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Date: March 18, 2010

Subject: Evaluation of the San Luis Obispo County Air Pollution Control District report, “South County Phase 2 Particulate Study,” dated February 2010.

The California Geological Survey (CGS) has prepared this evaluation of the report “South County Phase 2 Particulate Study” (Phase 2 report), at the request of the Off-Highway Motor Vehicular Recreation Division (Division) of California State Parks (CSP). The Phase 2 report was prepared by the San Luis Obispo County Air Pollution Control District (SLOAPCD). The Phase 2 report was issued via the SLOAPCD website on February 22, 2010. The Division manages the Oceano Dunes State Vehicular Recreation Area (SVRA), which is in southern San Luis Obispo County (Figure 1, attached). The SVRA is within the active Callender Dune Sheet, which is west of the Nipomo Mesa area of San Luis Obispo County (Figure 2, attached). The locations and general timelines of air monitoring stations operated by SLOAPCD for the Phase 2 report are shown in Figure 3, attached.

1.0 Summaries and Analyses of the Phase 2 Report

Please note the topics presented below are grouped for clarity and summary purposes. They do not correspond directly with the format of the Phase 2 report.

1.1 Misidentification of a dune “crust,” unquantified dune vegetation acreage, and inaccurate comparisons to Owens Lake.

<u>Summary</u>

The SLOAPCD determined PM10 particulate (airborne particles 10 microns in diameter and smaller) is impacting the Nipomo Mesa. It determined that much of the PM10 is derived from the earth’s surface—particle remnants of eroded rock and soil.

The Phase 2 report states that PM10 is generated naturally by prevailing west-northwest winds blowing over active coastal dunes in southern San Luis Obispo County. The Phase 2 report claims, based on downwind PM10 measurements taken at different air monitoring stations, that more PM10 is generated when the prevailing winds blow over that portion of the SVRA where off-highway vehicles (OHV) are driven. It states that less PM10 is generated by the prevailing winds blowing over the dunes undisturbed by OHV recreation, but during high winds these dunes can also be a notable source of PM10. The report states that the process of saltation, where sand grains are bounced along the dune surface by the wind, generates PM10. Saltation is a well-documented process of dune formation and migration (Bagnold, 1965; Hunter, 1977; White and Tsoar, 1998).

According to the report, more PM10 emanates from the SVRA because OHV activity "prevents formation of a stabilizing crust in the SVRA through continual disturbance of the sand surface" and "prevents vegetation from growing in the riding area" of the SVRA (page 6-5). The authors state wind will move sand more readily in a dune environment when there is no "stabilizing crust" and little or no vegetation. They equate their observation of a crust in the dunes south of the SVRA to a crust that forms in the Owens Lake playa, in Owens Valley, California.

<u>Analysis</u>

The process of grain saltation occurs with dune formation and migration and does cause, with each grain impact, finer material to be suspended and entrained in the air for varying distances, depending on the size and mass of the suspended particle and wind speed (Bagnold, 1965). The Phase 2 report adequately documents that PM10 derived from particles of eroded rock and soil is lifted by prevailing winds to the Nipomo Mesa.

It is likely that some of the PM10 detected in the Nipomo Mesa vicinity is due to the natural saltation processes which have built the extensive sand dune sheets of southern San Luis Obispo County and northern Santa Barbara County (Figure 2). Remarkably, given that detected PM10 likely occurs because of the geologic setting, the Phase 2 report does not have a section regarding regional geology and presents no discussion on the extent of dunes, dune formation, or dune morphology. Without such discussion, the authors missed the chance to explain why one area of the county is naturally more susceptible to PM10 that is silica-rich due to the deposition of quartz-rich sands onto the beach.

Additionally and probably because there was no consideration of geologic setting, the authors mistakenly and repeatedly equate the coastal dune environment of the south county to Owens Lake. Owens Lake is a high desert playa—a broad, very shallow basin with no outlet. Waters that flow to the basin are mineral-rich and eventually evaporate, leaving behind a durable crust of mineral salts. In the most basic of ways, the coastal dunes of southern San Luis Obispo County differ from the Owens Lake playa because they are dunes, not a dry lake, and because they are on the coast, not the high desert. And there is no "stabilizing crust" in the dunes south of the SVRA that is comparable to the salt flats of the Owens Lake playa. There is no "stabilizing crust" at all. The authors mistakenly identify dune laminae as a "stabilizing crust."

The laminae, which can be planar or concave, nearly horizontal or inclined, form and obliterate as a process of dune formation and migration and result from the grain sorting and packing processes that occur with saltation (Bagnold, 1965; Hunter, 1977). Different laminae types are present throughout a given dune (Figure 4), whether the dune is in the SVRA (Figures 5 and 6) or somewhere else.

