Appendix B:
District evaluation of past PM10 exceedances linked to high winds:
Memo from James Sweet to Doris Lo - April 15, 2004

April 15, 2004

Doris Lo
Planning Office (AIR2)
EPA Region 9
75 Hawthorne Street
San Francisco, CA 94105

Dear Ms. Lo:

The San Joaquin Valley Unified Air Pollution Control District (District) has reviewed issues raised in a comment letter from Mr. Charles Swanson dated March 18, 2004 and finds no cause for amendment or revision to the District's 2003 PM10 Plan.

The District reexamined supporting data to review winds on the west side of the San Joaquin Valley (SJV) for correlation with PM10 data at all reporting sites. The analysis included all data available from 1990 to 2002 and was not confined to the 2002 period discussed by Mr. Swanson. The review of Blackwells Corner wind data, Caltrans wind advisories, CIMIS wind data and District PM10 monitoring data does not indicate a relationship that impacts federal exceedances or requires revision of the proposed Plan.

Statements made in the Plan that are challenged by Mr. Swanson are generally correct as written. The statements provide a general characterization of the San Joaquin Valley (SJV) and, as with all generalizations, are not without exception. Exceptions to the characterization of low wind speeds in the SJV are expected in passes, along ridges, on mountainous terrain and other areas of terrain influence that create slope flows. PM10 monitoring site locations for the SJV are selected in accordance with federal guidelines. They are selected to evaluate exposure of populated areas to adverse air quality caused by anthropogenic activity. Monitoring where airflow is rapid such as in passes, where strong slope flows occur, near ridges and mountainous terrain does not meet requirements for most pollutants.

Blackwells Corner, the specific location noted by Mr. Swanson, does have CIMIS data that can be reviewed. District analysis did not reveal any linkage of high wind events at Blackwells Corner or at other CIMIS sites in the southwestern portion of the San Joaquin Valley to observed PM10 episodes.

However, no definitive statement can be made about peak PM10 concentrations at Blackwells Corner because there is no PM10 monitoring site near the location. This would also be true at any other location in the SJV that does not have a PM10 monitor nearby. Scientific analysis of the representativeness of ozone monitoring sites established an average representational radius of 15 kilometers per site that would also probably be applicable to PM2.5, but the coarse fraction of PM10 is known to be even more variable and would require an even denser network for full monitoring. District, State and EPA resources cannot be expected to saturate the SJV with monitoring at a density that would be required to establish a definitive case for the entire valley.

Note that many high wind events are not accompanied by blowing dust. The CIMIS 2002 data for Blackwells Corner reports 118 days with winds over 13 miles per hour (mph) but Caltrans issued blowing dust advisories on only 14 days for locations in Kings and Kern Counties. Also, entrainment of blowing dust in such an event moves the particulates from the source area to other areas in the Valley where downwind monitors would be able to detect the heightened levels of particulates. The District has detected some high hourly rates observed downwind for a few events but not for such substantial periods that the federal 24-hour standard is exceeded. Furthermore, evaluation of past events indicates that often the area with the highest PM10 levels is not where the wind is highest, but rather where the wind begins to slow. To understand the dynamics of this pattern we need only review the mechanisms for entrainment and deposition. When the wind slows, it can no longer keep the larger PM10 particles aloft and they settle toward the surface. The settling of particulates from aloft layers down into the surface layer results in an increased concentration in the deposition area.

Response to Issues Raised by Mr. Swanson

This correspondence will provide a review of the conclusions reached by the District in evaluation of issues raised by Mr. Swanson. Technical analysis and supporting information is provided in following discussion and attachments.

Caltrans 2002 Data Comparison to Air Quality Data

Wind caused by the regular summer cycle of heating and cooling has not been linked to PM10 exceedances. By definition, wind from this type of heating and cooling cycle does not result in prolonged high wind conditions. The cause of long periods of high winds is linked to larger scale synoptic factors.

