

City of Davis

2009/2010 Special Monitoring Study

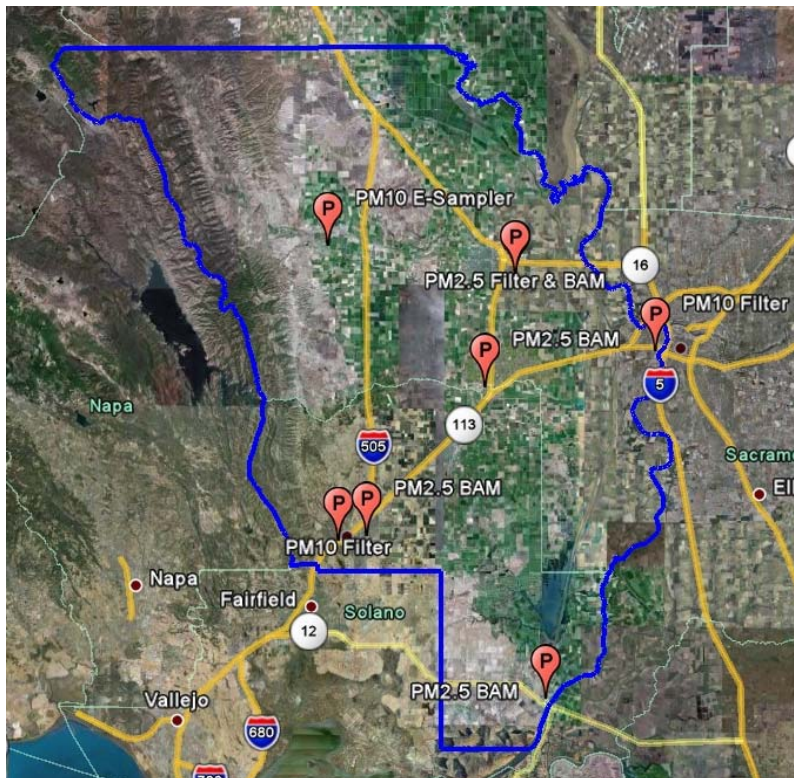
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Prepared by:
Yolo-Solano
Air Quality Management District
1947 Galileo Court, Suite 103
Davis, CA 95618
www.ysaqmd.org
(530) 757-3650 (800) 287-3650

CITY OF DAVIS SPECIAL MONITORING STUDY - INTRODUCTION

The Yolo-Solano Air Quality Management District (District) operates an air quality monitoring network that consists of several monitoring stations at various locations throughout the District's jurisdiction. At many of these monitoring sites, the District maintains equipment that monitors for particulate matter less than 2.5 microns in diameter (PM_{2.5}). Because it is expensive and resource-intensive to operate, the District places monitoring equipment only at certain locations. While PM_{2.5} monitors sample the air in their immediate vicinity, the monitoring network is arranged in such a way that the data that is collected should be representative of the entire district. Permanent PM_{2.5} monitors are located in Woodland, Vacaville, Davis, and Rio Vista.



In the past, the District has received questions concerning whether the data collected by the air monitoring network consistently represents conditions in other areas of the District where no monitors are located. This issue is especially important regarding PM_{2.5}, which is a more “localized” pollutant than a pollutant such as ozone, which has effects that are more regional in nature. The District has also received questions concerning whether monitors sited at one location in a city can be relied upon to accurately characterize PM_{2.5} in a different part of the same city. The District designed and implemented a special monitoring study for the City of Davis in order to investigate this relationship.

SPECIAL STUDY – BACKGROUND AND DATA COMPARISON

Over the last several years, the District has received complaints from Davis residents concerning smoky conditions within the City of Davis. Smoky conditions would normally indicate higher, possibly unhealthy levels of PM_{2.5}. While PM_{2.5} concentrations fluctuate throughout the fall and winter months at the permanent PM_{2.5} monitor operating in Davis, concentrations rarely exceed the federal standard of 35 µg/m³ averaged over 24 hours. This permanent Davis monitor is located north of Interstate 80 and West of highway 113, more or less on the outskirts of the developed portion of the city. Citizens questioned whether the monitoring data collected at the permanent monitor accurately represented ambient conditions throughout Davis, or whether concentrations could be higher at more urbanized locations in the city. While the District operates almost all of the PM_{2.5} monitors in the District, the Air Resources Board (ARB) is responsible for the maintenance and operation of the permanent Davis monitor.

Because PM_{2.5} can have localized impacts, the District designed a special monitoring study to evaluate the potential for higher levels of PM_{2.5} to exist in the more urban parts of the city. The study consisted of locating and operating two continuous PM_{2.5} monitors in two different portions of the urbanized areas of Davis. One of the monitors was a District-owned “E-Sampler”. The second was an “E-BAM” owned by the ARB. Both the E-Sampler and the E-BAM are capable of monitoring PM_{2.5} continuously over long periods of time. While both types of monitors can sample for PM_{2.5} with a high degree of accuracy, only the E-BAM is considered to be a “Federal Reference Method” sampler, meaning that it can be used for federal designation purposes. The E-BAM was placed in east Davis and the E-Sampler was placed in the northwest portion of Davis. Monitoring began at the beginning of November, 2009 and continued until the second half of March, 2010. This period of November through March coincided with the part of the year that has long been associated with higher levels of PM_{2.5}. While the E-BAM remained at one location for the duration of the study, the E-Sampler was re-located from north Davis to central Davis during the month of December. The monitor was re-located in order to place it in closer proximity to an area where complaints about smoky conditions were being registered. The data collected during the course of the monitoring study was compared to data collected at the permanent PM_{2.5} monitoring sites throughout the District, including the permanent Davis monitor.