The Phase 2 report states that SLOAPCD “staff discussions with experts on dune morphology and vegetation showed a consensus of opinion that OHV activity has increased the size of open sand sheets in the SVRA” (page 6-5). Two references are given with this statement. One is for a conversation with R.E. Moss. The other is for a “U.S. Geologic [sic] Survey” publication regarding OHV use on United States Bureau of Land Management (BLM) land. It is unclear what other experts were consulted so that a consensus of opinion could be discerned by SLOAPCD staff.

CGS conducted a study of the islands of vegetation within the SVRA (CGS, 2007). The report contains an extensive discussion on the regional geologic setting and dune processes, including the presence of laminae. The study also quantified that the total area of vegetation within the SVRA has increased, not decreased, by at least 80 acres since 1985. CGS staff gave a copy of the study to SLOAPCD staff in 2008 to use for their Phase 2 report (CGS, 2008). The CGS study was not among the references listed in the Phase 2 report.

1.2 “Threshold wind speed” for sand flux in SVRA based on winds measured 2.5 miles inland.

<u>Summary</u>

The authors conducted sand flux (sand movement) measurements in the SVRA and in undisturbed dunes south of the SVRA to demonstrate that the “threshold wind speed” needed to move sand in the SVRA was less than in the undisturbed dunes. “Threshold wind speeds” were determined to be 7.7 to 10.6 miles per hour (mph) in the SVRA and 13.3 mph in the undisturbed dunes. Wind velocities used to determine threshold wind speeds in the SVRA were taken from an anemometer positioned 7 meters above the ground surface and located at an air monitoring station (the CDF station) that is approximately 2.5 miles from the ocean shoreline (Figure 3). Wind velocities used to determine threshold wind speeds in the undisturbed dunes south of the SVRA were taken from an anemometer positioned 2 meters above the ground surface and located at an air monitoring station (the Oso station) that is approximately 1.5 miles from the ocean shoreline (Figure 3).

The wind velocity values from each anemometer were adjusted to what the wind velocity would be at 10 meters as calculated by the “wind profile power law.” The authors tested the validity of this multiplier law by positioning the 2-meter high anemometer at the Mesa-2 station (Figure 3) and correlating its readings and its corresponding calculated 10-meter-high wind velocity values to the readings from the Mesa-2 anemometer which is 10 meters high. The Mesa-2 station is approximately 4 miles from the ocean shore. Noting an acceptable correlation

(Appendix A of the Phase 2 report, page A-9), SLOAPCD staff deployed the 2-meter high anemometer to the Oso station.

The authors note that wind speeds measured at the Oso station were about 70% greater than measured at the CDF station and that winds at the Oso station “were much less variable,” blowing more consistently from the northwest and west-northwest.

To correlate the adjusted wind velocities from the Oso and CDF stations to respective sand movement on the undisturbed dunes and dunes in the SVRA, 15 canisters (Cox sand catchers) were deployed, nine in the SVRA, and six upwind of the Oso station (Figure 3). The canisters have a slot that is positioned 15 centimeters above the ground surface, and blowing sand at that height is collected in the canister. The amount of sand collected in each canister over a 24-hour period was weighed and used to calibrate hourly sand movement measured at one of three Sensit meters, two located in the SVRA and one upwind of the Oso station. The authors note that more sand mass was collected in the canisters upwind of the Oso station, in the undisturbed dunes, than in the canisters positioned in the SVRA. The authors state this is “likely due” to the higher winds measured at the Oso station compared to the CDF station.

Analysis

The canisters used to determine sand movement in the SVRA were located as close as 1/3 mile from the ocean shoreline (Figure 3). Wind velocity, used in conjunction with the sand mass data collected from the canisters to determine the “threshold wind speed” of sand movement in the SVRA, was measured from 7-meter high anemometer located at the CDF air monitoring station. The CDF station is approximately 2.5 miles from the ocean shoreline.

By contrast, wind velocity data used to determine “threshold wind speed” in the undisturbed dunes south of the SVRA were collected from a 2-meter high anemometer at the Oso station, approximately 1.5 miles from the shoreline.

Based on distance from the shoreline—and the active dunes—the Oso station and the CDF station are not comparative environments from which to collect wind speed data used to correlate sand movement in the dunes. This is underscored by the 70% difference in measured wind speeds between the two stations and the observation by the authors that winds “were much less variable,” at the Oso station, blowing more consistently in the prevailing wind direction. That information should have been an indication to the authors that a station more comparative to the Oso station, or the Oso station alone, should have been used for their calculations.

This is further underscored by Figure 3.49 in the Phase 2 report (page 3-38). This figure shows as lines the averaged wind direction from which “high PM10” was detected at the CDF, Mesa-2, and Oso stations. For clarity, these lines have been reproduced as blue-dashed lines on Figure 3, attached. As can be seen by the alignment with elongated dune morphology, the trend lines for the Oso and Mesa-2 stations align with the west-northwest prevailing wind direction. The averaged wind direction trend-line for the CDF station does not correspond with dune morphology and instead runs oblique to it, indicating a deflection of the prevailing wind. As noted in the Phase 2 report, terrain affects wind movement. It appears, based on the data presented in the report, terrain between the dunes and the CDF station influences wind velocities and directions at the CDF station. This too should have been an indication to the Phase 2 report authors that wind velocities measured at the CDF station cannot be extrapolated as representative of winds at the SVRA.

