SOUTH COUNTY PHASE 2
PARTICULATE STUDY

San Luis Obispo County
Air Pollution Control District

EXECUTIVE SUMMARY

February 2010

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Historical ambient air monitoring on the Nipomo Mesa has documented atypical concentrations of airborne particulate matter compared to other areas of San Luis Obispo County and other coastal areas of California. These historical measurements show that the California health standard for PM10 (airborne particles with a mean aerodynamic diameter of 10 microns or less) is regularly exceeded in many locations on the Nipomo Mesa. Population-based studies in hundreds of cities in the U.S. and around the world have demonstrated that both short-term and long-term exposure to elevated particulate levels can cause significant increases in hospital admissions, emergency room visits, asthma attacks and premature deaths. Groundbreaking long-term studies of children's health conducted in California have also shown that particle pollution may significantly reduce lung function growth in children.

To better understand the extent and sources of these unusually high concentrations of particulate pollution on the Nipomo Mesa, the San Luis Obispo County Air Pollution Control District (SLO APCD) has conducted comprehensive air monitoring studies in that region. The Phase 1 South County Particulate Matter (PM) Study began in 2004 and utilized filter-based manual particulate samplers measuring both PM10 and PM2.5 (particles 2.5 microns in diameter or less) concentrations at 6 monitoring sites located throughout the Mesa. Samples were collected over a one year period and analyzed for mass and elemental composition; meteorological measurements of wind speed and direction were also performed at numerous locations in the study area.

Data from the Phase 1 study showed air quality on the Nipomo Mesa exceeds the state 24-hour PM10 health standard at one or more monitoring locations on over one quarter of the sample days. Elemental analysis of PM2.5 filter samples demonstrated that on these high particulate days, the largest fraction of particles are composed of the wind blown crustal material containing silicon, iron, aluminum, and calcium. Meteorological data showed that high wind events entraining crustal particulate from the dune fields at the Oceano Dunes State Recreational Vehicle Area (SRVA) upwind of the Nipomo Mesa area and transporting them inland as the likely cause; data from a directional PM10 sampler on the Mesa that only operated on high wind days strongly supported this conclusion. Further analysis of Phase 1 study data was unable to provide a conclusive determination on whether off-road vehicle (OHV) activity in the SVRA played a role, either direct or indirect, in the particulate pollution observed on the Nipomo Mesa.

The Phase 1 Study Report was presented to the SLO APCD Board of Directors in March of 2007. The Board directed staff to design and conduct a follow-up study with the primary goal of determining if OHV activity on the SVRA played a role in the high particulate levels measured on the Nipomo Mesa; a secondary goal of the study was to determine what, if any, particulate impacts on the Mesa are due to fugitive dust from the petroleum coke piles at the ConocoPhillips Refinery complex. To help design and conduct the Phase 2 study, the SLO APCD retained the services of the Delta Group, an affiliation of scientists, mostly from the University of California at Davis (UCD), dedicated to the detection and evaluation of aerosol transport. The Great Basin Unified Air Pollution Control District (GBUAPCD), a recognized leader nationwide in understanding and mitigating wind blown particulate pollution, also lent their considerable expertise to the design and implementation of the study. Scientists from the Santa Barbara County APCD, the California Air Resources Board (CARB) and the California State Parks Department also provided significant input in the design phase of the study.

The Phase 2 Study design involved three independent investigations using a broad array of technologies and measurement techniques to better understand the source(s) and activities responsible for the observed particulate pollution problem on the Nipomo Mesa. Determining the role of OHV activity on the SVRA was a key focus of the study, so it was important to conduct measurements and analyses both within and downwind of the dunes at the SVRA, as well within and downwind of "control site" dunes north and south of the SVRA where offroad vehicles are not allowed, to evaluate the differences between them. PM and meteorological measurements downwind of the refinery coke piles and agricultural fields on the Mesa were also a necessary design element to determine potential contributions from those areas. Further, since the Phase 1 study showed that high PM concentrations on the Mesa occur primarily on high wind days, it was critical to ensure that study measurements captured the high wind events that typically occur during the early spring and late fall months.

