Placer County
AIR POLLUTION CONTROL DISTRICT

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MEMORANDUM

TO: Board of Directors, Placer County Air Pollution Control District

FROM: Yushuo Chang, Planning and Monitoring Manager

AGENDA DATE: April 13, 2006

SUBJECT: The Report of Data Analysis on Roseville Railyard Air Monitoring Project (Information)

Action Requested:

None. This is an information item to present the first of three annual reports describing the analyses of the RRAMP data. This first annual report covers the data collected in 2005.

Background:

On December 9, 2004 the Board approved Resolution #04-21 authorizing the Chairperson and the APCO to sign an Agreement with Union Pacific Rail Road (UPRR) in regard to diesel particulate matter (DPM) resources toward the District's effort in conducting a PM air-monitoring project. The Roseville Railyard Air Monitoring Project (RRAMP) has a three-year cycle (2005-2007) associated with the mitigation plan. The first-year monitoring took place between July and October 2005, and focused on air monitoring at locations upwind and downwind of the railyard. At the conclusion of monitoring, the collected data set was forwarded to the Desert Research Institute (DRI) to conduct a comprehensive data analysis. This staff report will be the summary of DRI data analysis results for the first-year monitoring data.

Discussion:

Objective of RRAMP Data Analysis

DRI performed the necessary data review, analysis, and interpretation to support the first of two general objectives of the study: (1) to determine the impacts from the UPRR facility as measured as the differences between upwind and downwind monitoring site pairs; and (2) to determine any discernible trends in reduced impacts over a three-year period as a result of

emissions mitigations implemented by UPRR. (The second objective can only be determined following the third year of monitoring.) The DRI report (Report) is the first of three annual reports to be provided by DRI. This 84 page report is available from Staff and will be posted on our website for your detailed review

Evaluation and Validation of RRAMP Data

The Report reviewed the first-year RRAMP data. Data was collected from many instruments, both continuous and periodic. Key continuous measurements were made for black carbon (BC), an indicator of DPM; oxides of nitrogen (NO and NOx), fine particulates (PM2.5), and meteorological parameters, including wind speed and direction. Filter-based measurements were collected once every three days, and the filters were sent to the laboratory at the South Coast Air Quality Management District (SCAQMD) for analysis of total mass concentrations, as well as organic and elemental carbon. Because filter-based measurements are the "standard" measurement techniques advocated by the U.S. Environmental Protection Agency, these were used to help validate the measurements of the continuous monitors. A summary of the continuous data collected during the 2005 study period is shown in Table 1.

Table 1 Summary of RRAMP Continuous Measurements During Summer 2005.

	Denio Site					
	Wind Spd	Wind Dir	NO	NOx	BC	PM2.5
monitoring period	7/15 - 10/15	7/15 - 10/15	7/21 - 10/15	7/21 - 10/15	7/15 - 10/15	7/15 - 10/15
total hours	2232	2232	2087	2087	2232	2232
count	2228	2228	1978	1978	2225	2226
% data capture	99.8%	99.8%	94.8%	94.8%	99.7%	99.7%

	Pool Site					
	Wind Spd	Wind Dir	NO	NOx	BC	PM2.5
monitoring period	7/15 - 10/15	7/15 - 10/15	7/24 - 10/15	7/24 - 10/15	7/15 - 10/15	7/15 - 10/15
total hours	2232	2232	2015	2015	2232	2232
count	2232	2232	1930	1930	2105	2232
% data capture	100%	100%	95.8%	95.8%	94.3%	100%

	Church St. Site					
	Wind Spd	Wind Dir	NO	NOx	BC	PM2.5
monitoring period	9/7 - 10/15	9/7 - 10/15	8/9 - 10/15	8/9 - 10/15	9/9 - 10/15	9/7 - 10/15
total hours	925	925	1621	1621	875	925
count	780	780	1573	1573	875	780
% data capture	84.3%	84.3%	97.0%	97.0%	100%	84.3%

	Vernon St. Site					
	Wind Spd	Wind Dir	NO	NOx	BC	PM2.5
monitoring period	9/7 - 10/15	9/7 - 10/15	9/13 - 10/15	9/13 - 10/15	9/9 - 10/15	9/7 - 10/15
total hours	925	925	781	781	875	925
count	925	925	781	781	839	925
% data capture	100%	100%	100%	100%	95.9%	100%

As can be seen from the table, we successfully captured a very high percentage of possible data. This reflects a successful field operations program.