The applicability of the “wind profile power law,” used to equate wind speed measured at a given height with what wind speed would be at a height of 10 meters, was only tested and determined to be valid at the Mesa-2 station, 4 miles from the shoreline. Its applicability was never tested at the Oso location or the CDF location, and raises questions regarding the accuracy of adjusting measured wind velocities at these locations.

Based on the analysis above, it is reasonable to conclude CDF station wind velocities do not reflect wind velocities at the SVRA. Given that the Oso station is approximately the same distance from the shoreline as the eastern extent of the SVRA (Figure 3), wind velocities measured at the Oso station would be more representative of both undisturbed dunes and dunes within the SVRA.

If only Oso wind velocities were used with the measured sand mass data which showed more sand collected in the sand flux canisters that were positioned in the undisturbed dunes than those in the SVRA, the combined data would indicate that more sand flux—and sand-grain saltation—occurs in the undisturbed dunes than the SVRA. This is not surprising. Dune formation is a display of efficiency. The windward side of a dune is gently sloped and smooth. This provides a relatively unobstructed path for grains to move by saltation. When this surface plane is disrupted, such as by a foot print or a tire track, the wind flow over the sand surface is disrupted, becoming more turbulent and decreasing in velocity (Bagnold, 1965). As a result, sand flux and saltation decrease. This is illustrated in Figure 6, attached, which shows coarse sand grains collecting in tire tracks that have broken through dune laminae.

1.3 SVRA vehicle entrance data show no correlation between daily OHV activity and high PM10 measurements.

<u>Summary</u>

The Division provided SLOAPCD staff with SVRA vehicle entrance data so that the number of vehicles entering the SVRA on a given day could be compared to corresponding downwind PM10 measurement data. The Phase 2 report analysis showed there was little difference in PM10 readings when comparing the busy days to days when there are fewer vehicles driven in the SVRA, and that levels of “average PM10 concentration” on both the 50 busiest days and the 50 least busy days were below levels that would create a health concern. From this the authors conclude day-to-day OHV activity “is not the primary factor responsible for the high PM10 levels measured downwind from the SVRA” (page 6-4).

Analysis

As presented in the Phase 2 report (pages 3-51 to 3-53), 50 days that showed the most vehicles entering the SVRA (the busiest days) were contrasted with 50 days that showed the fewest vehicles entering the SVRA (the least busy days). The average number of vehicles entering on the 50 busiest days was 3738. On the 50 least busy days the average number of vehicles was 380. Corresponding downwind PM10 measurements indicated there is little difference in PM10 readings when comparing the busy days with the least busy days. Table 3.2 in the Phase 2 report (page 3-53) shows an "average PM10 concentration" increase of 5.4 to 7.9 microns per cubic meter when the number of the vehicles recreating at SVRA is increased by an order magnitude.

It seems many more useful comparisons could be made with vehicle entrance data, but the authors only made one comparison that is vaguely described and does not appear to consider meteorological conditions. What is clear from the presented data is that daily OHV activity shows no correlation to high PM10 readings.

1.4 Other potential sources: Data from short-term monitoring for PM10 from agricultural fields and Petroleum Coke Piles are inconclusive.

Summary

Two other potential sources were also monitored for PM10: 1) The agricultural fields west of the Nipomo Mesa; and 2) the petroleum coke piles, which are on land occupied by the Conoco Phillips refinery, located between the SVRA and Nipomo Mesa (Figure 3). The monitoring was performed with specialized equipment called DRUM samplers. The DRUM samplers are used to collect airborne particulate and are battery-operated when deployed to remote locations.

Monitoring for agricultural-related PM10 was conducted as part of the "spring intensive" portion of the Phase 2 field work. The "spring intensive" was a 16-day period in April/May 2008 predicted to have high winds based on seasonal patterns. The "Bluff" intensive station, positioned on the western edge of the Nipomo Mesa (Figure 3), was used to monitor for potential agricultural-related PM10 generated in the fields west of the Nipomo Mesa. Based on data collected from the Bluff station, the Phase 2 report concludes that agricultural activities are not a significant source of PM10 on the Nipomo Mesa (page 6.2).

Monitoring for PM10 from the petroleum coke piles was performed using DRUM samplers positioned at the Mesa-2 station. The Mesa-2 station is downwind, in the prevailing wind direction of the petroleum coke piles (Figure 3). One stated goal of setting up the Mesa-2 DRUM sampler was to "connect coarse aerosols to potential dust sources" (page 5-8).