The field measurement phase of the study was conducted from January 2008 through March 2009. The portion of the study performed by the SLO APCD entailed the deployment and use of real–time particulate monitors and wind sensors at a variety of locations downwind of both the SVRA and the control sites, as well as downwind of the coke piles and agricultural fields. These measurements were designed to assess the relative levels of airborne particulate coming from those areas, particularly on high wind days.

The portion of the study directed by the GBUAPCD involved measuring the amount of sand movement at different wind speeds, both in the SVRA and a control site, to better understand the mechanism and potential source location responsible for wind blown emissions. The Delta Group was responsible for deploying and operating sophisticated research sampling instruments designed to measure the mass, size distribution and elemental composition of the particulate pollution. These samplers were located downwind from the SVRA and a number of control sites that currently do not allow OHV activity. The samplers were also used to look for tracer elements to assess if petroleum coke from the ConocoPhillips refinery facility was being entrained by winds and impacting ambient PM levels in the area. The Delta Group also collected and analyzed soil samples upwind from each monitoring station.

The 3-pronged field investigation effort for the Phase 2 study gathered well over two million data points, requiring nearly a year to review, validate and analyze the data and compile the results. The data analysis was performed by the three independent research groups involved in designing and implementing the study, followed by peer review of the draft study report by a diverse and respected group of scientists with expertise in this field. This wealth of data and critical review of the results by numerous independent experts, combined with the results from the Phase 1 study, provides a much more complete understanding of the particulate pollution problem in the area, leading to the following major findings:

- The airborne particulate matter predominantly impacting the region on high episode days does not originate from an offshore source.
- Neither the petroleum coke piles at the ConocoPhillips facility nor agricultural fields or activities in and around the area are a significant source of ambient PM on the Nipomo Mesa.
- The airborne particulate matter impacting the Nipomo Mesa on high episode days predominantly consists of fine sand material transported to the Mesa from upwind areas under high wind conditions.

- The primary source of high PM levels measured on the Nipomo Mesa is the open sand sheets in the dune areas of the coast.
- The open sand sheets subject to OHV activity on the SVRA emit significantly greater amounts of particulates than the undisturbed sand sheets at the study control sites under the same wind conditions.
- Vegetated dune areas do not emit wind blown particles; the control site dunes have significantly higher vegetation coverage than is present at the SVRA.

The major findings resulting from detailed analysis of the diverse and comprehensive data sets generated during the Phase 1 and Phase 2 South County PM Studies clearly lead to a definitive conclusion: OHV activity in the SVRA is a major contributing factor to the high PM concentrations observed on the Nipomo Mesa.

There are two potential mechanisms of OHV impact. The first is direct emissions from the vehicles themselves, which includes fuel combustion exhaust and/or dust raised by vehicles moving over the sand. Elemental analysis of study data shows combustion exhaust particles are not a significant component in the samples during high concentration periods. However, analysis of SVRA vehicle activity data does show a weak relationship between high PM10 concentrations and high vehicle activity. This indicates a very small direct emissions impact from OHV activity caused by wind entrainment of dust plumes raised by vehicles moving across the open sand. While significant, the study data shows this is not the major factor responsible for the high PM levels downwind from the SVRA.

The second potential mechanism of impact from OHV activities involves indirect emission impacts. Offroad vehicle activity on the dunes is known to cause de-vegetation, destabilization of dune structure and destruction of the natural crust on the dune surface. All of these act to increase the ability of winds to entrain sand particles from the dunes and carry them to the Mesa, representing an indirect emissions impact from the vehicles. The data strongly suggests this is the primary cause of the high PM levels measured on the Nipomo Mesa during episode days.