A comparison of the data collected by the temporary Davis monitors to data collected at nearby permanent PM_{2.5} monitoring sites is shown in the following sections.

Issues with Placement and Operation of Temporary Monitors

EPA has specific criteria for the placement of monitors. The criteria exist so that monitored PM_{2.5} levels will reflect ambient conditions and will not be unduly influenced by sources such as pollen, localized dust, etc. If a monitor is being used to collect data for federal designation purposes, the data can be considered invalid if the monitor does not meet the siting requirements of the EPA protocol. In addition to the EPA’s criteria for monitor siting, it is also necessary to find a monitor location that is publicly owned, secure, and has a power source. Since most of urbanized Davis is both relatively dense and is populated by tall, mature trees, no locations in urbanized Davis were identified that could meet all of the requirements of the EPA protocol, plus the requirements for safety and power. Consequently, the District placed monitors at locations that best approximated the EPA requirements. Because EPA criteria was not strictly followed, there is a possibility that the

concentrations recorded at the temporary monitors could have been to some extent influenced by sources of particulate that were not representative of normal conditions.

E-Sampler Maintenance Issues

Throughout the November through March study period, there were several instances of equipment malfunction concerning the E-Sampler. This resulted in several days each month (except February) where no data was collected by the E-Sampler. Each time an equipment malfunction prevented data from being collected at the E-Sampler, the problem was quickly corrected. On days when the E-Sampler did not operate, the temporary E-BAM did collect data. Consequently, there were no days during the study period where data was not collected from at least one temporary monitor.

Calibration errors were also consistently recorded by the E-Sampler during the months of November and December. These errors indicate that the monitor was experiencing mechanical problems over this period and the data collected during these months is most likely not accurate. This is supported by the fact that once the reason for the calibration errors was diagnosed and corrected, PM_{2.5} concentrations recorded by the E-Sampler were much more consistent and did not exhibit the large data spikes that are typical of a malfunctioning unit.

A summary of the E-Sampler malfunctions and maintenance activities during the study period is provided in Appendix A.

CHART – MONTHLY AVERAGE OF 24-HOUR CONCENTRATIONS

Chart 1, below, depicts average PM2.5 concentrations for each of the months covered by the study. E-Sampler data is not shown for the months of November and December, as monitor malfunctions produced data that is not verifiable. As illustrated in the chart, monthly average PM2.5 concentrations at the temporary Davis sites increased and decreased in a pattern somewhat similar to concentrations at the permanent sites. However, the average concentrations recorded by the E-BAM were consistently higher across all months. This data indicate that, during the season of 2009/2010, PM2.5 concentrations in east Davis were more elevated than those at the center or periphery of the City. The data also show that on average, according to the data collected at the permanent and temporary monitors, concentrations in and around the City of Davis were consistently lower than the federal standard of 35 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

In all following charts, “Davis E-S” refers to the temporary E-Sampler, and “Davis E-B” refers to the temporary E-BAM.

