

**PARTICULATE MATTER
MONITORING NETWORK DESCRIPTION
FOR THE
LAKE TAHOE
MONITORING PLANNING AREA**

PREPARED BY

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1.0 INTRODUCTION

This plan provides a description of the PM_{2.5} and PM₁₀ ambient monitoring network designed for the Lake Tahoe Monitoring Planning Area (MPA). Airborne particles with aerodynamic diameter less than 10 microns (PM₁₀) are small enough to be inhaled. The PM₁₀ includes fine particles with aerodynamic diameter less than 2.5 microns (PM_{2.5}) as a component. The deployment of the PM_{2.5} network is critical to the implementation of the new PM_{2.5} National Ambient Air Quality Standards (NAAQS). The ambient data from this network will be used for designating areas as attainment or nonattainment, developing particulate matter control programs, and tracking the progress of such programs.

During the early stages of the PM_{2.5} network design process, the Air Resources Board (ARB) and the local air quality management districts established MPAs for the State. The entire State is covered by 18 MPAs. These MPAs will be used for planning monitoring locations for PM_{2.5}. They are not intended for designating areas as attainment or nonattainment or planning control measures. The boundaries to be used for these purposes will not be established until adequate PM_{2.5} data are available. The ARB and the local air quality management districts will recommend appropriate nonattainment boundaries to the U.S. EPA.

The proposed PM_{2.5} monitoring network for the Lake Tahoe MPA includes three monitoring sites. One of the proposed PM_{2.5} sites is located at an existing PM₁₀ site, and the other two sites are new sites. These monitoring sites will operate PM_{2.5} Federal Reference Method (FRM) monitors and one of these sites will include a speciation monitor to further define the chemical composition of the PM_{2.5}. All monitoring sites in the Lake Tahoe MPA will be operated by the Air Resources Board.

1.1 Physical Setting

Lake Tahoe is situated in a setting in the Sierra Mountain Range at an elevation of 6,225 feet. It is set in a structural basin rimmed by ice-sculptured summits rising above conifer forested slopes. Tahoe is more than 20 miles long and covers 193 square miles (partially in Nevada).

1.2 Population Characteristics

The population of a Metropolitan Statistical Area (MSA) is one of the key parameters in determining the minimum number of required monitoring sites per the U.S. EPA PM_{2.5} regulations. The Lake Tahoe MPA includes portions of Placer County and El Dorado County. The entire MPA is located within the Sacramento Primary Metropolitan Statistical Area (PMSA). The counties included in the MPA are listed along with population figures in Table 1.2.1

Table 1.2.1 Population in the Lake Tahoe MPA by County

<u>County</u>	<u>Population (based on 1990 figures)</u>
El Dorado County (P)	30,832
Placer County (P)	10,512
Total Population	41,344

(P) - Portion of a county within the MPA

1.3 Climate and Weather

Winters are longer and more severe than in the adjacent lowlands, usually with moderate to heavy snowfall. Summers are generally mild and cool.

1.4 Dominant Economic Activities and Emission Sources

The dominant economic activities within the Lake Tahoe MPA revolve around tourism and recreation. This includes boating, fishing, hiking, skiing, along with an assortment of other activities.

The PM_{2.5} in California's air is the result of primary and secondary particulates. Primary particulate emissions are directly emitted from sources such as residential fireplaces, diesel trucks, forest burning, dust sources, and industrial processes. Secondary particulates form when gaseous or non-particulate substances react in the atmosphere with other substances to produce particulate matter.

The predominant sources of directly emitted PM_{2.5} vary regionally in California. The Lake Tahoe MPA emission inventory estimates show that the largest contributor of directly emitted PM_{2.5} is residential fuel consumption. Other sources are estimated to be less substantial PM_{2.5} contributors.

Precursors to secondary PM_{2.5} formation in California include oxides of nitrogen (NO_x) from motor vehicles and other combustion sources, ammonia emissions, certain organic substances which form particulate matter, and additional emission sources. Secondary particulate levels are highly variable and are dependent on atmospheric conditions and precursor levels for formation. For example, in some regions at certain times of the year the secondary particles can comprise 50% or more of the total ambient measured PM_{2.5} concentrations. At other times, the secondary particulates are nearly negligible. Because secondary particles form through complex and variable atmospheric processes, it is not currently possible to produce accurate secondary particulate emission estimates as can now be done for the primary, directly emitted PM_{2.5}.