One fundamental aspect of data compilation is to assure the integrity of the data collected. To do so, a number of quality assurance techniques were used, including co-located monitoring to determine the precision (i.e., accuracy) and bias of the data; identification of outliers (e.g., abnormal measurements caused by electronic spikes) and other data inconsistencies; and understanding specific characteristics of the monitors employed in the study.

One of the key findings in the data quality assurance review is that the instrument used for black carbon (an aethalometer) is subject to internal variations, which can affect the short-term (e.g. one hour) accuracy of the measurements. However, the known nature of these occurrences allow for high confidence in the data if averaged over a period of at least six hours. It also turns out that the favorable wind conditions for upwind/downwind comparisons occurs typically between 10 pm and 6 am – a period of 8 hours. Therefore the results and interpretations of the data are most useful when aggregated into at least 6-hour increments.

The "standard" for particulate measurements historically has been 24-hour filter-based measurements. Comparison of 24-hour continuous monitor data with 24-hour filter-based mass data was used to identify outliers and help to show accuracy of the data. The results of this analysis identified one outlier, which was removed from the data set, and also showed that measurement errors were mostly random. Random errors are minimized when data are aggregated over a period of time, again supporting the need to use at least 6-hour averages when analyzing the results of the data.

Results

Although the Report describes a number of detailed analyses, some of the key results are provided here. First, in order to determine the conditions upon which upwind-downwind analyses are appropriate, three screening criteria were established: (1) winds need to be from a semi-circular arc between 45 degrees (i.e., northeasterly) through 225 degrees (i.e., southwesterly); (2) only winds from 1 to 5 mph were used to avoid calm or windy conditions; and (3) only overnight hours from 10 PM to 5 AM were used. This is the time frame when the winds blow most consistently across the rail facility directly from the upwind to the downwind locations, and therefore the emissions from the rail facility can most readily be detected.

Once the subset of appropriate data was determined, the Report evaluated the differences between upwind and downwind site concentrations of BC, PM2.5, NO, and NOx. The results are shown in Figures 1 through 4.

Figure 1 shows the 7-hour average concentrations of black carbon. This bar chart shows the average concentrations over the study period for which data are available from both pairs of

upwind and downwind sites. The concentrations at both downwind sites (Danio and Church) are significantly higher than at their corresponding upwind sites (Pool and Vernon). The red bars depict the uncertainty of the values depicted, and as can be seen, these are small in comparison to the observed concentrations. From a statistical standpoint, we have greater than a 99.9% confidence that these findings are real and not due to chance alone. Also shown in Figure 1 are the differences between the upwind and downwind pairs to show the presumed impact from the rail yard facilities. For BC, these are over 1.5 micrograms per cubic meter – a significant amount. Also shown are the comparisons of the both upwind sites and both downwind sites. These are the two rightmost bars, and these are relatively small, indicating that the upwind sites and downwind sites consistently reflect the same conditions.