Evaluation of the Caltrans data for 1998 to 2002 wind advisory events and dust incidents did not show a correspondence to observed PM10 events, and District observed PM10 events did not correspond to Caltrans reported incidents of blowing dust. The dates identified by Caltrans were not connected with high PM10 events except for a May 20, 2002 event involving thunderstorms and hail. When a high

PM10 event was detected during this 1998 to 2002 period, other than the May 20th event, the local wind speeds were less than thirteen miles per hour with very few hours above even eight miles per hour detected at any CIMIS site in the SJV.

Windblown dust as reported by Caltrans does not necessarily mean there is a PM10 exceedance. Caltrans low visibility warnings should not be interpreted as an indication that PM10 levels exceeded the 24-hour federal standard causing an exceedance day. Some of these events have passed through urban areas where we have hourly monitors. The data has been observed to achieve hourly levels two or three times the federal 24-hour standard, but the daily average still meets the federal 24-hour PM10 standard requirements. The form of the federal standard would have to be revised in the future if it is determined from health studies that short-term multi-hour exposures require action. Also, we should keep in mind that much of the wind blown material observed and of importance to Caltrans windblown dust safety advisories may be larger than 10 microns in aerodynamic diameter, which was previously regulated under the TSP (total suspended particulate) standard that has been withdrawn from air quality regulation requirements by subsequent federal health impact review that established the PM10 24-hour federal standard.

Blackwells Corner and Other SJV High Wind Events

Analysis of all high wind events since 1990, including special evaluation of sites on the west side of the SJV, did not establish a linkage to observed PM10 events. A representative spectrum of high wind days was captured by the sixth-day monitoring schedule to allow examination for evidence of correlation. This review included the 2002 and prior CIMIS data for Blackwells Corner and did not find a correlation to observed PM10 federal exceedance episodes.

The data was processed to evaluate all observed PM10 federal exceedances since 1990 for evaluation of correlations to CIMIS wind data reported for those dates. The CIMIS data was processed to identify the hours of wind at all reporting sites that exceeded twenty mile per hour, thirteen miles per hour and eight miles per hour. CIMIS data was also evaluated for the effect of gusts by examining data involving the highest maximum hourly winds. A special grouping of west side CIMIS sites was also established to examine the top events of high winds in the southwest portion of the SJV. This data was also reviewed for the effect of precipitation by examining data including precipitation events and excluding events where more than trace levels of precipitation were recorded at three or more SJV CIMIS sites. Viewing the data with and without rainfall events ensures that including or omitting rainfall does not bias the analysis of probable wind events.

The PM10 data observed at monitoring sites was evaluated in comparison to the top one hundred values of each of the CIMIS analyses to determine whether the sixth-day sampling schedule captured a representative set of these events and what correlations might exist between the high winds and PM10 observations. The

monitoring schedule did capture a representative sample averaging 18 percent coincidence with high wind days (expected is 17%). From this review, only five PM10 events were connected to high winds in the thirteen years of PM10 data. A table describing these events is attached. Other PM10 events occurred during stagnation events or days with relatively few hours of elevated winds. The other PM10 events are listed in the analysis files but are not further described herein because this evaluation is an effort to examine the correlation, if any, of long periods of high winds to PM10 concentrations that violate the federal 24-hour standard.

Three of the five PM10 events that correlate to periods of high wind occurred in 1990 and 1991 during a multi-year protracted drought. One event affected only one site that may have been impacted by local activity. The second was regional in the Lake Tulare area. The third affected only the southeast SJV Bakersfield-Oildale area but did not cause a violation at Taft.

The fourth PM10 event occurred during harvest activities on October 4th 1995 during a special monitoring program to evaluate the cause of high PM10 readings in Corcoran (the IMS95 study). Additional non-federal reference monitoring conducted during the IMS95 study in the area surrounding the community of Corcoran recorded levels near but below the federal 24-hour PM10 standard on days when Corcoran exceeded the federal 24-hour PM10 standard. This supplemental data helps us to understand that high levels in Corcoran do not represent a regional episode but rather the combination of elevated regional levels combined with harvest related activities in the community.