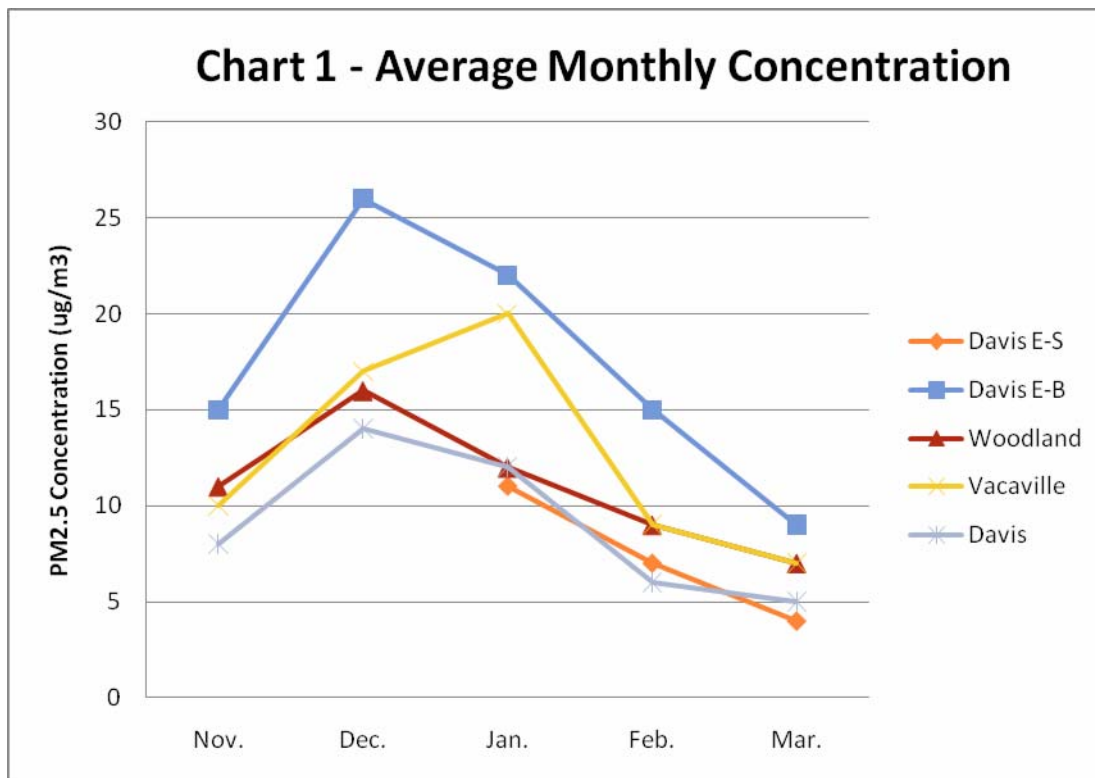
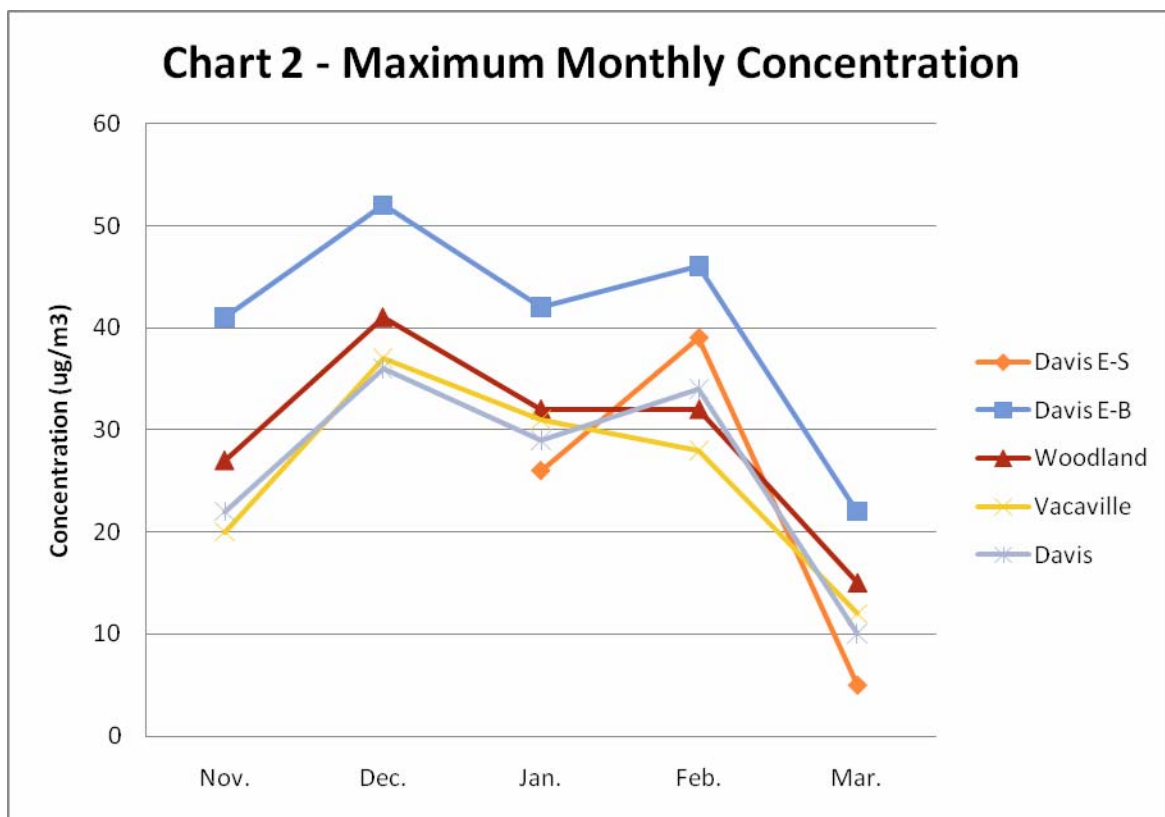


CHART – MAXIMUM MONTHLY 24-HOUR CONCENTRATIONS

Chart 2 shows a comparison of the single highest 24-hour concentrations recorded at the Davis E-BAM, Davis E-Sampler, Woodland monitor, Vacaville monitor, and permanent Davis monitor for each month covered by the study. The chart shows that in every month but March, one or both temporary monitors recorded a maximum 24-hour average concentration that was higher than the maximum reading recorded at any permanent monitor, including the permanent Davis monitor. This suggests that on the days when elevated PM_{2.5} concentrations were experienced in the District, concentrations were higher in the more urbanized parts of Davis. It should also be noted that, in all but one month, at least one monitor located in Davis recorded an exceedance of the federal PM_{2.5} standard. In some cases, the maximum monthly 24-hour concentration at the temporary E-BAM site was substantially higher than the standard.

E-Sampler data in Chart 2 reflects data collected after re-occurring calibration errors had been corrected (January 9, 2010 – March 2010).



THE AIR QUALITY INDEX AND DATA COMPARISON


The District’s PM2.5 monitors calculate concentrations of PM2.5 in a given amount of sampled air. However, to a member of the general public, it may be difficult to understand what a given PM2.5 concentration means for their health. Consequently, in order to relay monitoring results to the public, the District uses the “Air Quality Index” (AQI). Under this system, monitored pollutant concentrations are converted to a number on the AQI. The District uses the AQI to show how healthy or unhealthy the air is on a given day. Different number ranges are equated to different levels of health concern, such as “Good”, “Moderate”, or “Unhealthy.” On days where the AQI is high, the District may publish health alerts. A diagram of the AQI is shown below. Many people use the AQI as a tool to help determine the duration and intensity of their physical activity, or to make choices such as whether or not to remain indoors.

Because the AQI is the public’s most visible and recognizable measure of the health of the District’s air, it is useful to compare daily AQI levels at each PM2.5 monitoring station across the special study months.

For the charts shown below, daily AQI levels are shown, by month, for the temporary monitors, the permanent Davis monitor, and the next nearest permanent monitor, which is located in Woodland. Charts 3 through 6 show the number of days at each monitor that recorded an AQI at either “Good”, “Moderate”, “Unhealthy for Sensitive Groups”, or “Unhealthy” levels.