1.5 PM2.5 Monitoring Requirements

Based upon the U.S. EPA PM2.5 regulations, all Metropolitan Statistical Areas with population greater than 200,000 are required to have a core PM2.5 SLAMS (this is a site in a populated area representing PM2.5 concentrations on a neighborhood or urban scale). The required number of core SLAMS and the sampling frequency is determined by the 1990 census population statistics for each MSA. The greater the population in an MSA, the more monitoring sites required for that area. One additional core PM2.5 monitor that samples everyday is required for each Photochemical Assessment Monitoring Station (PAMS) area included in the MPA.

The Lake Tahoe Monitoring Planning Area is part of the Sacramento PMSA. The Sacramento PMSA has a population level that requires PM2.5 monitors but the population density varies greatly within the PMSA. The highest population density area lies outside of the Lake Tahoe MPA. Consequently, only a small fraction of the monitoring requirements for this PMSA was taken to apply to the Lake Tahoe MPA.

The regulations also require a supplemental PM2.5 monitor for every 200,000 people living either outside of an MSA or in MSAs with fewer than 200,000 people. These additional sites are supposed to sample for PM2.5 once every three days. Since the entire Lake Tahoe MPA is included in the Sacramento PMSAs, supplemental monitors are not required in this area.

Table 1.5.1 identifies the number of core PM2.5 monitoring sites to be operated within the Lake Tahoe MPA.

Table 1.5.1 Required Core PM2.5 Monitors

MSA/PMSA/County	Population in 1990	Required Core PM2.5 Monitors		Planned PM2.5 Sites
		Sampling everyday	Sampling 1 in 3 day	
Sacramento PMSA (Lake Tahoe Portion)	41,344	3*	1*	3

* The Lake Tahoe portion of the Sacramento PMSA is relatively small and sparsely populated. Total population in the Sacramento PMSA was 1,340,010 compared to 41,344 in the Lake Tahoe portion of the PMSA. Consequently, only a small fraction of the monitoring requirements for this PMSA was taken to apply to the Lake Tahoe MPA.

2.0 PM2.5 MONITORING NETWORK ELEMENTS

This section summarizes PM2.5 monitoring sites planned for deployment in 1998 and 1999. In most cases, the existing particulate matter monitoring sites will be used for the additional PM2.5 monitoring. The existing particulate matter data have assisted in the design of the PM2.5 network by providing information on the trends and the magnitude of concentrations. These data will be valuable in the future in understanding particulate size distribution of emission sources and developing control strategies. The particulate matter monitors currently operating at the sites selected for PM2.5 monitoring are also summarized in this section.

Refer to Section 2.0 in the California Particulate Matter Monitoring Network Description for a summary of particulate matter monitoring outside of the PM2.5 monitoring network

2.1 PM2.5 Monitors Planned for Deployment

The planned PM2.5 monitoring network will collect data for multiple objectives, including:

- (1) Comparing sampling results with the PM2.5 NAAQS to determine attainment/nonattainment status.
- (2) Developing and tracking implementation plans for the area.
- (3) Assisting health studies and other ambient aerosol research activities.

In order to understand the nature of the PM2.5 problem in Lake Tahoe and to develop control strategies, multiple monitor types will be needed. The PM2.5 Federal Reference Method (FRM) sampler is a gravimetric filter-based sampler that produces a concentration measurement of PM2.5 over a 24-hour period. The FRM alone cannot support the multiple information needs of the PM2.5 network. The sampler design includes a Teflon filter that can experience a loss of volatile constituents, which can be captured and retained better by other sampling techniques. In addition, it does not provide temporally resolved data or full chemical characterization of ambient aerosols.

In addition to FRM monitors, two other types of instruments are required for deployment as part of the PM2.5 network: speciation samplers and continuous mass monitors. Speciation samplers provide a chemical characterization of ambient aerosols for developing emission mitigation strategies and for tracking the success of implemented control programs. Continuous PM2.5 mass monitors will collect data for public reporting of short-term concentrations, for understanding diurnal and episodic behavior of fine particles, and for use by health scientists investigating exposure patterns. However, currently available instruments for continuous measurements of suspended particles mass have many shortcomings. The Tapered Element Oscillating Microbalance (TEOM) sampler uses a heated inlet which causes evaporation of the volatile components of the air sample. The Beta Attenuation Monitor (BAM), which samples at ambient temperatures and relative humidities may overestimate particle concentrations by allowing liquid water to be collected along with particles. Currently, there are no plans to deploy

continuous PM2.5 monitors in the Lake Tahoe MPA.

