Santa Barbara County
Air Pollution Control District

Network Assessment

of the

Santa Barbara Air Pollution Control District

Ambient Air Monitoring Network

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Prepared by the

Santa Barbara County

Air Pollution Control District

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Table of Contents

List of Tables

List of Figures

1.0 Introduction

This report was prepared by the Santa Barbara County Air Pollution Control District (SBCAPCD) as an assessment of the air quality surveillance system in Santa Barbara County. Title 40, Part 58, Section 10 of the Code of Federal Regulations (40 CFR 58.10) requires that an assessment be performed every 5 years to determine if the network meets the monitoring objectives of this title. There are three basic monitoring objectives:

1 Provide air pollution data to the general public in a timely manner.
2 Support compliance with ambient air quality standards and emissions strategy development.
3 Support for air pollution research studies.

The assessment is also required to help determine if new sites are needed or existing sites can be terminated and whether new technologies are appropriate for incorporation into the ambient air monitoring network.

This is the first assessment of the Santa Barbara County Air monitoring network.

2.0 Santa Barbara County Setting

Santa Barbara County is located on the Pacific coast of California bordered to the north by San Luis Obispo County and to the east by Ventura County. The Pacific Ocean forms the west and southern borders of the county. The Santa Ynez mountain range, which runs east/west parallel to the southern coast of the county is one of the predominate land features of the county which serves as a dividing feature between the northern and southern portions of the county.

Local air quality is highly dependent upon the climate and meteorology of the area because meteorological conditions control the transport and diffusion of emitted pollutants. Climate is a long term average of daily and seasonal weather conditions while meteorology deals with the day by day and hour by hour specific weather conditions. Understanding the climate of Santa Barbara County helps to explain annual cycles of local air quality. Understanding the meteorology of Santa Barbara County helps to explain shorter term variations in local air quality.

2.1 Climate of Santa Barbara County

Santa Barbara County has a Mediterranean climate characterized by warm, dry summers, and cooler, relatively damp winters. Mild temperatures occur throughout the year, particularly near the coastline. Maximum summer temperatures average 70 degrees Fahrenheit near the coast and in the high 80s to low 90s inland. During winter, average minimum temperatures range from the 40s along the coast to the 30s inland.

The climate of Santa Barbara is strongly influenced by a persistent high pressure area which lies off the Pacific Coast. As a result, sunny skies are common throughout most of the area. Rain storms periodically occur, mostly from October to April. Annual rainfall amounts range from 10 to 18 inches along the coast, with more substantial amounts in the higher elevations. On occasion, tropical air masses produce rainfall during the summer months.

Cool, humid, marine air causes frequent fog and low clouds along the coast, generally during the night and morning hours in the late spring and early summer months. The fog and low clouds can persist for several days at a time until broken up by a change in the weather pattern.

2.2 Meteorology of Santa Barbara County

Meteorology deals with shorter time periods and smaller spatial scales than climate. Understanding the interaction between local meteorology and emitted pollutants is essential in understanding how elevated levels of pollutants can occur in the atmosphere. This relationship between local meteorology and elevated pollutant levels is necessary in evaluating the design of an ambient air monitoring network.

2.2.1 Surface Winds

The airflow around the county plays an important role in the movement of pollutants. In northern Santa Barbara County (north of the ridgeline of the Santa Ynez Mountains), the sea breeze (from sea to land) is typically northwesterly throughout the year. During summer months, these northwesterly winds are stronger and persist later into the night. At night, the sea breeze dies, and as air adjacent to the surface cools, it descends down the coastal mountain and mountain valleys resulting in light land breezes (from land to sea). This land/sea breeze cycle combined with local topography greatly influence the direction and speed of the winds throughout the county. In addition, the alternation of the land-sea breeze cycle can sometimes produce a "sloshing" effect, where pollutants are swept offshore at night and subsequently carried back onshore during the day. This effect is exacerbated during periods when wind speeds are low.

Topography plays another role in wind patterns experienced in the county. The terrain around Point Conception, combined with the change in orientation of the coastline from north-south north of Pt. Conception to east-west south of Pt. Conception can cause

counter-clockwise circulations (eddies) to form east of the Point. These eddies fluctuate from time-to-time and place-to-place often leading to highly variable winds along the southern coastal strip. Point Conception also marks the change in the prevailing surface winds from northwesterly north of Pt. Conception to southwesterly south of Pt. Conception.