As presented in Table 2.2 and C-4 of the Phase 2 report, the Mesa-2 DRUM sampler was positioned at the Mesa-2 station from January 2008 to February 2009. It does not appear that the sampler was operational for that entire time. At least one episode of equipment malfunctioning occurred during late April and May, 2008 (page 5-12). The entire length of this breakdown is not presented in the report, and it is unclear if the Mesa-2 DRUM sampler broke down at other times.

Select filter strips from the Mesa-2 DRUM sampler were analyzed for vanadium and nickel, which are, according to the Phase 2 report, “robust tracers of coke materials” (page C-44).

The selected DRUM sampler data represented a 42-day timeframe, from January 14, 2008 to February 24, 2008. Based on vanadium and nickel analyses of the selected filter strip data, the Phase 2 report concludes that the petroleum coke piles are not a significant source of PM10 on the Nipomo Mesa (page 6-2). The rationale for selecting this 42-day period—which is different than the “spring intensive” period—for coke-pile related PM10 source analysis is not presented in the Phase 2 report. Several dust-suppressing rain events during this period were noted in the Phase 2 report (page 5-10).

Analysis

Some shortcomings of the DRUM samplers deployed for the Phase 2 field work are noted in Section 5.3.1 of the Phase 2 report. The specialized DRUM sampler equipment differs from equipment used at CDF and Mesa-2 stations and elsewhere to determine 24-hour PM10 concentrations. These instruments are called tapered element oscillating microbalance samplers, or TEOMs. According to the Phase 2 report, the TEOM sampler is designated as a federally equivalent measurement method for use in determining compliance with ambient air quality standards, and “DRUM data should not be compared to TEOM data or health standards” (page 5-8). Additionally, the report states “TEOM data always showed higher 24-hour average concentrations than the DRUM samplers” on days with elevated winds (page 5-8). This was apparently due to the “coarsest fraction of the DRUM data appearing suppressed during wind/PM episodes, indicating the possibility of loss of mass on the coarsest drum stages” (page 5-8).

These shortcomings indicate that whatever particulate concentration is determined from DRUM data it will be less than federally-recognized TEOM data and because DRUM data cannot be compared to TEOM data, a proportional difference between DRUM and TEOM data cannot be determined. This makes the relevance of the DRUM data to the Phase 2 report unclear. Additionally, because the coarsest PM10 material is not being captured by the DRUM samplers, the stated goal of setting up the Mesa-2 DRUM sampler to “connect coarse aerosols to potential dust sources” is compromised and potentially unachievable.

Additionally, with regard to potential agricultural PM10 sources, it seems the Phase 2 report authors are making a year-round correlation to DRUM data collected over 16 day period. Given that no data are presented regarding agricultural operations in the south county, and no data regarding annual precipitation and seasonal fluctuations in soil moisture are presented in the Phase 2 report, this correlation is unsupported.

Similarly, a year-round correlation with DRUM data collected downwind from the petroleum coke piles during January and February 2008, when several dust-suppressing rain events were documented, is unsupported in the Phase 2 report.

1.5 A potential PM10 source disregarded: Fine particles observed on SVRA fences

Summary

In October 2007, when the Phase 2 effort was in its initial design stages, CGS led SLOAPCD staff to a wire fence that runs along the shoreline and marks the western perimeter of a dune preserve on CSP property. CGS wanted SLOAPCD staff to observe fine particulate that had glommed onto the wire (CGS, 2008). Some of the material formed what appeared to be dried, droplet-shaped clods hanging off the wire strands. The clods could be pulled off the wire and easily smeared between thumb and finger to a makeup-like fineness. The material has been observed by CGS and CSP staff to be present seasonally in the spring and fall, during and after periods of high winds and high surf. It has been observed on the fences and on vegetation within the SVRA. We felt this could be a potential source of PM10 which originates from the ocean, and we explained to SLOAPCD staff that the material could be fines washed to the ocean via Arroyo Grande Creek, the Santa Maria River, and the many coastal drainages in the headlands north and northwest of the SVRA.

According to the report presented in Appendix C of the Phase 2 report, two samples of a similar material “adhering to beach fences” were taken in “spring, 2008.” One sample was taken from the fence near shore; the other was from a fence near the eastern perimeter of the SVRA. The samples were analyzed “for elements from aluminum though molybdenum, plus lead.” The Appendix C report concluded that the material was “very fine soil-derived material with only a small admixture of oceanic components” (page C-31). Lead was detected in the near-shore sample, and the authors deduced that the lead was a “relic of vehicle use of the beach prior to banning leaded gasoline in the state; or it may reflect local illegal use of leaded gasoline” (page C-29).

Analysis

The Phase 2 report authors chose to interpret detected lead as a legacy sign of leaded gasoline use and/or a sign of illegal activity by OHV recreationists. A more objective interpretation might be that particles of galvanized metal from the fence were included with the collected sample, and that metal may contain lead, along with zinc, from the galvanization process.

