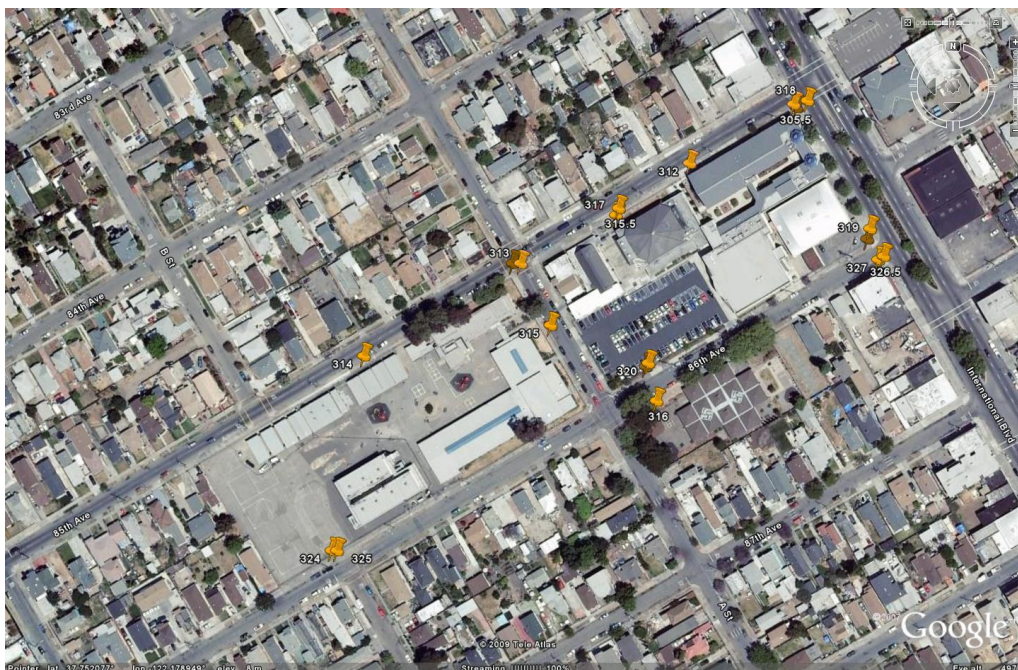


Figure 12. PM 2.5 air monitoring locations at Allen Temple Baptist Church and Highland Elementary.

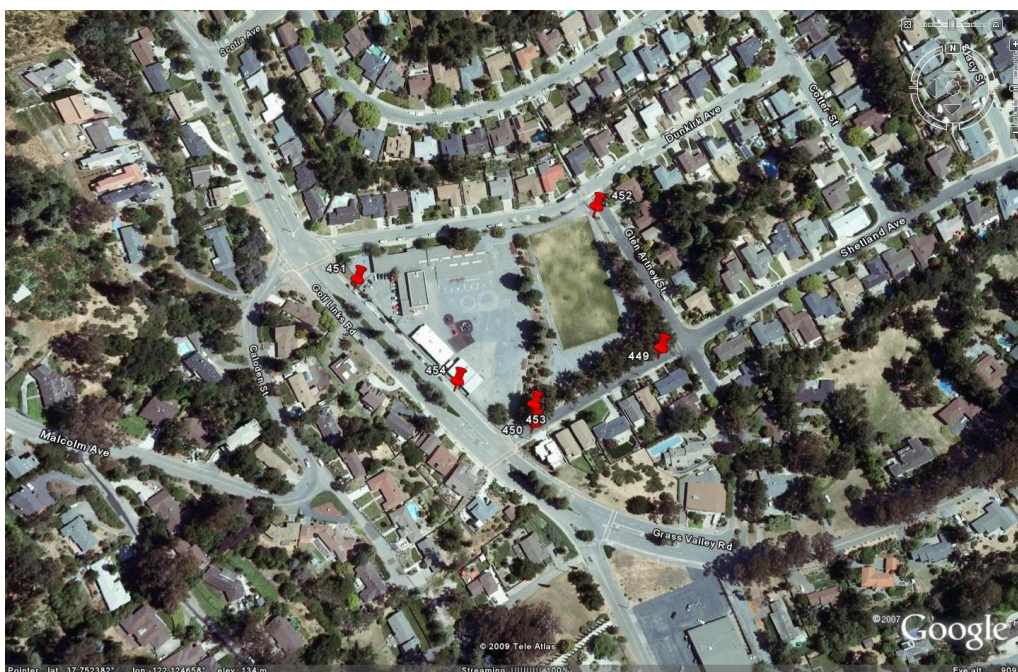


Figure 13. PM 2.5 air monitoring locations near Grass Valley Elementary School.

## **CBE East Oakland PM 2.5 Air Monitoring Protocol**

### Equipment

GPS device  
GPS and sampling log sheet for Hegenberger sites  
Dust Trak air sampler  
Clipboard  
Paper  
Pens or Pencils

### Useful phone numbers

CBE: 510-302-0430 Anna (ext 20) or Nehanda (ext 21)  
Anna cell: 510.XXX.XXXX

### Example of Site Specific Instructions

Thank you for participating in Phase II of documenting Cumulative Impacts in East Oakland. Monitoring particulate matter (PM) 2.5 is especially important because the state and federal government have a threshold/ target that should be achieved and because PM 2.5 can be inhaled deep into the lungs and cause respiratory problems. Our hope is to gain the scientific evidence to show that air quality needs to be improved and to fight for environmental justice for East Oakland residents. Improvements to air quality will indirectly benefit all Bay Area residents.