Another type of wind regime that influences air quality in Santa Barbara is the "Santa Ana" wind condition. Santa Ana winds are dry northeasterly winds that occur primarily during the fall and winter months. These are warm, dry winds which descend down the slopes of a mountain range. Wind speeds associated with Santa Ana are generally 15-20 mph, though they can reach speeds in excess of 60 mph. During Santa Ana conditions, pollutants emitted in Santa Barbara, Ventura County, and the South Coast Air Basin (the Los Angeles region) are moved out to sea. These pollutants can then be moved back onshore into Santa Barbara County (via the Santa Barbara Channel) in what is called a "post Santa Ana condition." The effects of the post Santa Ana can be experienced throughout the county. However, not all post Santa Ana conditions lead to high pollutant concentrations.

2.2.2 Upper Level Wind and Temperature

Upper-level winds in the atmosphere are also critical to the air quality of Santa Barbara County. The winds at 1,000 feet and 3,000 feet are generally from the north or northwest throughout the year. Occurrences of southerly and easterly winds are most frequent in winter, especially in the morning. Upper-level winds from the southeast are infrequent during the summer months, though they are usually associated with periods of high ozone levels. As with the surface winds, upper level winds can move pollutants that originate in other areas into the county.

Another factor that affects the concentrations of pollutants in the air is the stability of the atmosphere. Atmospheric stability regulates the amount of air exchange (referred to as mixing) both horizontally and vertically. Restricted mixing (a high degree of stability) and low wind speeds are generally associated with higher pollutant concentrations. These conditions are typically related to temperature inversions (temperature increase with height) which cap the pollutants that are emitted below or within them.

Surface inversions (0-500 ft), as measured at Vandenberg Air Force Base, are most frequent during the winter, and subsidence inversions (1000-2000 ft) are most frequent during the summer. Generally, the lower the inversion base height and the greater the rate of temperature increase from the base to the top, the more pronounced effect the inversion will have on inhibiting dispersion. The subsidence inversion is very common along the California coast and is one of the principle causes of air stagnation.

Poor air quality is often associated with "air stagnation" (high stability/restricted air movement). Therefore, it is reasonable to expect a higher frequency of pollution events in the southern portion of the county where light winds are frequently observed, as opposed to the North County where the prevailing winds are strong and persistent.

2.3 Santa Barbara County Population Distribution

The 2010 population of Santa Barbara County is estimated to be 430,200 according to the report “Regional Growth Forecast 2005 – 2040” produced by the Santa Barbara County Association of Governments (SBCAG) in August 2007. This is a 7.7 percent increase from the year 2000 Census count of 399,347. SBCAG also forecast the population to be 444,900 in the year 2015, a 3.4 percent growth in the next five years.

The population is concentrated in the areas surrounding the cities of the south coast, Lompoc, Santa Maria, and Santa Ynez/Solvang. The remaining areas of the county are very scarcely populated, especially the large area of National Forest in the northeastern area of the county. Most of the forecasted growth in the next five years is predicted to occur in the north county: Buellton and Santa Maria. The Goleta valley area of the south coast is also predicted to see significant population growth.

3.0 Air Monitoring Network

The SBCAPCD and the California Air Resources Board (CARB) began monitoring air quality within the populated urban areas of Santa Barbara County in the early to mid-1970's, as required under the 1970 federal Clean Air Act. Between the mid-1970's and the mid-1980's, the number and location of monitoring stations did not change. No new large industrial sources of air pollution were permitted in the county during this period.

A number of changes occurred in the early to mid-1980's which resulted in an expansion of the monitoring network. First, Santa Barbara County adopted its New Source Review/Prevention of Significant Deterioration Rule, as required by the federal Clean Air Act Amendments of 1977, Part D. This rule guides all aspects of the SBCAPCD's air quality permitting program and includes federal requirements for air monitoring.