As shown in the charts, most days fell into the categories of either “Good” or “Moderate”, regardless of where the monitor was located. However, while no “Unhealthy” AQI levels were recorded at permanent monitors in Davis or

AIR QUALITY INDEX			
	Health Categories	Ozone	Particulate Matter
300	Very Unhealthy 201 - 300	Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.	People with heart or lung disease, older adults and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.
200	Unhealthy 151 - 200	Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children, should limit prolonged outdoor exertion.	People with heart or lung disease, older adults and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.
150	Unhealthy for Sensitive Groups 101 - 150	Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.	People with heart or lung disease, older adults and children should reduce prolonged or heavy exertion.
100	Moderate 51 - 100	Unusually sensitive people should consider limiting prolonged outdoor exertion.	Unusually sensitive people should consider reducing prolonged or heavy exertion.
50	Good 0 - 50	None	None



For detailed information about health effects visit: SpareTheAir.com

Woodland, or at the temporary Davis monitors, more AQI readings over 100 (“Unhealthy for Sensitive Groups”) were recorded at the E-BAM than at either the Davis or Woodland permanent monitors or the temporary Davis E-Sampler.

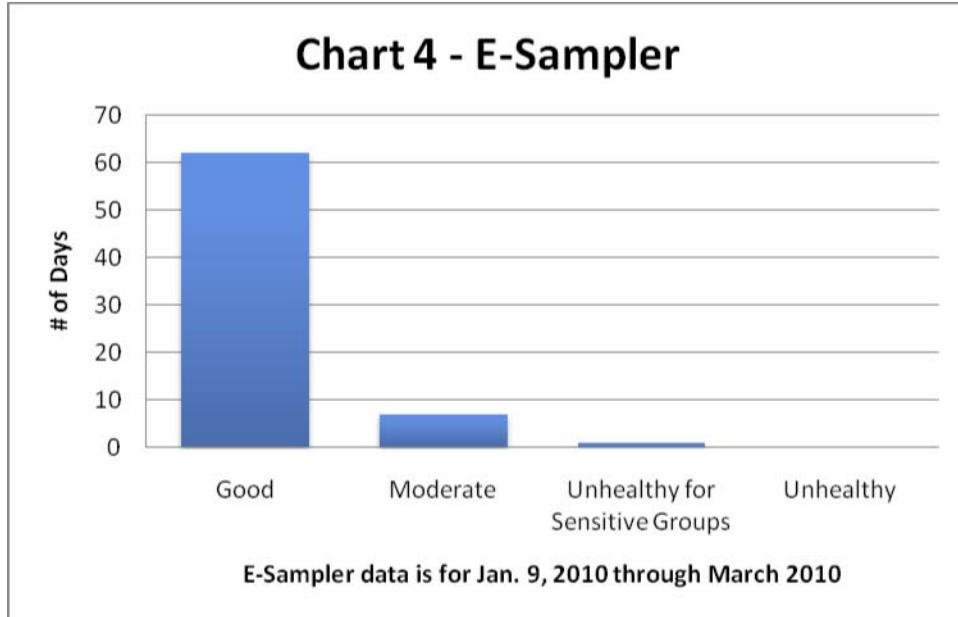
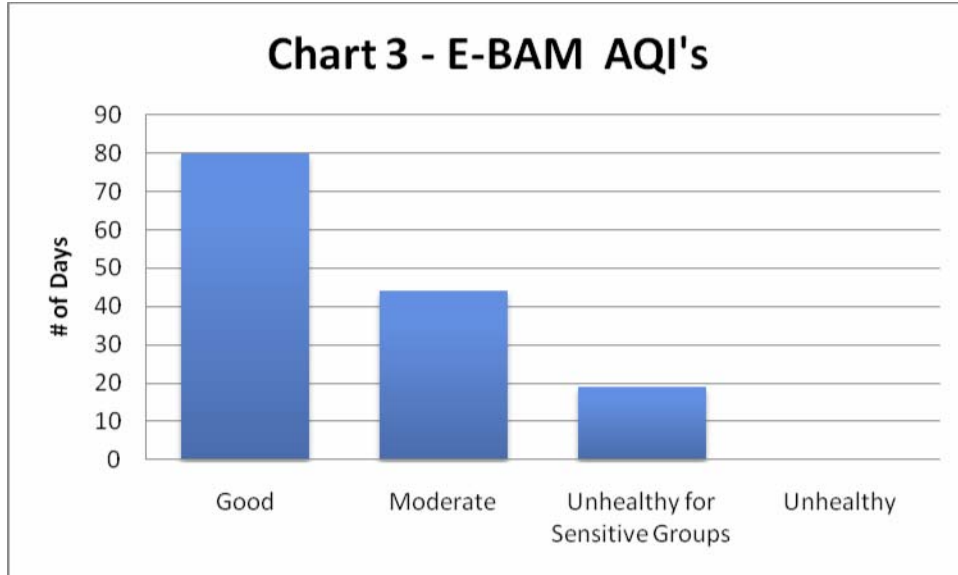