The fifth and final PM10 event correlating to high winds was observed during the already mentioned May 20, 2002 thunderstorm that caused an exceedance at one site in Bakersfield but had lower PM10 concentrations only a few miles away in the same city and very low values elsewhere in the Valley. Clearly this was not a regional particulate event even though the stormy weather affected the entire Valley.

Supporting Documentation for the Analyses

Analysis of Caltrans wind advisory information included review of the list of 2002 wind advisories discussed by Mr. Swanson and the Caltrans list of fall 1998 to February 2003 blowing dust episodes.

CIMIS wind information from 1990 to 2002 was correlated to SJV PM10 observations for the same years. An electronic file of this data is available for your review. The data was sorted to examine:

- Maximum 24-hour PM10 concentrations above the150 microgram federal standard, correlated to evaluate CIMIS wind observations
- CIMIS maximum hours observed with winds over 13 mph for all events, and separately for events with winds over 13 mph not related to significant rainfall, checking at least the top hundred events on each of these lists for correlation to observed federal PM10 exceedances

- CIMIS maximum hours observed with winds over 8 mph for all events, and separately for events with winds over 8 mph not related to significant rainfall, checking at least the top hundred events on each of these lists for correlation to observed federal PM10 exceedances
- CIMIS maximum hourly wind observed for all events, and separately for events with maximum hourly wind observed not related to significant rainfall, checking at least the top hundred events on each of these lists for correlation to observed federal PM10 exceedances
- CIMIS maximum hours observed with winds over 13 mph for a special grouping of CIMIS sites in the southwest SJV for all events to check for correlation to significant large scale wind events, and separately for the same sites examining events with winds over 13 mph not related to significant rainfall, checking at least the top hundred events on each of these lists for correlation to observed federal PM10 exceedances

Prior Submission of Related Evaluations

The meteorological evaluation for PM10 episodes that occurred during previous recent years (1997-2002) was included with the District's PM10 Plan. This analysis is also available as a separate file for each episode. The review in the PM10 Plan includes information about synoptic patterns, meteorological parameters of importance for each event, observed PM10 concentrations and their chemical composition if available.

Additional information was sent by electronic message to Ms. Karen Irwin at EPA Region IX with preliminary information on this issue. A file of 1990 to 2002 federal PM10 exceedance events was provided to allow your direct examination of PM10 exceedance data and related parameters. After the drought ended 1990-1991, none of the events listed are connected with high wind events and only one (in 1991) was connected to a moderate period of elevated winds. The historical review file also includes 1997-2002 average and peak wind speed data for federal PM10 exceedance events reflecting that high winds were not involved in the observed episodes. A historical rainfall chart included in this file reflects the drought that began in 1986 and did not end until 1992. This protracted drought and reduced irrigation water deliveries did cause increased levels of geologic dust emissions, with or without wind.

The electronic message sent to Ms. Irwin also contained text and attachments that provide independent verification of the District's analysis contained in the PM conceptual model from evaluation of IMS95 data by AER, paid for by PGE. Table 4-1 on page 4-3 of the AER document indicates wind speeds during episodes of less than 2 meters per second (4.5 miles per hour). This conceptual model has been accepted in the CRPAQS Technical Committee. The Committee accepted their analysis as valid and sent it to our CRPAQS modeling and data analysis contractors for their information and use. It confirms our District analysis that the highest PM10

events in the fall are related to low wind speeds with low inversion heights and strong stability factors rather than high winds. Relevant discussion from the AER document is excerpted from pages 4-8 and 4-10 and page 5-4.