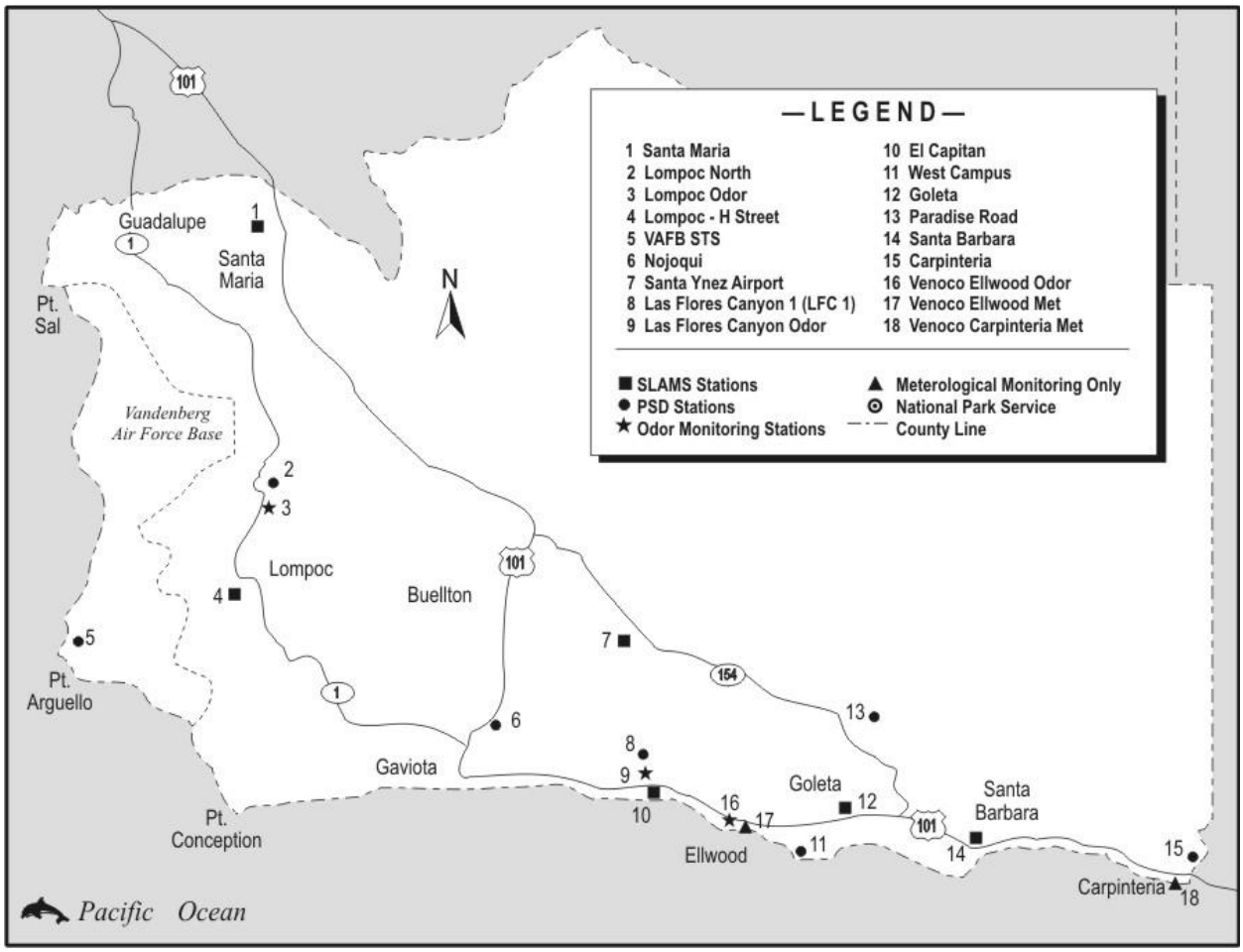
At the same time, a number of oil companies requested development permits from the County and the SBCAPCD for major onshore industrial facilities associated with large-scale offshore oil development projects. This triggered monitoring requirements as part of the Prevention of Significant Deterioration (PSD) program which requires major industrial pollution sources to conduct air monitoring for various purposes. Prior to constructing the facilities, air monitoring is used to determine baseline conditions and to provide input to computer models used to estimate air quality impacts. After construction, air monitoring is used to determine the impacts that facility operations may have on overall air quality and to validate the assumptions used for issuing the permit. The primary purpose of all these requirements is to protect public health and welfare.