Safety is important and we do not want to put ourselves in danger during this study. Please make sure you do not get too near moving trucks. Always conduct your visits in groups of two or more.

Here is a protocol and some guidelines for air sampling.

#### Site # 1: Rakha Towing and Auto Repair, 945 - 77<sup>th</sup> Ave between Hawley St and Spencer St

Spread out over the next 2 weeks, we need at least:

- 3 morning visits during business hours;
- 3 afternoon visits during business hours;
- 2 weekend visits when business is closed.

Every time your group goes out on a visit, you will need to conduct 3 samples (standing or walking) in different areas of the site that are at least 10 minutes long.

### **Part I: Instructions for collecting location information for monitoring sites with the GPS device**

#### Monitoring Location

1. Drive or walk to the each of the addresses listed on the log sheet
2. Walk to the location where you will be using the air monitor
3. Turn on the GPS unit with the power button at the top and allow it to calibrate for at least 30 seconds. Machine is looking for satellite connections to pinpoint YOUR location.
4. At your location, Press the "MARK" button to mark the exact place you are in according to satellites (this is your waypoint).
5. Using the rocker key (the one with the arrows on it), move the yellow highlight to the lower right hand corner to the location that says, OK.
6. Press the ENTER button. Congratulations, you've just entered your location!

#### Recording data on site data sheet



7. Now you record your number on the data sheet for your site. To do this, look at GPS device screen under the heading: "location" and record on your sheet the first number (the latitude or "N") in the first box. It should begin with a 3. Record all digits.
8. Record the second number (the longitude or "W") in the second box. It should begin with a 12. Record all digits past the decimal point.
9. Record the date of data collection in the column marked "Date".
10. Record the time of the data collection in the column marked "time"
11. Push the "page" button to get back to the "Waypoint" option.
12. You're done! Move on to the next location and repeat the process.

## **Part II: Taking an air sample:**

### At air monitoring site:

- 1) Find a safe place where you can stand or walk with the monitor for several minutes.
- 2) Turn on the Dust Track (button on lower left)
- 3) Wait 5-20 seconds for machine to cycle through its internal checks. Note: the numbers that look like ## : ## is the battery life. When this is low (say less than 10%), contact Anna to download the data. Not doing so could result in lost data!
- 4) You will then see a 4 digit number that is changing with the units (mg/m3). That is the real time PM 2.5 measurement that the machine is taking at the location you are at.
- 5) Push the green SAMPLING MODE button until you see the words "Log 1" on the top of the screen (the print is small). You are now in the sampling mode where the sampler will store the data you collect.
- 6) Push the purple SAMPLE button on the upper right side of the machine (you'll hear it beep) to start the collection of your data. You should see the word "Recording" at the top of your screen. The air monitor is now recording a sample in its internal memory base. **If you don't see "Recording" on the screen make sure you are in "Log 1" mode and then push the sample button again.**
- 7) When you are through collecting your air sample, push the SAMPLE button again to turn off the sample cycle. The machine will go through a series of beeps which will show you the following numbers for the sample you just took (don't worry about writing these down):
  - Average PM 2.5 level
  - minimum level
  - maximum level
  - sample #
  - % memory
- 8) Make sure you record the date, time and GPS waypoints each time you take a sample at your site from the GPS unit. You may take samples at different locations at your site, but each time you take a sample, please make sure you MARK your location, so that we have that information. Enter each sample you take on your data sheet. **YOU DO NOT NEED TO RECORD THE ACTUAL AIR LEVELS, ON THE SHEET, JUST THE SAMPLE NUMBER THAT SHOWS ON THE MONITOR EVERYTIME YOU TAKE A SAMPLE. ALSO RECORD THE DATE AND TIME THE SAMPLES WERE TAKEN FROM THE GPS UNITS.**
- 9) Make sure that you visit this site at least 4-5 times and vary those visits by time of day and day of the week. Rachel will tailor the sampling protocol for each site. This ensures that we get a good range of PM 2.5 levels at the site and we have a sense of when levels might be high or low at the site.
- 10) Try to run the sampler for a minimum of 10 minutes for each sample you take.
- 11) When the machine is through cycling through its beeps, take a look at the number that says % memory (lower right side of window). If it's getting low (say less than 10%) contact CBE, so that we can download the data that you have collected so far.

Table 1. CBE East Oakland PM 2.5 Monitoring Data, Oct 2008										
	Rakha / Residential		Tassafaronga		Allen Temple/Acorn Woodland/Highland		Diesel trucks / AB&I		Grass Valley Elementary	
Total number of DustTrak measures	31		15		27		47		6	
median PM 2.5 (ug/m3)	25		44		12		27		17	
inter-quartile range	14	40	22	61.5	8.5	24.5	15.5	33.75	2.25	30.75
full range	3	84	17	77	6	55	2	80	2	31
number of weekend measures	7		3		0		12		0	
median PM 2.5 (ug/m3)	26		22				18			
full range	7	31	20	27			2	40		
number of weekday morning measures	14		6		7		13		3	
median PM 2.5 (ug/m3)	33		57		43		34		2	
full range	3	77	35	77	24	55	24	80	2	3
number of weekday afternoon measures	10		6		20		21		3	
median PM 2.5 (ug/m3)	19		34		10		25		31	
full range	4	84	17	68	6	38	12	44	30	31