The Lake Tahoe MPA PM2.5 monitoring network will consist of three monitoring sites. Two of these sites will be deployed in 1998 and one in 1999. The sites will operate FRM samplers purchased through the National PM2.5 Sampler Procurement Contract established by the U.S. EPA. One monitoring site in the MPA will operate a collocated sampler for quality assurance and quality control evaluation.

A PM2.5 speciation sampler will be deployed at one site in 1999. Table 2.1.1 lists the proposed PM2.5 monitoring sites in the Lake Tahoe MPA and the types of instruments planned at these sites. The proposed sites are shown on the map (Figure 2.1.1).

Table 2.1.1 PM2.5 Monitoring Network Planned for Deployment

Site Location	AIRS Site ID	PM2.5 FRM	PM2.5 Speciation	PM2.5 TEOM/BAM	Other PM2.5 Monitor
North Lake Tahoe	new site	X			
South Lake Tahoe-Sandy Way	060170011	XX	Y		
Squaw Valley	new site	X			

Codes:

- X Monitor to be deployed in 1998
- Y Monitor to be deployed in 1999
- XX Collocated particulate monitors used for precision data to be deployed in 1998

2.2 Existing Particulate Matter Monitors

The existing particulate matter network in the Lake Tahoe MPA consists of two monitoring sites. The monitoring instruments operating at these sites include:

- ▶ 1 High Volume Size Selective Inlet (SSI) samplers collecting 24-hour PM10 samples.
- ▶ 1 coefficient of haze instrument.
- ▶ 1 nephelometer.

Two of the proposed PM2.5 sites will be established at new monitoring locations. One site will be established in 1998 near Tahoe City and another one in 1999 in the Squaw Valley. Table 2.2.1 summarizes the particulate matter monitoring resources available at the proposed PM2.5 monitoring sites. The complete summary of particulate matter monitoring resources in Lake Tahoe can be found in Attachment 1 in the statewide summary.

Figure 2.1.1

The particulate matter data obtained from these sites are used to meet the following objectives:

- ▶ Compare measured concentrations to the State and national PM10 standards.
- ▶ Track changes in the particulate matter concentrations over time.
- ▶ Evaluate the population exposure.
- ▶ Assess the impact from transported particulate matter.
- ▶ Assist in health studies and other research.

Table 2.2.1 Existing Particulate Matter Monitors at Proposed PM2.5 Sites

Site Location	AIRS Site ID	Dichot	PM10 SSI	PM10 TEOM/BAM	Other PM Monitors
South Lake Tahoe-Sandy Way	060170011		X		
North Lake Tahoe	new site				
Squaw Valley	new site				

Codes:

- X Existing monitor
- SSI High Volume Size Selective Inlet sampler collecting 24-hour PM10 samples
- Dichot Dichotomous sampler collecting 24-hour fine fraction and coarse fraction samples
- TEOM Tapered Element Oscillating Microbalance collecting PM10 measurements hourly
- BAM Beta Attenuation Monitor collecting PM10 measurements hourly

2.3 PM2.5 Quality Assurance

The agency operating PM2.5 monitors in the Lake Tahoe MPA will adopt a schedule for implementing quality assurance procedures developed by the ARB. Please refer to Section 3.7 in the statewide summary for more information about the schedule.

2.4 Laboratory Analyses

The FRM instruments collect PM2.5 over 24-hour periods on Teflon-membrane filters from air drawn at a controlled flow rate through a tested PM2.5 inlet. Within 96 hours after the sample collection period, the filter contained in the filter cassette will be removed from the sampler and placed in a protective container. During the period between filter retrieval from the sampler and the start of conditioning, the filter will be maintained at a temperature below 25 degrees centigrade. The filters will be transported to the ARB Monitoring and Laboratory Division in Sacramento. The filters containing PM2.5 samples will be “conditioned” and weighed

at the laboratory.

Samples collected from the speciation monitors will be analyzed by a nationwide network of 1 to 3 laboratories. These laboratories will be working under contract performing the necessary laboratory analyses. The establishment of this network of laboratories is still under development, with the specific laboratories yet to be determined.

3.0 PM2.5 MONITORING SITES TO BE DEPLOYED IN 1998

During 1998, two PM2.5 monitoring sites are planned for deployment in the Lake Tahoe MPA. This section discusses the criteria used in the selection of the two PM2.5 monitoring sites along with the important parameters that characterize each site.