The next change came in the early 1990s when these major facilities were at peak operational capacity and reducing operations. The sites operating under the PSD program were evaluated and a number of them were allowed to shut down because there was enough data to characterize the emissions around the facilities.

Currently, there are 18 ambient air quality monitoring stations in operation within Santa Barbara County (Figure 3.1). The network consists of state and local air monitoring stations (SLAMS) and special purpose monitors (SPM). The sites are operated by the SBCAPCD, CARB or private contractors. The SPMs can be subdivided into PSD monitors (source specific monitors and regional air quality monitors), research, and safety monitors

Figure 3.1

2009 Santa Barbara County Air Quality Monitoring Stations



The SLAMS sites were set up to monitor air quality in populated urban areas. The PSD stations monitor local impacts of specific industrial facilities. Regional PSD stations were also established to monitor cumulative impacts of large facilities on regional air quality in the county. A particular monitoring station can serve a dual purpose when its location satisfies the objectives of more than one classification, or for more than one facility. Many of the county's large industrial facilities, however, are located in areas of complex topography with complex meteorological conditions, for example, in separate canyons along the coast between Goleta and Gaviota, limiting the ability of a single station to represent multiple facilities.

3.1 SLAMS Sites

There are six SLAMS monitoring stations in operation within Santa Barbara County. They are located in Santa Barbara, Goleta, Lompoc, Santa Maria, El Capitan State Park, and at the Santa Ynez Airport. The CARB operates the downtown Santa Barbara and Santa Maria stations, while the SBCAPCD is responsible for the operation of the remaining sites. These sites have been operating in these areas since the late 70's or early 80's which have provided long term air quality trend data.

3.2 PSD Monitoring Sites

There are seven PSD sites which are set up to measure maximum pollutant concentrations, regional air quality, background levels or transport emissions. All of these sites are required to be operated by various permit to operate conditions.

The Paradise Road site is located downwind of the populated areas of northern Santa Barbara County. It is sited to measure the maximum ozone levels of the county. Las Flores Canyon site 1 (LFC1) is located in the foothills on the south side of the Santa Ynez Mountains and records maximum ozone levels in the southern section of the county.

Two sites were setup to measure the impacts from transport. Carpinteria is located in the southeastern portion of the county which measures transported pollutants from the Los Angeles basin. Nojoqui is located at the top of the Gaviota pass and is designed to measure the transport of pollutants between northern and southern portions of the county.

LFC1, Lompoc HS&P, and VAFB are three which serve dual purposes. They are sited downwind of major facilities to measure the impacts of those facilities on the local environment. However, ozone is also measured at these sites as part of the regional ozone monitoring network.

The West Campus site is set up to measure the impacts from oil storage tanks and barge loading/unloading activities. The data from this site is also used by UCSB researchers for various studies.

3.3 Odor Sites

There are three sites set up to measure odorous compounds which could potentially be emitted from certain oil and gas facilities. These sites typically measure hydrogen sulfide, and total reduced sulfur, wind and temperature. These three sites are LFC

Odor, Elllwood Odor, and Lompoc Odor. These sites are required by permit to operate conditions for these facilities.

3.4 Meteorological Sites

Two sites are set up specifically for monitoring meteorological conditions. These two sites are Venoco Ellwood Met and Venoco Carpinteria Met. These sites measure wind speed, wind direction and temperature. The data from these sites are used to characterize where emissions from these facilities will be dispersed.

4.0 Pollutants Monitored

EPA has established as set of air quality standards known as the National Ambient Air Quality Standards or NAAQS. The standards were established to protect human health and welfare. They include: ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, particulate less than 10 microns and particulate less than 2.5 microns. The SBCAPCD monitors these pollutants at a number of locations to determine if we meet the standards. Other pollutants are also monitored in the county. Some are monitored for state air quality standards, some for safety and others for research. These pollutants include: hydrogen sulfide, total reduced sulfur, and total hydrocarbons. Wind speed/direction and temperature are also measured at each site to help characterize the source of the measured pollutants. This report is only evaluating the pollutants measured for comparison with the NAAQS.