Figure 1 Black carbon 7-hour average concentration

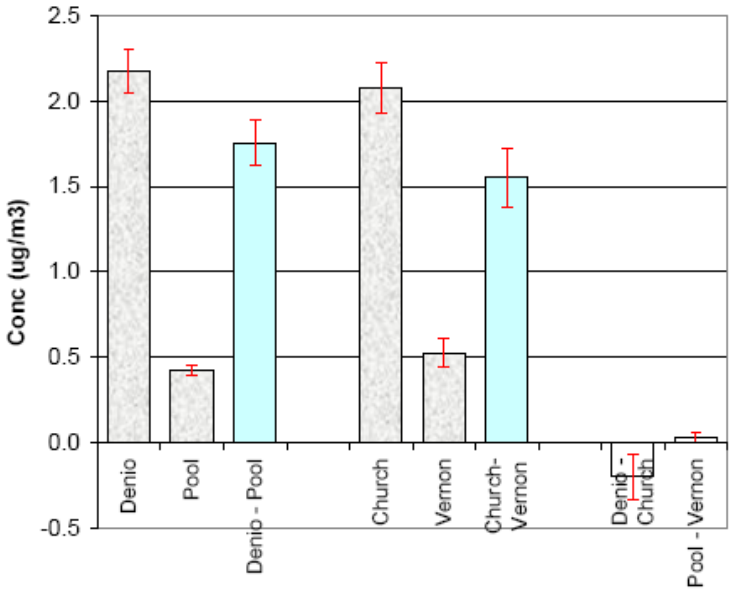


Figure 2 shows the same depiction for PM2.5. While the downwind sites have levels which are statistically higher than the upwind sites, these differences are not as pronounced as for BC. This is because PM2.5 is a regional pollutant which affects both upwind and downwind sites. Nevertheless, the differences between upwind and downwind sites are in the order of 7 to 12 micrograms per cubic meter.

Figure 2 $PM_{2.5}$ 7-hour average concentration

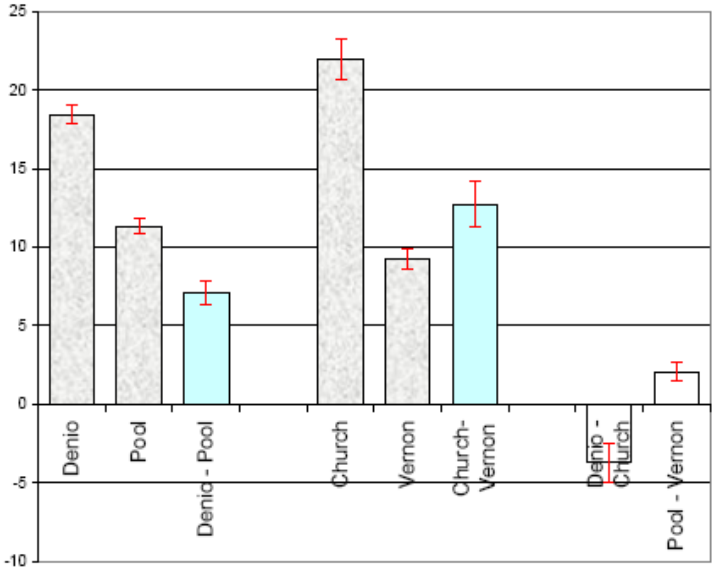


Figure 3 is a similar chart for NO concentrations. NO is a good indicator of fresh NOx emissions, since ultimately with time, NO converts to other nitrogen products. This chart may be the most indicative of all that the downwind sites are picking up the emissions from the rail yard facility. While downwind sites show concentrations about 120 parts per billion (ppb), the upwind sites are less than 10 ppb.