No interpretation as to the origin of the “very fine soil-derived material” was made in the Phase 2 report. This leaves a potential source of PM10, one that appears to have been blown shoreward from the ocean, uninvestigated.

2.0 Other Concerns

Much data were presented in the Phase 2 report, and there was only a limited time to review the document and prepare this evaluation. The above evaluation only partially summarizes our concerns as to the adequacy and accuracy of the Phase 2 report. Remaining concerns include:

- Equipment Malfunctions. Much of the equipment used to collect data for the Phase 2 report malfunctioned. While this is understandable whenever sensitive equipment is deployed to the field, the extent of equipment malfunctions for the Phase 2 work is significant. A partial compilation of malfunctions is presented below, as printed in the Phase 2 report (page 5-12).

  > "Note that samples from the 10 Commandments site are absent from these data because the 8 DRUM sampler used at this location failed the ± 15% equivalency in the side-byside [sic] tests at Mesa 2. In addition, the Oso sampler failed due to battery/inverter problems afterthe [sic] 4/29 episode, and the Mesa2 sampler failed following the 4/30 episode due to electrical problems. As a result, the Oso data is only represented in the 4/29 episode, and the Mesa2 data presented represents an average of the 4/29 and 4/30 episodes."

  It is important to note the above excerpt is from Section 5.3.3, which details findings of the "spring intensive" portion of the study. The "spring intensive" monitoring, described as the "heart of the Phase 2 study design," was to occur over a two-week period. Based on the malfunctions described above, it appears only one day of usable "spring intensive" data was obtained from the Oso site and only two days from the Mesa-2 site. The ramifications of these data gaps are not discussed in the report, nor are the data gaps disclosed when "spring intensive" data are displayed in Figures 5.16 and 5.17 of the report (page 5-13).

- 24-hour versus hourly PM10 concentrations on Nipomo Mesa. The report confusingly alternated between displaying hourly PM10 concentrations and 24-hour PM10 concentrations without adequately explaining in the report text the difference in presented data. The number of days when 24-hour PM10 concentrations violated state and federal standards, and the station locations where those violations were measured, were not mentioned in the report.

- Salt component of PM10. This was inadequately and confusingly explained in the Phase 2 report. Salt concentrations downwind of the SVRA were alternatingly 5 percent, 10 percent, or 25 percent of detected PM10, as determined by analysis of DRUM sampler strips. As stated above, the Phase 2 report stipulates that DRUM data cannot be compared to federally-recognized TEOM data, and so a proportional correlation that would accurately represent salt concentrations in TEOM readings cannot be made.

- Quality assurance side-by-side testing of DRUM samplers. Section 5.3.1 of the Phase 2 report (page 5-7) and Part 3 of the Appendix C report (page C-48) detail quality assurance testing of DRUM samplers deployed for the April 26 to May 11, 2008 "intensive period." A DRUM sampler was deployed to the Guadalupe Dune Center (Dune Center) in September 2008. No quality assurance testing of the Dune Center DRUM sampler is presented in the Phase 2 report. Additionally, the relevance of the Dune Center data to the "spring intensive" data is not explained.

- Analytical Data from Lawrence Berkeley National Laboratory. The Appendix C report notes that soil particles less than 56 microns in diameter were to be analyzed by "Lawrence Berkley [sic] National Laboratories for elemental composition in October, 2009, but the results were not returned until late December 2009" (page C-8). This leaves the impression that the authors received the data too late to incorporate into the Phase 2 report, but it is also ambiguous. There were approximately 3 months of "peer review" conducted prior to issuing the Phase 2 report on February 22, 2010, during which time the Lawrence Berkeley analytical data could have been incorporated into the report. It remains unclear if these important particulate composition data are presented and discussed in the Phase 2 report.
- Data presentation. Many graphs were used in the Phase 2 report but few, if any, of the numbers used to generate the graphs were provided when the Phase 2 report was posted to the SLOAPCD website on February 22, 2010. Additionally, graphs developed for the reports in the appendices of the Phase 2 report have been excerpted for use in the main report. While this is not an unusual practice, in the case of the Phase 2 report misrepresentations have resulted. For example, a bar graph labeled as Figure C-67 in Appendix C (page C-55) is entitled, "Aerosol Episodes of April 29, 30, and May 1." There is an important note in the caption of the figure that reads: "Note that, due to sampler failures, the Oso data represents only 4/29, and Mesa 2 represents only 4/29 and 4/30. Data from TEOM monitors show 4/29 was the highest PM episode, followed by 4/30; 5/1 was the lowest." This bar graph is used in the body of the Phase 2 report (Figure 5-16 on page 5-13) and in the executive summary of the Appendix C report (Figure EX-10 on page C-EX-11), and in public presentations given by SLOAPCD staff, but the important note regarding partial data sets and equipment breakdown is not.
- Ten Commandments "Intensive." CGS and CSP staff were briefed on the findings of the Phase 2 report by SLOAPCD staff on November 25, 2009. SLOAPCD staff gave a PowerPoint presentation of the findings, but no documents or data were given to us. We were told the report was undergoing peer review. We inquired about data collected at the Ten Commandments "intensive" station, located on a large open dune sheet several miles south of the SVRA (Figure 3). The Ten Commandments station was chosen for comparative purposes because it was in an open dune sheet that is similar in origin to the Callender Dune Sheet, and the area has been closed to OHV recreation for more than three decades. We were told by SLOAPCD staff that the equipment at the station was buried by sand. This important anecdote was not disclosed in the report.