4.1 Ozone Monitors

Ozone is monitored at twelve locations in the county. Santa Barbara, Goleta, Lompoc H Street, Santa Maria, Santa Ynez are located in the major populated areas of the county for population exposure. Paradise Road, LFC1, Lompoc HS&P, Nojoqui, Carpinteria, VAFBSTS and El Capitan were sited as part of a regional network. Paradise Road and LFC1 have consistently measured the highest concentrations of ozone in the county. Paradise Road is north of the Santa Ynez mountain range and represents air in the north county while LFC1 is south of the Santa Ynez mountain range and is representative of the foothill region of the south county.

Summary statistics were compiled for these sites and summarized in Table 4.1. The fourth highest eight hour ozone value was determined for each year from 2007 through 2009. These fourth highest values were averaged for each site and compared with the NAAQS standard of 0.075 ppm. The sites were ranked based on the percent of the standard.

Table 4.1
Ozone Summary

AQS #	STREET_ADDRESS	2007 4th Max ppm	2008 4th Max ppm	2009 4th Max ppm	3 year Average ppm	% of Std 0.075 ppm	Rank
06-083-1025	Las Flores Canyon #1	0.078	0.07	0.083	0.077	103	1
06-083-1014	Paradise Road	0.077	0.068	0.071	0.072	96	2
06-083-1021	Carpinteria	0.066	0.072	0.079	0.072	96	3
06-083-1013	Lompoc HS&P	0.066	0.067	0.064	0.065	87	4
06-083-3001	Santa Ynez Airport	0.063	0.067	0.064	0.064	85	6
06-083-4003	VAFB STS	0.069	0.065	0.059	0.064	85	5
06-083-0011	Santa Barbara	0.063	0.062	0.058	0.061	81	7
06-083-0008	El Capitan	0.057	0.066	0.058	0.060	80	8
06-083-2011	Goleta	0.057	0.062	0.059	0.059	79	9
06-083-1018	Nojoqui	0.055	0.056	0.06	0.057	76	10
06-083-2004	Lompoc H Street	0.056	0.062	0.055	0.057	76	11
06-083-1008	Santa Maria	0.048	0.056	0.055	0.053	71	12

LFC1 was the highest and the only site which is above the NAAQS standard. Paradise Road and Carpinteria were both 96 percent of the standard. The SBCAPCD believes that these three sites were influenced by the Guiberson fire in September 23, 24 and 25 2009 and are requesting that data for these dates be excluded as an exceptional event. The concurrence or non-concurrence of this exclusion request will affect this statistical summary. Overall, there are eight sites which are within 20 percent of the standard.

The ozone NAAQS is currently under revision and the new standard is expected to be in a range of 0.070 ppm to 0.060 ppm. If it is lowered to 0.060 ppm, there would be up to eight sites at 100 percent of the standard or above.

4.2 Nitrogen Dioxide Monitors

Nitrogen Dioxide (NO2) is monitored at 11 locations in the county, every site that measures ozone except Santa Ynez. NO2 is sited in conjunction with the ozone monitors to characterize the precursors to ozone.

In February of 2010, a new 1 hour NAAQS was set at 100 ppb for NO2. The form of the standard is based on the three year average of the 98th percentile of the daily maximum 1-hour average. Table 4.2 shows the summary of the county's NO2 concentrations

from 2007 – 2009 compared with this new standard. No sites in the county exceed the standard. Santa Barbara, Santa Maria and Goleta measure the highest concentrations. They are located in urban areas and are influenced by exhaust from automobile traffic.

Table 4.2
Nitrogen Dioxide Summary

AQS #	STREET_ADDRESS	2007 98th ppb	2008 98th ppb	2009 98th ppb	3 Yr Avg 98th ppb	% of Std 100 %	Rank
06-083-0011	Santa Barbara	35	34	31	33	33	1
06-083-1008	Santa Maria	31	28	25	28	28	2
06-083-2011	Goleta	26	25	23	25	25	3
06-083-0008	El Capitan	21	20	17	19	19	4
06-083-2004	Lompoc H Street	21	19	18	19	19	5
06-083-1018	Nojoqui	15	14	13	14	14	6
06-083-1021	Carpinteria	11	11	9	10	10	7
06-083-1025	Las Flores Canyon #1	8	8	7	8	8	8
06-083-1013	Lompoc HS&P	4	4	5	4	4	9
06-083-4003	VAFB STS	3	4	4	4	4	10
06-083-1014	Paradise Road	4	3	3	3	3	11

El Capitan is the 4th highest followed by Lompoc H street and Nojoqui. El Capitan is located south of the 101 freeway and train track. Lompoc H Street is located in an urban area and Nojoqui is located near the 101 freeway at the top of a grade separating the North and South County. LFC1, Lompoc HS&P, VAFB STS and Paradise Road are located in rural settings which are sited as part of permit required regional network.