Chart 5 - Davis Monitor AQI's

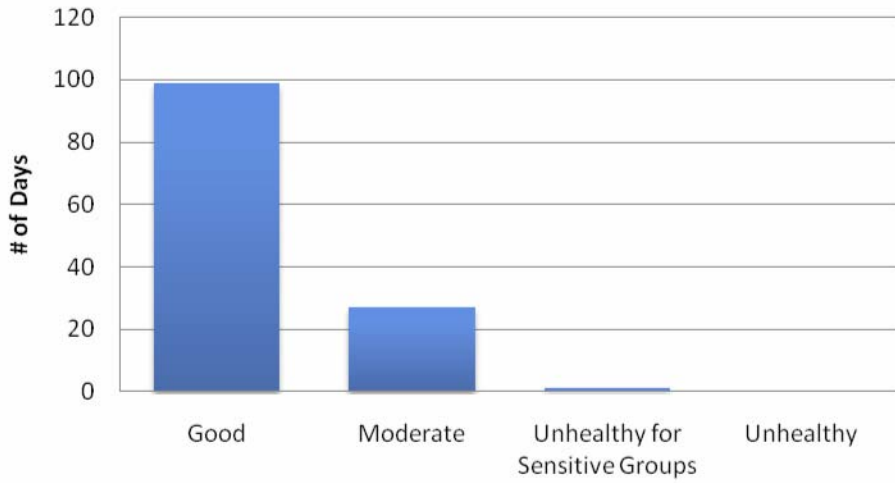
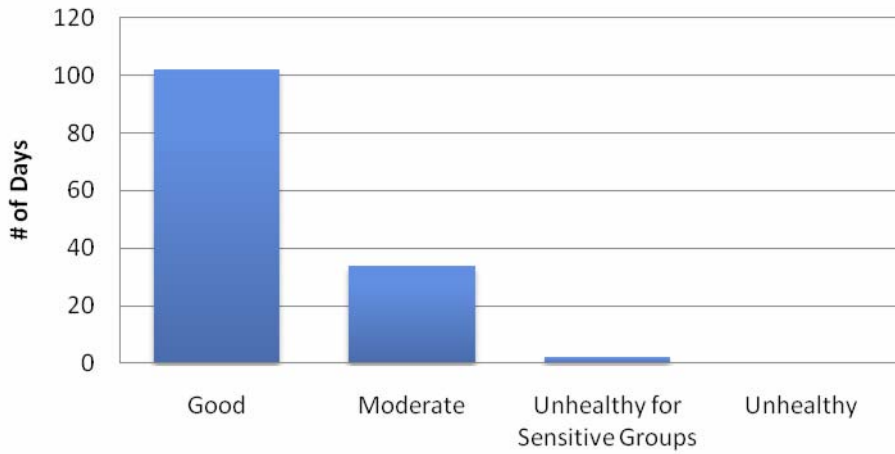


Chart 6 - Woodland AQI's



In addition to looking at AQI levels by monitor for the entire study period, it may also be useful to examine daily monitored AQI levels for each day in a given month. This helps to show how recorded PM2.5 levels compare at the various monitors over the course of a month. Looking at daily AQI can also help to show whether monthly averages for a monitor are affected by “spikes” in PM2.5 concentrations.

For the charts below, daily AQI levels are shown by month for the temporary monitors, the permanent Davis monitor, and the next nearest permanent monitor, which is located in Woodland. The data show that PM2.5 levels tended to increase and decrease in a similar pattern across all sites. However, the data also indicate that there were periods during each month where AQI levels monitored at the E-BAM were higher, sometimes significantly higher, than levels monitored at the permanent sites. In addition, the charts demonstrate that PM2.5 concentrations tended to fluctuate over a wide range during the course of most months, and that this effect appeared to be more pronounced at the temporary E-BAM site. No E-Sampler data is shown for the months of November and December due to the consistent calibration errors experienced by the E-Sampler during these months. The E-Sampler was overhauled on January 8 after which only one calibration error was recorded.