3.0 Conclusions

The Phase 2 report documents elevated PM10 concentrations in the Nipomo Mesa area, but because the report fails to address the geologic setting and natural processes that created the massive dunes sheets in southern San Luis Obispo County and northern Santa Barbara County (Figure 2, attached), it fails to adequately differentiate and evaluate potential PM10 sources. With regard to specific data and interpretations presented in the Phase 2 report, CGS concludes:

- With no consideration for geologic setting or processes, the authors misidentify dune laminae (Figures 4, 5, and 6, attached) as a dune “crust” and make inaccurate comparisons to Owens Lake, a very broad, high desert dry-lake basin.
- Correlations of wind speed that was measured 2.5 miles inland cannot be made to sand movement in the coastal dunes.
- More sand was collected in sand canisters positioned in undisturbed dunes than those positioned in the dunes of the SVRA. Given this and assuming wind speeds are the same in each setting, more saltation—and potentially the generation of more PM10—is occurring in the undisturbed dunes.
- No analysis of SVRA dune vegetation acreage over time is presented in the report. The authors failed to use a CGS study offered to them (CGS 2007) which quantified an increase in vegetation acreage within the SVRA since 1985.
- SVRA vehicle entrance data shows no correlation between daily OHV activity and high PM10 measurements in the Nipomo Mesa area.
- Agricultural operations data for the south county, annual precipitation data and soil moisture data were not presented or analyzed in the Phase 2 report. Year-round correlation to data collected from short-term monitoring for PM10 from agricultural fields cannot be made without consideration of these data. The Phase 2 report finding that agricultural activities are not a significant source of PM10 on the Nipomo Mesa appears unsupported.
- No rationale was presented in the Appendix C report as to why a 42-day period with several documented rain events was deemed correlative to determining the extent of PM10 from the Conoco Phillips petroleum coke piles on a year-round basis. The Phase 2 report finding that the petroleum coke piles are not a significant source of PM10 on the Nipomo Mesa appears unsupported.
- The DRUM sampler equipment used for short-term monitoring differed from the TEOM samplers used at CDF and Mesa-2 stations and elsewhere to determine 24-hour PM10 concentrations. According to the Phase 2 report, the TEOM sampler is designated as a federally equivalent measurement method for use in determining compliance with ambient air quality standards and “DRUM data should not be compared to TEOM data or health standards” (page 5-8). Additionally the report states “TEOM data always showed higher 24-

hour average concentrations than the DRUM samplers" on days with elevated winds (page 5-8). This indicates that whatever particulate concentration is determined from DRUM data it will be less than federally-recognized TEOM data and because DRUM data cannot be compared to TEOM data, a proportional difference between DRUM and TEOM data cannot be determined. This makes the relevance of the DRUM data to the Phase 2 report unclear and the DRUM data inconclusive.

- Fine material accumulates on near-shore fences and vegetation in the SVRA. The material is observed to accumulate seasonally with high winds and high surf. CGS led SLOAPCD staff to locations where they observed this material. While the Phase 2 report authors analyzed the material, they failed to address its potential origin. This leaves a potential source of PM10, one that appears to have been blown shoreward from the ocean, uninvestigated.
- Constraint of time prevented CGS from conducting a more thorough evaluation of the Phase 2 report. Other concerns as to the adequacy and accuracy of the Phase 2 report are listed in Section 2.0 above.

Based on the above evaluation of the Phase 2 report, CGS ultimately concludes that the data presented in the report do not support the report's finding that open sand sheets disturbed by OHV activity emit significantly greater amounts of particulates than undisturbed sand sheets under the same wind conditions.

Should you have any questions regarding this evaluation, please feel free to call.