4.3 Sulfur Dioxide Monitors

Sulfur Dioxide (SO2) is measured at six locations in the county. Lompoc H is located in an urban area while the other five sites are located in more rural settings which are installed as part of permit conditions for major oil and gas sources.

In June 2010, EPA established a new 1-hour NAAQS standard of 75 ppb for SO2. The standard is in the form of the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour average concentrations. Table 4.3 compares the county concentrations from 2007 – 2009 with this new standard. All of the sites are below the standard. All of the sites are located in areas near potential SO2 sources.

Table 4.3
Sulfur Dioxide Summary

AQS #	STREET_ADDRESS	2007 99th ppb	2008 99th ppb	2009 99th ppb	3 Yr Avg ppb	% ofStd 75 %	Rank
06-083-1025	Las Flores Canyon #1	3	4	3	3	4	1
06-083-2004	Lompoc H Street	3	2	2	2	3	2
06-083-0008	El Capitan	2	2	2	2	3	3
06-083-1013	Lompoc HS&P	1	2	2	2	2	4
06-083-1020	West Campus	1	2	2	2	2	5
06-083-4003	VAFB STS	1	2	2	2	2	6

4.4 Carbon Monoxide Monitors

Carbon Monoxide (CO) is measured at six locations in the county. Santa Barbara, Lompoc H Street, Santa Maria, and Goleta are located in the major urban areas in the county. LFC1 and VAFB STS are sited at part of permit conditions for major sources.

The 1 hour standard for CO is set at 35 ppm. The form of the standard is not to exceed more than once per year. Table 4.4 compares the 2nd maximum daily hourly maximum value for years 2007 – 2009. No site exceeds the standard with the highest reading being 10% of the standard at Santa Barbara.

Table 4.4
Carbon Monoxide Summary

AQS #	STREET_ADDRESS	2007 2nd Max ppm	2008 2nd Max ppm	2009 2nd Max ppm	3 Year Avg 2nd Max ppm	% of Std 35 %	Rank
06-083-0011	Santa Barbara	3	**3**	**3**	**3**	10	1
06-083-2004	Lompoc H Street	2	**2**	**2**	**2**	5	2
06-083-1025	Las Flores Canyon #1	1	**3**	**1**	**2**	5	3
06-083-2011	Goleta	2	**1**	**2**	**2**	4	4
06-083-1008	Santa Maria	1	**2**	**1**	**1**	4	5
06-083-4003	VAFB STS	1	**1**	**0**	**1**	2	6

4.5 Particulate (< 10 Microns)

Particulate less than 10 microns in diameter (PM10) is currently being measured in standard conditions at four locations in the county. The monitor at Santa Maria was removed in early 2009. A real-time monitor which measures the PM10 in local conditions was installed at Santa Barbara and Santa Maria.

The standard for PM10 is based on the daily averages. The maximum daily concentration shall not exceed 150 ug/m3 more than once per year measured in standard conditions. The Santa Maria and Santa Barbara monitors are not comparable to the standard because they are collected in local conditions. Table 4.5 compares the PM10 data collected from 2007 – 2009 in the county. All sites are below the standard. Santa Maria is the highest where the concentrations are 37 percent of the standard.