> "There is little direct evidence from which to infer the dominant physical transport processes affecting the concentrations of PM in the San Joaquin Valley in the fall. Collins (1998) showed that PM concentrations are generally highest during periods of light and variable winds which tend to come from the southeast. Lower PM concentrations were associated with stronger northeasterly winds. As shown in Figure 4-4, PM10 concentrations correlate well with the aloft temperatures measured at Oakland, CA (850 mB temperature at about 1500 m or 5000 ft), indicating reduced mixing as a major cause of the observed PM episodes. Furthermore, both primary (e.g., dust) and secondary components (e.g., nitrates) increased during the fall episodes. These observations tended to support a sub-regional build-up of PM as the culprit of the pollution episodes under the particular fall conditions.
>
> The dominance (57%) of dust or geological material in the PM composition also supported the sub-regional build-up hypothesis, as coarse materials are generally not transported over great distances. The correlation of PM10 concentrations among the core and satellite sites (i.e., the fact that the concentrations at all sites increase and decrease together) indicated that meteorology was the driving force behind episodes in the Corcoran area. Spatial variability recorded by the network was attributed to local influences. It was found that industrial sites tended to record higher concentrations than the residential sites. Average PM10 concentrations were 134 mg/m3 at the industrial sites, 113 mg/m3 at the agricultural sites, and 112 mg/m3 at the commercial / residential sites (Chow and Egami, 1997). However, because of the intermittent nature of the many PM-generating activities, observations of activities did not correlate well with the 24-hour data that were collected (Coe and Chinkin, 1998). No meteorological data were available at the monitoring sites to evaluate the contribution of local wind-blown dust.
>
> Long-range surface transport from upwind pollutant sources to Corcoran was unlikely, as the surface wind speed was typically less than 2 m/s during the fall episodes in Corcoran. Mixing height, upper air winds, and concentration data are necessary to evaluate the impact of vertical mixing and long-range transport of precursors and PM aloft.
>
> Wet deposition probably played a minor role in the dissipation of PM during the fall episode. No rain was reported during the PM monitoring period in November, and only patchy evening fog was reported in Fresno."
> "….A primary component of the fall PM10 is geological material (dust), which accounted for over 50% of the mass according to CMB analyses. Limited information is available regarding the source of the dust particles. Given that wind speeds were typically less than 2 ms-1, it seems unlikely that wind

blown dust was a significant contributor to PM10. Other sources of mechanically generated aerosols, such as paved and unpaved roads and farming activities, may be addressed by tracer experiments. Ammonium nitrate (16%) was the second most common component, followed by excess OC (about 10%), which included both primary and secondary components. Accurate geological material profiles and tracer-based organic profiles are needed for major San Joaquin Valley primary sources to increase the resolution of the CMB methods and to elucidate the importance of secondary organic compounds.

A sub-regional build up in the vicinity of Corcoran seemed to be a reasonable hypothesis during a multi-day episode. Although local sources were postulated to explain the spatial variability, there was no direct evidence to link observations of local emissions to elevated 24-hour PM measurements. The atmospheric lifetimes of particles due to settling are functions of particle diameters. The range of PM transport may be estimated if particle size measurements are available. This information may be used to infer the mechanism of sub-regional buildup of PM in the San Joaquin Valley during the fall season. To evaluate the effects of transport, upper level wind and mixing height data are required. Measurements of dry deposition of particles and precursor gases may be needed to refine estimates of areas of influence."

Technical Limitations of the Evaluations

As with any technical evaluation, there are limits to the quantity and quality of data available for analysis. A discussion of the technical limitations is appropriate in order to fairly reflect the uncertainties inherent in the analyses performed to examine this issue.

