Quality Assurance Project Plan for Criteria Pollutant Monitoring Program

November 2012

South Coast Air Quality Management District
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Issued by:
Office of Science & Technology Advancement

FOREWORD

This Quality Assurance Project Plan (QAPP) for the South Coast Air Quality Management District (AQMD) Criteria Pollutant Monitoring Program is a comprehensive document that describes in detail the necessary quality assurance, quality control (QC), and all other technical activities that are implemented to ensure that the work performed satisfies the stated performance criteria. The requirements set forth have been developed to be consistent with the AQMD's Quality Management Plan (QMP) for Environmental Measurement Programs, and comply with agency quality assurance policies. This QAPP conforms to the requirements of the United States Environmental Protection Agency (U.S. EPA) Order 5360.1 and the applicable sections of 40 CFR Parts 30, 31, and 35, as well as any specific grant agreements, as applicable. This QAPP was generated using the U.S. EPA Quality Assurance (QA) regulations and guidance described in *EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans* and the accompanying document *EPA QA/G-5, Guidance for Quality Assurance Project Plans.* All pertinent elements of the regulations and guidance are addressed in this QAPP.

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LIST OF ACRONYMS	
AM	Atmospheric Measurements
AQ Chemist	Air Quality Chemist
AQIS	Air Quality Instrument Specialist
AQMD	South Coast Air Quality Management District
AQMP	Air Quality Management Plan
AQS	Air Quality System
BAM	Beta Attenuation Monitor
CAA	Clean Air Act
CAR	Corrective Action Report
CARB	California Air Resources Board
CBSA	Core Based Statistical Area
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CV	Coefficient of Variation
DEO/STA	Deputy Executive Officer/Science & Technology Advancement
DMS	Data Management System
DQI	Data Quality Indicator
DQO	Data Quality Objectives
ESC	Environmental System Corporation
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GLP	Good Laboratory Practices
IP	Internet Protocol
LSST	Laboratory Services & Source Testing
MAD	Monitoring & Analysis Division
MDL	Minimum Detection Limit
MQO	Measurement Quality Objectives
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standard
NAMS	National Air Monitoring Station
NAP	Non-Attainment Plan
NATTS	National Air Toxic Trend Site
NCORE Multipollutant Monitoring Network (NCORE)	Multi pollutant network for particles, pollutant gases and meteorology
NEI	National Emissions Inventory
NIST	National Institute of Standards and Technology

NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
O_3	Ozone
PAMS	Photochemical Assessment Monitoring Stations
PAQ Chemist	Principal Air Quality Chemist
Pb	Lead
PE	Performance Evaluation
PGVP	Protocol Gas Verification Program
PM_{10}	Particulate Matter (diameter less than or equal to 10 microns)
$PM_{2.5}$	Particulate Matter (diameter less than or equal to 2.5 microns)
PQAO	Primary Quality Assurance Organization
PWEI	Population Weighted Emissions Index
QA	Quality Assurance
QAA	Quality Assurance Alert
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
RFP	Request for Proposal
RFQ	Request for Quotation
SAQ Chemist	Senior Air Quality Chemist
SCAB	South Coast Air Basin
SLAMS	State and Local Air Monitoring Stations
SO_2	Sulfur Dioxide
SO_4	Sulfates
SOP	Standard Operating Procedure
SPM	Special Purpose Monitors
SRM	Standard Reference Material
SSAB	Salton Sea Air Basin
STA	Science & Technology Advancement
TRM	Traceable Reference Material
TSA	Total Systems Audit
TSP	Total Suspended Particulate
U.S. EPA	United States Environmental Protection Agency

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APPROVALS		
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DISTRIBUTION LIST

To ensure that the intent and spirit of AQMD quality assurance policies are appropriately distributed so that they are inherent in all applicable ambient air quality data collection processes, the Criteria Pollutant Monitoring Program QAPP is distributed to the following:

- Persons listed in APPROVALS section.
- AQMD Monitoring & Analysis Division (MAD) supervisory and line staff involved in any aspect of this Criteria Pollutant Monitoring Program.

Distribution is performed via MAD on-line documentation resources for centralized access and hardcopies available by the QA Branch. Training of staff members new to the Criteria Pollutant Monitoring Program will include QAPP content and location of centralized documents.

SECTION 0. INTRODUCTION

AQMD is designated as one of four Primary Quality Assurance Organizations (PQAO) in California and is the air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside, and San Bernardino counties. AQMD is responsible for controlling emissions primarily from stationary sources of air pollution. AQMD develops and adopts an Air Quality Management Plan (AQMP) that delineates the strategy for bringing the area under its jurisdiction into compliance with federal and state clean air standards. To attain these goals, AQMD conducts monitoring programs to provide information for assessing the improvement of regional air quality. AQMD conducts criteria pollutant monitoring programs that have demonstrated a significant spatial distribution of pollutant sources across the South Coast Air Basin (SCAB).