Table 4.5
Particulate < 10 Microns Summary

AQS #	STREET_ADDRESS	2007 2nd Max ug/m3	2008 2nd Max ug/m3	2009 2nd Max ug/m3	3 Year Avg ug/m3	% of Std 150	Rank
06-083-1008	Santa Maria	53	57		55	37	1
06-083-0008	El Capitan	72	50	41	54	36	2
06-083-1025	Las Flores Canyon #1	52	49	33	45	30	3
06-083-4003	VAFB STS	39	44	42	42	28	4
06-083-2004	Lompoc H Street	38	38	45	40	27	5

4.6 Particulate (< 2.5 Microns)

Particulate less than 2.5 microns in diameter (PM2.5) is measured at four locations. Santa Barbara and Santa Maria data are collected using FRM samplers on a one in six day schedule. These are the only two monitors which are currently comparable to the NAAQS. CARB plans on installing real time FEM samplers in June of 2010 which will replace the FRM samplers. The other sites where PM2.5 is measured is at Lompoc H Street and Goleta. Theses samplers are real-time samplers but are not FEM so they are not comparable to the NAAQS.

The 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard of 35 ug/m3. Table 4.6 compares the concentrations from 2007 – 2009 to this standard. Santa Barbara is 60 percent of the standard while Santa Maria is 41% of the standard.

Table 4.6
Particulate < 2.5 Micons Summary

AQS #	STREET_ADDRESS	2007 98th ug/m3	2008 98th ug/m3	2009 98th ug/m3	3 YEAR AVG. 98% ug/m3	% of Std 35	Rank
06-083-0011	Santa Barbara	21	17	25	21	60	1
06-083-1008	Santa Maria	16	15	14	14	41	2

4.7 Particulate Real Time Monitors

PM2.5 BAMS real-time particulate monitors were first installed at Santa Barbara and Santa Maria in 2004 and 2005 to report hourly particulate air quality index (AQI) values to the public and AIRNOW. This was expanded with a PM2.5 and PM10 BAMS monitor at Lompoc H Street in 2008 and at Goleta in 2010. This expansion was done to provide particulate air quality data to the public via web sites. The PM2.5 BAMS are not comparable with the NAAQS and are just used for real-time reporting as they do not have FEM status.

5.0 Data Users

Data is collected from all of the monitoring sites and stored in a data base by a central data acquisition system (DAS) located at the SBCAPCD office. Internet connections were added to all 18 sites to allow the DAS to poll data every minute. This data is screened for outliers before being reported to the public and other end users of the air quality data.

Every hour, data is sent to several outside agencies. Some data is used for reporting air quality data to the public and some data is used by researchers and scientists. Ozone, PM10, PM2.5, wind and temperature data are posted to the SBCAPCD website hourly. This data is posted as AQI values and engineering units. Ozone and PM2.5 data are also sent to the AIRNOW system hourly for AQI reporting on a national scale. All hourly values are sent to CARB's AQMIS system for reporting data on a state wide level. Wind and temperature data are sent to the national weather service and naval weapons group.

On a monthly basis a quality assurance review is performed on the data. The final data are then submitted to the AQS data base for compliance with the NAAQS.

Periodically throughout the year, the SBCAPCD will receive various data requests. A UCSB researcher is using hydrocarbon and wind data to study oil and gas seeps in the ocean off of our coast. Other researchers will use wind data to study beach erosion or sand migrations. Other data users are National Weather Service, US Fish and Game, and private consultants.

6.0 Conclusions and Future Changes

The air monitoring network in Santa Barbara County meets the objectives discussed at the beginning of this report. Air quality data is reported to several end users on an hourly basis. Quality assured data is submitted for compliance purposes and data is readily available for research and or general air quality purposes.

Looking forward to the next five years, the SBCAPCD does not plan any major changes to the network. Some changes that will be made or evaluated include the following.

1. The PM2.5 BAMS monitor at Santa Barbara and Santa Maria will be replaced with FEM BAMS in July 2010 by CARB. This will provide daily concentrations for comparison to the NAAQS instead of the current one in six day schedule.
2. Relocation of the Santa Ynez air station due to trees growing up around the existing location. This station has been in operation in the current area since 1977 so the SBCAPCD is looking for another location in the general area to preserve the long-term trend.
3. The new location for the Santa Ynez site will be evaluated for the installation of real-time particulate samplers. The Santa Ynez Valley does not currently have any particulate samplers.
4. The Ellwood Odor monitoring station will be relocated west of the current location which is going to be developed into an assisted living center.
5. New software for the current DAS will be installed to meet the needs of future reporting requirements and end users needs.