- CIMIS data doesn't report gusts. The closest surrogate value we can use is high maximum hourly speed as reported in he CIMIS data. Most CIMIS data is collected at two meters rather than ten meters (ASOS and District method). CIMIS data provides values that are known to frequently understate the wind aloft, but two-meter data is more appropriate to establish surface wind entrainment speeds.
- The District network of PM10 monitors are placed in accordance with NAAQS CAA requirements, but this results in a lack of monitors on the west side of the SJV. This has been addressed to the extent possible by synoptic evaluation and special analysis and grouping of CIMIS site data from the west side of the SJV.
- Sixth-day sampling for PM10 will not capture every high wind event; therefore, the data has been analyzed to determine if the six day sampling schedule for PM10 has captured representative events of high wind.

- PM10 and CIMIS monitors are not necessarily located where winds are highest during each event. This limits the ability to review with certainty whether winds actually reached entrainment velocities at some location in the SJV during the episodes. This possibility has been addressed in the District's analysis by also examining winds over eight miles per hour.
- Extensive synoptic analysis has been performed only for high PM10 observations during the period of review required for the development of the PM10 Plan. Synoptic evaluation for days when we have low PM10 values is, of course, not enlightening for this discussion. CIMIS data has been used in conjunction with on file analysis of historical events to review high wind events that occurred in years prior to the events reviewed for the PM10 Plan.

Summary

Reevaluation with CIMIS and Caltrans data confirms the District PM10 Plan statements and does not provide a basis for revision. Review of more than a decade of data provides no evidence of any significant linkage between high winds and PM10 federal exceedance events in the SJV. While uncertainties and data limitations restrict the depth of this evaluation, statistical checks have determined that a representative sample of the high winds days did coincide with PM10 observation days to permit a reasonable evaluation. Both scientific third party analysis and internal review by the District provide the same conclusion that SJV PM10 events are linked to low wind speed events coupled with other synoptic factors.

Regards,

James W. Sweet

James W. Sweet
Air Quality Project Planner/Atmospheric Modeler
Central Region Office, Planning Division,
1990 E. Gettysburg Avenue, Fresno, CA 93726-0244

c: Karen Irwin, EPA Region IX, Carol Bohnencamp, EPA Region IX

1 enclosure

	Days with Monitored PM10 Exceeding 150 ug/m3 that Correspond to High Wind Screening Criteria				
	2/16/1990	**9/9/1991**	**11/14/1991**	**10/4/1995**	**5/20/2002**
Concentrations	439 ug/m3 Kettleman	279 ug/m3 Kettleman, 204 ug/m3 Corcoran, 175 ug/m3 Visalia 164 ug/m3 Hanford	173 ug/m3 Bakersfield, 169 ug/m3 Oildale	279 ug/m3 Corcoran	189 ug/m3 Bakersfield (Chester Avenue site)
Monitoring Comments	Valley wide monitoring. 89 ug/m3 in Modesto was the next highest concentration.	Valley wide monitoring.	Valley wide monitoring. 123 ug/m3 in Taft was the next highest concentration.	Corcoran monitoring only. Extra sampling for the IMS 95 Study.	Valley wide monitoring. 65 ug/m3 in Bakersfield (California Street) was the next highest concentration. All other sites were less than 25 ug/m3.
Precipitation Comments	All CIMIS sites recorded precipitation. This is a known drought year.	No CIMIS sites recorded precipitation. This is a known drought year.	Two CIMIS sites recorded precipitation, but the data looks suspect and should be verified. This is a known drought year.	No CIMIS sites recorded precipitation.	Most CIMIS sites recorded precipitation. Thunderstorms and hail were witnessed on this day in the SJV.
Wind Comments	Strong winds throughout the valley.	Strong winds throughout valley.	Strong winds throughout valley.	Strong winds throughout valley.	Strong winds throughout valley. Strongest winds in the southern SJV.
Additional Comments	Site affected by local activity – moving of bulk storage pile of sand.	Reduced water delivery impacted west side agricultural activities.	Episode occurred during a transitional time of year. This could be either a geologic or nitrate dominated episode.	IMS-95 measurements in the surrounding area during this study showed lower concentrations in the rural areas than at the urban site.	Regional weather influence; however, only one site experienced an elevated PM10 concentration.