3.1 Monitor Siting

The existing particulate matter network in the Lake Tahoe MPA consists of two sites. During the PM2.5 site selection process the following factors were evaluated:

- ▶ Population statistics and distribution.
- ▶ Land use characteristics.
- ▶ Local climate.
- ▶ Suspected area emission sources (wood smoke, agricultural burning, etc.).
- ▶ Existing particulate matter monitoring network.
- ▶ Existing particulate matter data, including data collected by the dichotomous network, PM10 network, and special studies.
- ▶ Potential transport corridors.
- ▶ Ongoing special health studies.

After the review process, it was determined that one existing PM10 site would be well suited as a location for monitoring PM2.5. Two of the proposed PM2.5 sites will be located at new locations. All sites selected to operate PM2.5 samplers are located in the more populated areas of Lake Tahoe where high PM2.5 concentrations are expected. They will provide useful information about PM2.5 emission sources and population exposure.

3.2 Site Description

The network for the Lake Tahoe MPA, as proposed, includes two sites that will be deployed in 1998. The following characteristics apply to both sites:

- ▶ Use a Federal Reference Monitor (FRM) type sampler purchased through the national contract established by the U.S. EPA.
- ▶ Sited in a population-oriented location.
- ▶ “Site Type” is Core SLAMS.
- ▶ Represent neighborhood spatial scale.
- ▶ Provide data that will be compared to both the annual standard and the 24-hour standard.

Based on these criteria, the monitoring sites listed in Table 3.2.1 are identified for use for PM2.5 monitoring within the Lake Tahoe MPA.

The monitoring site at South Lake Tahoe-Sandy Way was selected to represent an area of

maximum PM2.5 concentration in a populated area in the Lake Tahoe MPA.

The monitoring site in North Lake Tahoe will be selected to represent an area of poor air quality in a populated area. It may not necessarily be in an area of expected maximum concentrations.

These monitoring objectives will be further evaluated during the annual network review period next year when PM2.5 data will be available from these sites.

Table 3.2.1 PM2.5 Monitoring Sites to be Deployed in 1998

Site Location	AIRS Site ID	Operating Agency	Spatial Scale	Monitoring Objective	Site Type	Measurement Method
North Lake Tahoe	new site	ARB	Neighborhood	R	C	FRM/SCH
South Lake Tahoe-Sandy Way	060170011	ARB	Neighborhood	M	C	FRM/SCH

The following codes are used in this table:

Operating Agency :

ARB California Air Resources Board

Monitoring Objectives:

R Represent high concentrations in a populated area.
 M Determine the highest concentration expected to occur in the area covered by the network (more than one site per area may be needed).

Site Type:

C Core SLAMS
 S Non-core SLAMS
 P Special Purpose Monitors

Measurement Method :

FRM/SCH Federal Reference Method Single Channel Sampler
 FRM/SQ Federal Reference Method Sequential Sampler

4.0 PM2.5 MONITORING SITES TO BE DEPLOYED IN 1999

There are plans to establish one additional PM2.5 monitoring site in 1999 that would operate an FRM monitor. The PM2.5 data from this site are intended to help better define the boundaries of nonattainment areas and satisfy other monitoring objectives of the PM2.5 monitoring network. One of the PM2.5 sites deployed in 1998 will have a chemical speciation monitor added in 1999.

4.1 Monitoring Sites Operating PM2.5 FRM Monitors

There are plans to deploy an additional PM2.5 FRM monitoring site in Squaw Valley in 1999. This additional site will represent an area of poor air quality in a populated area. The PM2.5 data collected at this site will be used to determine the boundaries of PM2.5 national attainment/nonattainment areas and provide better geographical representation.

Table 4.1.1 PM2.5 Monitoring Sites to be Deployed in 1999

Site Location	AIRS Site ID	Operating Agency	Spatial Scale	Monitoring Objective	Site Type	Measurement Method
Squaw Valley	new site	to be determined	Neighborhood	R	C	to be determined

ARB Air Resources Board
 R Represent high concentrations in a populated area.
 C Core SLAMS

4.2 PM2.5 Chemical Speciation Sampling

The basic objective of the PM2.5 chemical speciation sampling and analysis program is to develop seasonal and annual chemical characterizations and distributions, across the country, of the ambient aerosols present in PM2.5 samples. These chemically resolved data will be used to perform source attribution analyses, evaluate emission inventories and air quality models, and support health related research studies.