Respectfully submitted,

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Figures attached:

Figure 1: Oceano Dunes SVRA and Vicinity
Figure 2: Location of the Callender Dune Sheet within the Santa Maria Valley Dune Complex
Figure 3: Oceano Dunes SVRA and Vicinity – Detail of SLOAPCD Phase 2 Monitoring
Figure 4: Cross-bedded dune laminae exposed in a cutbank of the Santa Maria River, Mussel Rock Dune Sheet, Santa Barbara County
Figure 5: Planar dune laminae and over-riding sand ripples observed within a vegetation island of Oceano Dunes SVRA
Figure 6: Planar dune laminae and OHV tire tracks, Oceano Dunes SVRA

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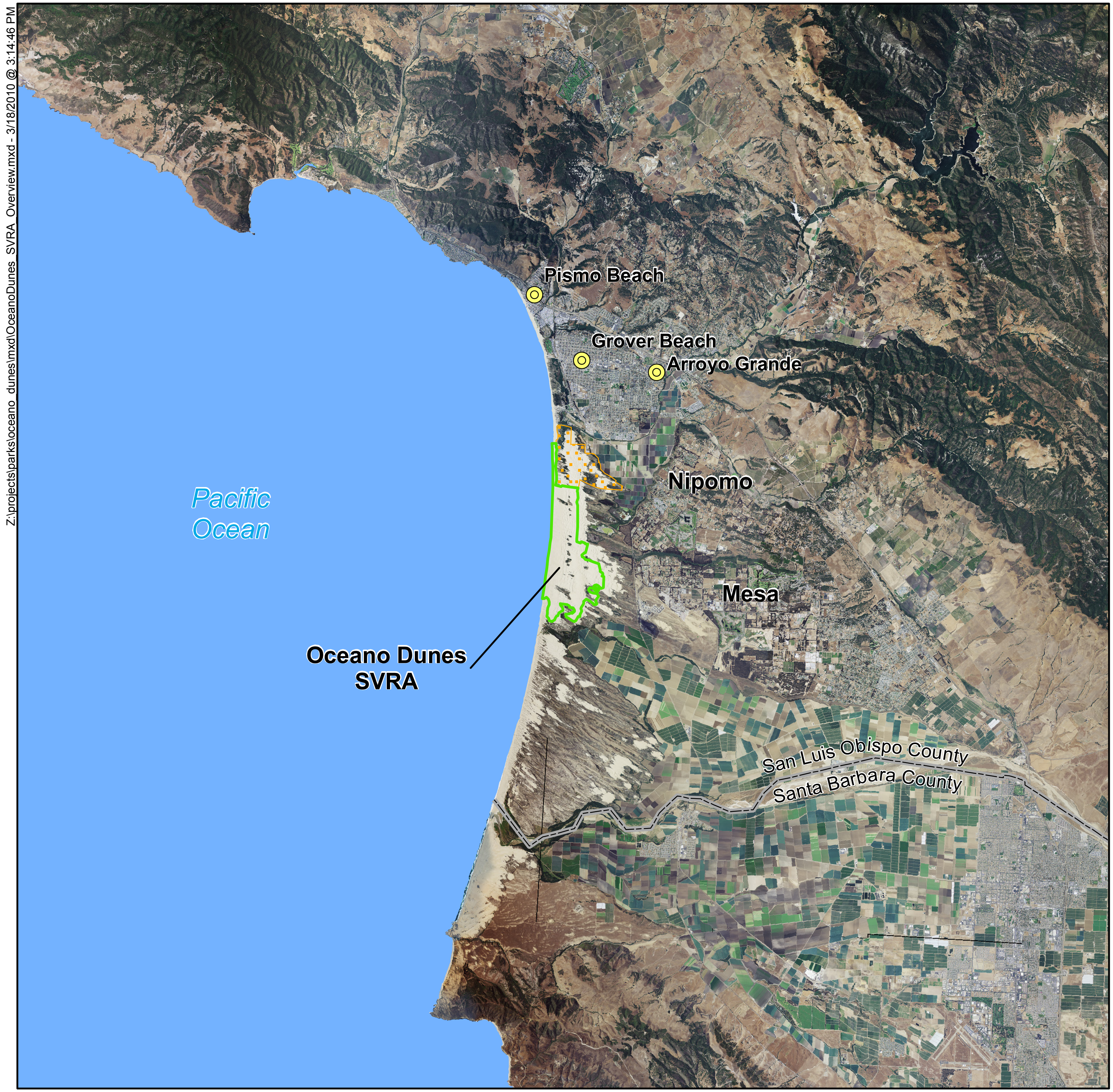

Figure 1

Oceano Dunes SVRA and Vicinity San Luis Obispo County, California

Local Communities

Riding Area (Off-Highway Vehicles)