Figure 3 NO 7-hour average concentration

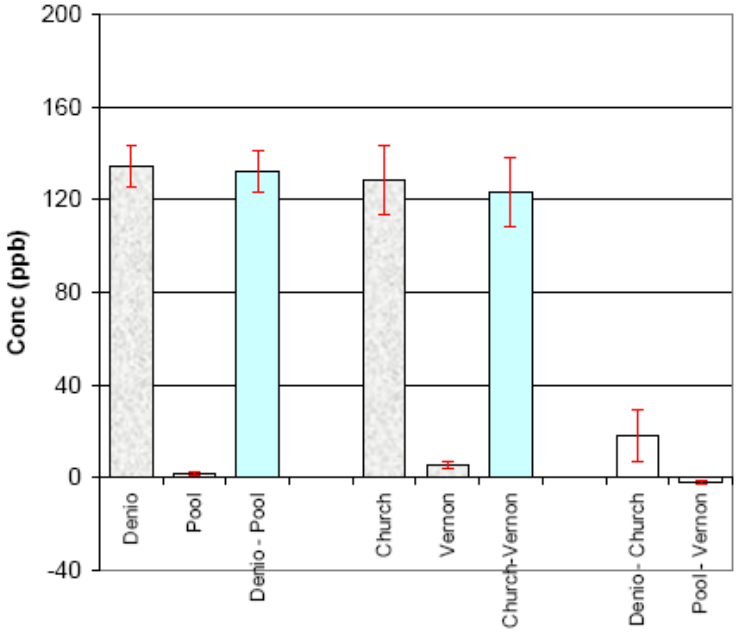
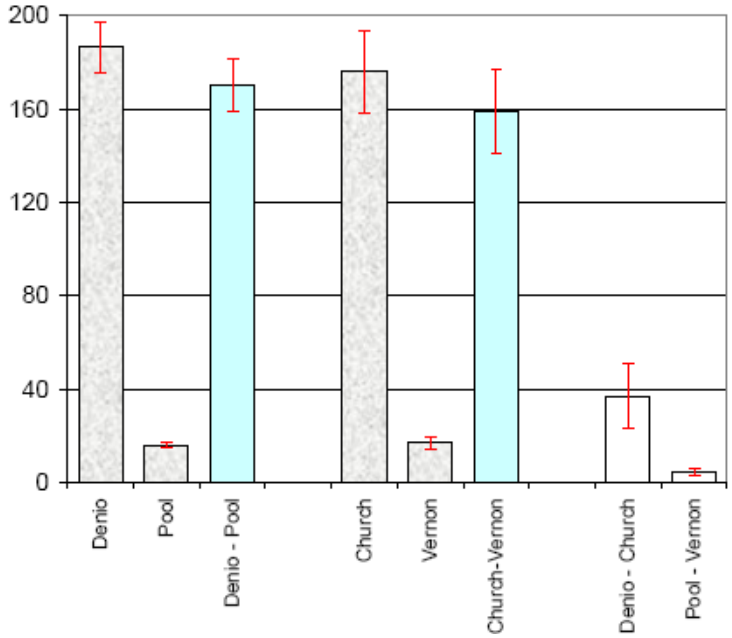


Figure 4 shows the results for NOx, which is NO plus other oxides of nitrogen, often nitrogen dioxide (NO2). While the results of Figures 3 and 4 are very similar, there are some interesting differences. The downwind sites show a very high percentage of NOx as NO, meaning these sites are dominated by fresh emissions. Conversely, the upwind sites have a low percentage of NOx as NO, meaning the upwind areas are affected to a much greater degree from aged NOx emissions, perhaps attributable to earlier mobile source emissions in the local or greater Sacramento area. In any case, the differences between upwind and downwind influences are dramatic.

Figure 4 NOx 7-hour average concentrations



Other analyses were conducted by day-of-week. The upwind sites show patterns that are somewhat reflective of typical motor vehicle dominated conditions, while the downwind sites do not. Since the downwind sites do not show much difference by day of week, and since the rail yard operates seven days a week, these results are consistent with the influence of the rail yard at the downwind sites.

The interesting aspect of the overall scope of the data analyses is that all the results are consistent with each other, and show that the monitors are capturing effects of the rail yard emissions.

Conclusion

We have an excellent data set upon which to base the analytical results. The Report showed generally good agreement with no significant biases between paired instruments. The value of the analyses is strongest when time-averaging the data over periods of six hours or more.

Downwind sites show statistically significant impacts of BC, NO, NOx, and PM2.5. The fact that downwind sites are dominated by fresh NO emissions while upwind sites are more indicative of aged NO emissions strongly suggests that the downwind sites are indeed picking up the emissions from the rail yard facility. For BC, that influence is about 1.5 micrograms per cubic meter, while for PM2.5, it is about 7 to 12 micrograms per cubic meter.

The differences in mean concentrations between the two pairs of downwind and upwind sites (Denio-Pool and Church-Vernon) are all significant at above the 99% confidence level.

All of the analyses conducted are consistent with each other in detecting rail yard impacts at the downwind sites. Nothing in the analyses contradicts these findings.

Trend analyses cannot be conducted until at least the end of the third year of sampling (in 2007); however, the current data set provides an excellent baseline from which such trend analyses can be based.

Fiscal Impact:

None. This data analysis report (Report) is the first of three annual reports that provide descriptive and statistical analyses of the RRAMP data. The District's FY 2005/2006 Budget contains funding to support the contract signed between the DRI and the District. As of this time, there will be no fiscal impact on the District to continue finishing the following two annual reports of RRAMP data analysis.

Recommendation:

None. This is an informational item to provide an overall status to your Board on the RRAMP first-year data analysis. The Report will be posted on the District's website in the section containing rail road related information.