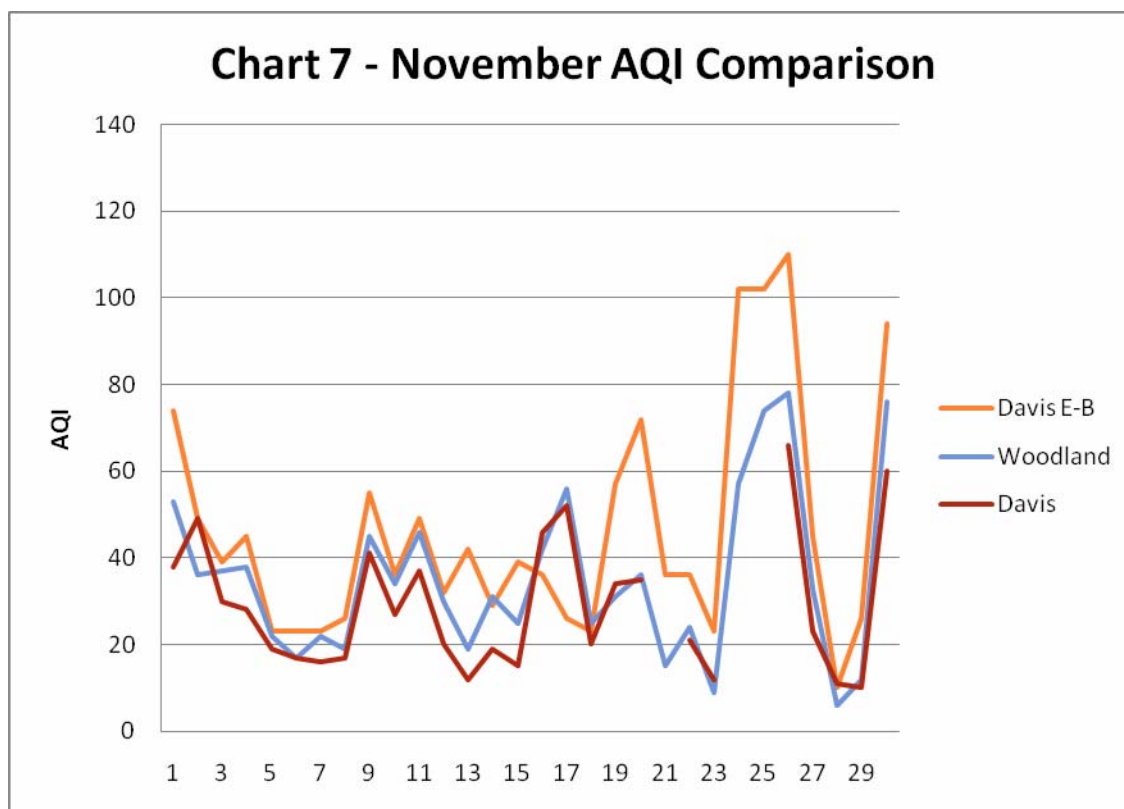


Chart 8 - December AQI Comparison

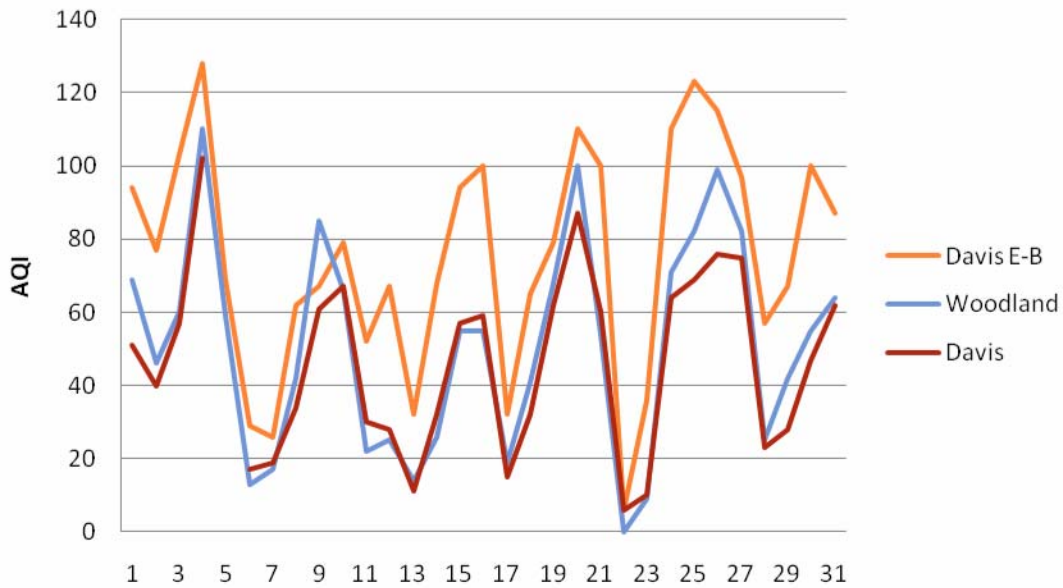


Chart 9 - January AQI Comparison