Dune Preserve

Scale : 1:200,000

Projection UTM 10, NAD83
2009 NAIP imagery

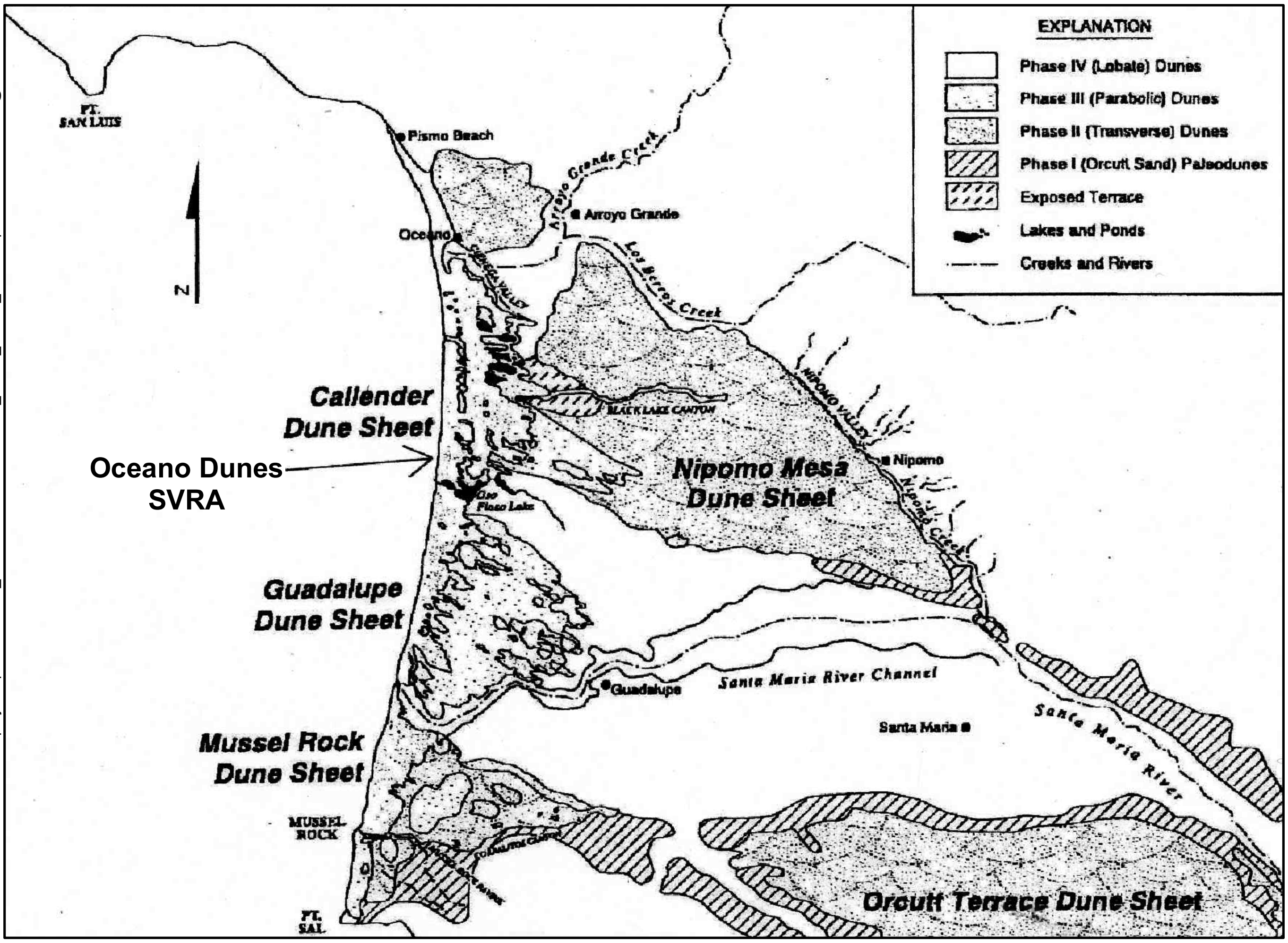

Figure 2

Location of Callender dune sheet within the Santa Maria Valley dune complex. Excepted from Hunt, 1993, figure 2.

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Figure 3

Oceano Dunes SVRA and Vicinity
San Luis Obispo County, California
Detail of SLOAPCD Phase 2 Monitoring

- Air Monitoring Station, March 2008 - March 2009
- "Intensive" Station, April 26, 2008 - May 11, 2008
- Sand Flux Monitoring Sites
- "Centerline direction of High PM10" (from Fig. 3.49 in SLOAPCD Phase 2 Report)
- OHV Recreation Riding Area (excluding vegetation islands)
- Beach access for Vehicles (OHVs & street legal)
- Dune Preserve
- Dune Center Air Monitoring station, March 2009

N

0 4,000 8,000 12,000 16,000 Feet

0 1 2 3 4 Miles

Scale : 1:62,000

Projection UTM 10, NAD83
2005 NAIP imagery

Figure 4: Cross-bedded dune laminae exposed in a cutbank of the Santa Maria River
Mussel Rock Dune Sheet, Santa Barbara County

Figure 5: Planar dune laminae and over-riding sand ripples observed within a vegetation island of Oceano Dunes SVRA

Figure 6: Planar dune laminae and OHV tire tracks, Oceano Dunes SVRA