The EPA recognizes that sampling for chemical speciation is a developing science, and encourages creative approaches to chemical speciation sampling. The ARB and the local air quality management districts will evaluate existing chemical speciation samplers and select the best-suited instruments for the monitoring conditions in the Lake Tahoe MPA. The selected instrument will collect samples for the currently targeted chemical analytes, that include the following:

- ▶ Cations: particulate ammonium, ionic sodium, calcium, and magnesium.
- ▶ Anions: particulate sulfate, nitrate, and chloride.
- ▶ Carbon: total, organic, and elemental.

- ▶ Trace elements: sodium, magnesium, etc., through lead.
- ▶ Semi-volatile organic particles.

The site listed in Table 4.2.1 below was selected for collecting chemically speciated data because it best meets the following list of criteria in the order of importance:

- ▶ High PM2.5 concentrations, or expected significant contribution of PM2.5 to high PM10 concentrations.
- ▶ Located in a area of significant population density.
- ▶ Located in PAMS areas where there is a maximum precursor site for PM2.5 (this may also be a high concentration site).
- ▶ Significant for atmospheric transport determinations.
- ▶ Geographical representation of a monitored area.

Table 4.2.1 PM2.5 Chemical Speciation Sampling

PM2.5 Chemical Speciation Site	AIRS Site ID	Operating Agency	Monitoring Method
South Lake Tahoe-Sandy Way	060170011	ARB	to be determined

ARB California Air Resources Board

4.3 Continuous PM2.5 Monitoring

The Federal regulation 40 CFR 58, Appendix D, 2.8.2.3, requires that continuous PM2.5 samplers be placed in metropolitan areas where there is a population greater than 1 million people. Continuous PM2.5 data are useful for public reporting of short-term concentrations, for understanding diurnal and episodic behavior of fine particles, and for use by health scientists investigating exposure patterns. The Lake Tahoe MPA, with a population of 42,344 based on the 1990 census, is not required to have a continuous PM2.5 monitor. There are no plans to deploy a continuous PM2.5 monitor in this MPA.

5.0 PM2.5 SAMPLING FREQUENCY

The U.S. EPA requirements call for everyday sampling of PM2.5 at certain core SLAMS sites and one in three day sampling at all other PM2.5 and all PM10 sites. In order to collect sufficient data and at the same time conserve monitoring resources, the ARB and the local air quality management districts are proposing alternative sampling frequencies for PM2.5 and PM10.

5.1 PM2.5 FRM Sampling Frequency

Everyday sampling is not required at any of the three sites in the Lake Tahoe MPA as specified in the regulations, i.e., two sites per area over 500,000 population and one site per PAMS area. All core PM2.5 monitoring sites are required to collect a sample once every three days. Monitoring sites established in 1998 in the Lake Tahoe MPA will collect PM2.5 samples on a one in six day schedule. During the 1999 annual network review, the ARB and the local air quality agencies will propose a sampling schedule for the Squaw Valley site.

Table 5.1.1 PM2.5 FRM Sampling Frequency

Site Location	AIRS Site ID	Operating Agency	Sampling Frequency	
			Required	Proposed
North Lake Tahoe	new site	ARB	1 in 3 day	1 in 6 day
South Lake Tahoe-Sandy Way	060170011	ARB	1 in 3 day	
Squaw Valley	new site	to be determined	1 in 3 day	to be determined

ARB California Air Resources Board

5.2 PM2.5 Chemical Speciation Sampling Frequency

The federally required sampling frequency for PM2.5 chemical speciation is once in 12 days. This sampling frequency may not be sufficient in some cases to adequately support plans to control PM2.5 source emissions. The appropriate sampling frequency will be determined at a later date and will depend largely on PM2.5 data needs and available resources.

5.3 PM10 Sampling Frequency

The new U.S. EPA minimum requirement for PM10 sampling frequency is once every three days. The Air Resources Board and the local air pollution control districts in California are requesting that the U.S. EPA Region 9 grant a statewide waiver allowing sampling at the current schedule of 1-in-6-day, with certain exceptions to be determined on a case by case basis. To demonstrate a change in the attainment status of the national 24-hour PM10 standard, more

frequent sampling may be needed. Monitoring sites with maximum 24-hour concentrations close to the 24-hour standard may be required to sample everyday or at least on a 1-in-3-day schedule.