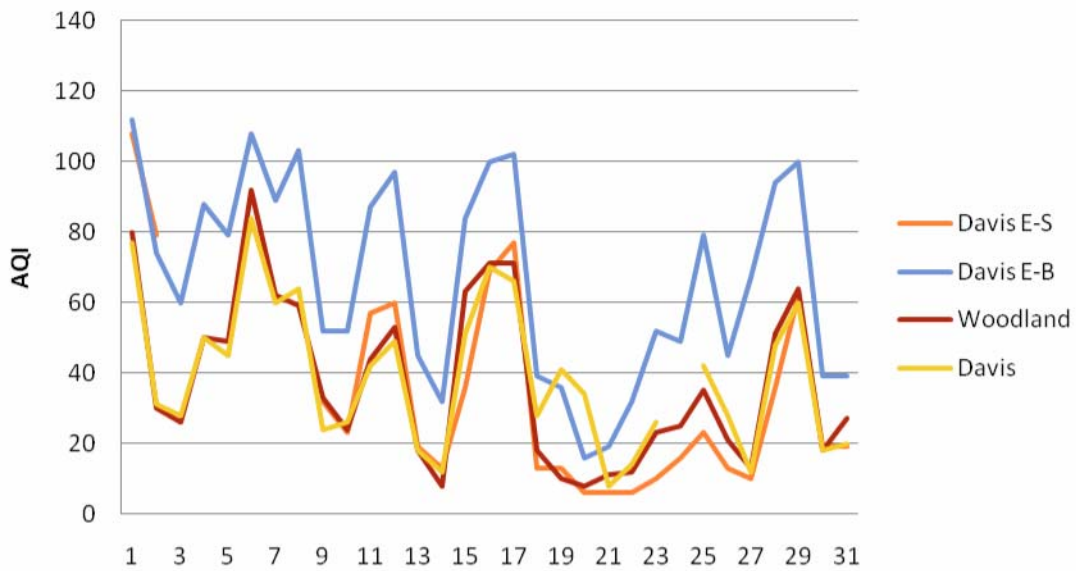


Chart 10 - February AQI Comparison

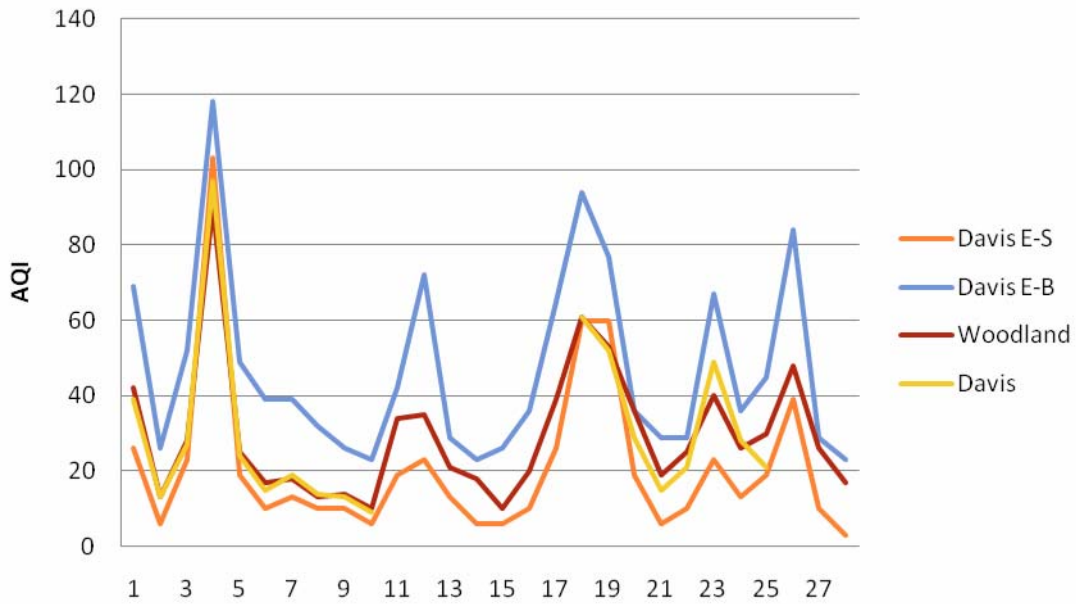
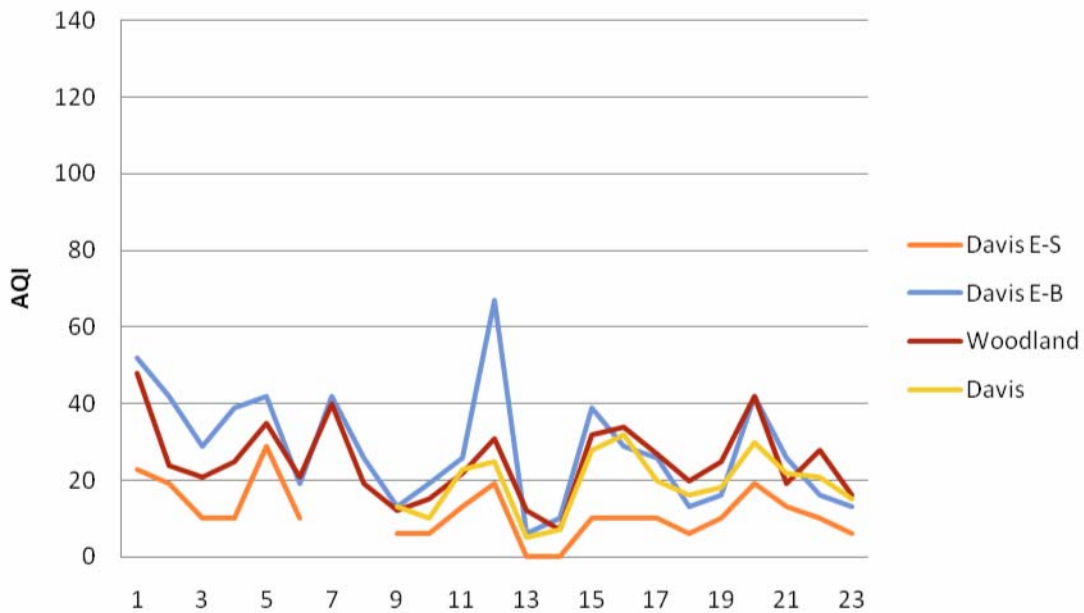


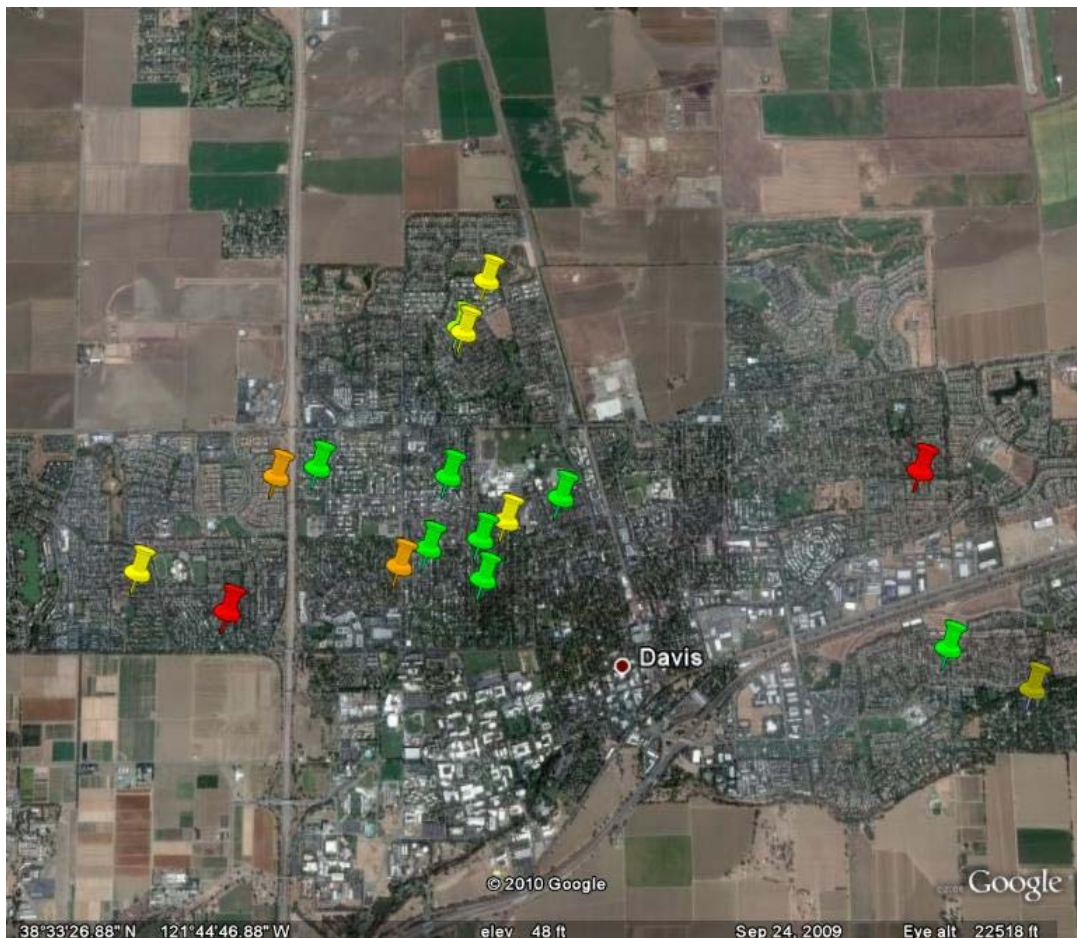
Chart 11 - March AQI Comparison



2009/2010 COMPLAINTS

In order to determine which City residents felt most impacted by particulate, resident complaints were documented during the course of the study. Complaints of smoky conditions were recorded during the study period by both the City of Davis and the Yolo-Solano AQMD. 68 complaints of wood smoke were logged in the period November 1, 2009 to February 15, 2010 by 19 named and 7 anonymous citizens. Many individuals submitted more than one complaint, with the maximum complaints from one individual being 18. Not all complaints described the specific nature of the complaint. When the complaint did describe an observation, there were 28 observations of smell and 13 reports of visible smoke (13).

The locations of the complaints are shown on the map below, with the color of the pin representing the number of complaints from that site: red > 10, orange 4 to 9, yellow or olive, 2 or 3, and green 1. As shown on the map, only one individual registered complaints in the vicinity of the temporary monitor in East Davis. The largest concentration of resident complaints occurred in the central/north-central portion of the city where the temporary E-Sampler was located from December 23rd 2009 through March 2010. However, most of these residents registered single, rather than multiple complaints.



SUMMARY AND CONCLUSIONS

In summary, data collected during the course of the study showed the following:

- The temporary E-BAM monitor located in east Davis showed PM2.5 concentrations that generally increased and decreased in a pattern similar to concentrations at the permanent monitors. However, overall PM2.5 concentration levels at the monitor were significantly higher than at the permanent monitors during the months of December, January and February.
- The temporary E-BAM monitor had more overall days with PM2.5 concentrations at AQI levels of “Unhealthy for Sensitive Groups”. During the majority of days, however, concentrations were at AQI levels of “Good” or “Moderate”.
- The temporary E-Sampler monitor experienced equipment malfunctions during the first part of the study period that calls into question the accuracy of the data collected by the E-Sampler in November and December. Once these mechanical problems were diagnosed and corrected, E-Sampler concentrations were similar to the concentrations observed at permanent PM2.5 monitors, including the permanent Davis monitor.

Based on the data collected during the study period, it appears that PM2.5 levels in some of the more urbanized parts of Davis can be higher than levels at the nearest permanent monitors during the late fall and winter months. Because the temporary monitors were specifically placed in urban areas where it was suspected that PM2.5 concentrations could be higher, it was not possible for the monitors to be sited in strict accordance with EPA protocol. This should be kept in mind when reviewing PM2.5 concentrations recorded at the temporary monitors. However, the fact that concentrations at the temporary monitors increased and decreased in patterns similar to those observed at the permanent monitors (Charts 7-11) suggest that the temporary monitors were not heavily influenced by non-traditional sources of PM2.5. Since there were no observed conditions during the study period that were out of the ordinary for the Davis area, the study period can be considered representative of typical conditions during the late fall and winter.

Appendix A – Maintenance Log for Davis E-Sampler (10/30/09 – 4/8/10)

10/30/09 E-Sampler installed at city well site (1188 Arlington Blvd)

11/6/09 Downloaded data, no errors.

11/13/09 “span calibration error” on display. Sampler reset.

11/17/09 Downloaded data, no errors.

11/25/09 “span calibration error” on display. Sampler reset.

12/4/09 Downloaded data, no errors.

12/8/09 “span calibration error” on display. Data was emailed to the manufacturer to see whether they could provide a diagnosis. Reset sampler, clearing the error.

12/9/09 Checked inlet heater. Found good voltage at heater plug indicating an inoperative heater.

12/15/09 Downloaded data, no errors.

12/22/09 “span calibration error” on display. Old inlet heater was replaced with a new heater. Reset sampler and cleared error.

12/23/09 Downloaded data, no errors. Moved sampler to city tank site (530 W. Eighth St) at the request of the City.

12/30/09 “span calibration error” on display. Removed and reinstalled inlet and ran multiple zero air checks to clear out sampling chamber. Unit was reset, clearing the error.

1/7/10 “span calibration error” on display. Unit was removed to office.

1/8/10 Sampler was disassembled. Pneumatic line and pump filter were replaced. Also ordered more purge filters and set unit to run a zero calibration (cleans out chamber) every 15 minutes rather than hourly. Unit was reinstalled at site.

1/13/10 Replaced purge filter. No errors found.

1/29/10 Downloaded data. No errors found.

2/5/10 Downloaded data. No errors found.

2/12/10 Downloaded data. No errors found.

2/25/10 Downloaded data. No errors found.

3/11/10 “span calibration error” on display. Sampler was reset. Error didn’t return.

3/19/10 Downloaded data. No errors found.

3/26/10 Downloaded data. No errors found.

4/8/10 Downloaded data. No errors found.