AQMD operates 40 permanent air monitoring sites in the SCAB and a portion of the Salton Sea Air Basin (SSAB) in the Coachella Valley. This area includes Orange County and the non-desert portions of Los Angeles, Riverside, and San Bernardino Counties.

Through this monitoring, AQMD is better able to implement effective criteria pollutant control measures targeting those constituents most harmful to public health quality of life. The goals of this program are consistent with AQMD's mission and belief that all people who live or work under its jurisdiction have a right to breathe clean air.

AQMD management policy requires that sufficient quality assurance activities be conducted to demonstrate that all data collected by and on behalf of AQMD are scientifically and legally valid for the purposes to which they are intended. The purpose of this QAPP is to document management policy and those activities and procedures necessary for accomplishing program objectives. This QAPP incorporates and follows the General Quality Assurance Policies for Environmental Measurements identified in Section 2.3 of the AQMD QMP so that the quality of all data reported from this program shall meet agency, state, and U.S. EPA program requirements where appropriate. A glossary of terms used in this document is provided in Appendix A.

SECTION 1. PROJECT MANAGEMENT

1.1 Project Organization

The AQMD organizational structure and the general description of the administrative, management, and staff responsibilities are outlined in the QMP, Appendix C. The Criteria Pollutant Monitoring program is mostly undertaken by MAD under the Office of Science & Technology Advancement (STA) within AQMD. The three branches of MAD are Atmospheric Measurements (AM), Laboratory Services – Source Testing (LSST), and QA. The roles and responsibilities of these three branches are outlined in the *Quality Management Plan for Environmental Measurement Programs* (Section 3, 2009). Table 1.1 shows the general QA responsibilities and upward lines of communication for staff involved in the Criteria Pollutant Monitoring Program. More detailed description of specific quality control responsibilities for various positions are identified in Section 2.2 in related SOPs.

Table 1.1
Position Responsibilities

Position	Responsibilities	Upward Lines of Communication
DEO: Science & Technology Advancement	Accountable for the successful accomplishment of project objectives	Executive Officer, Executive Council, and Governing Board
DEO: Information Management	Accountable for computer, software, hardware and communications support	Executive Officer, Executive Council, and Governing Board
Senior Enforcement Manager: Laboratory Services and Source Test Engineering	Responsible for preparation of sampling media and analysis of samples submitted to laboratory	DEO: Science Technology Advancement
Atmospheric Measurements Manager	Responsible for establishment, operation and maintenance of monitoring stations	DEO: Science Technology Advancement
Quality Assurance Manager	Responsible for reviewing, developing, documenting, and implementing QA/QC practices and procedures, implementation of performance and technical systems evaluations and coordinating evaluations with U.S. EPA and CARB. Annually Certifies the data submitted to U.S. EPA.	DEO: Science Technology Advancement
Principal Air Quality Chemist: Aerosol Analysis	Responsible for laboratory operations of the Aerosol Analysis group including $PM_{2.5}$ and PM_{10} Mass and TSP Lead.	Manager: Laboratory Services and Source Test Engineering

Table 1.1
Position Responsibilities (cont.)

Position	Responsibilities	Upward Lines of Communication
Senior Air Quality Chemist	Responsible for supporting Aerosol Analysis group operations and 2nd level data validation, submittal of data into AQS	Principal AQ Chemist: Aerosol Analysis
Assistant Air Quality Chemist and Air Quality Chemist	Responsible for following SOPs and GLP in the analysis of samples; submittal of data into AQS	Principal AQ Chemist: Aerosol Analysis
Laboratory Technician	Responsible for following SOPs and GLP for the preparation of samples or sampling media	Principal AQ Chemist: Aerosol Analysis
Principal Air Quality Instrument Specialist	Responsible for station operations and deployment and/or coordinating repair and calibrations	Atmospheric Measurements Manager
Senior Air Quality Instrument Specialist	Responsible for supporting operations and 2nd level data validation	Principal Air Quality Instrument Specialist
Air Quality Instrument Specialist I and II	Responsible for following SOPs and GLP in the collection of samples from the field sites, maintaining the station site, and/or repair and calibration of instruments	Principal Air Quality Instrument Specialist

As part of the extended quality system for the AQMD criteria pollutant data, U.S. EPA Region 9 reviews and approves the annual network plans, QMPs, QAPPs, tracks progress of data submission, and finalizes the certification of data in Air Quality System (AQS). Both California Air Resources Board (CARB) and U.S. EPA conduct performance evaluations and technical systems audits described in detail in Section 4.1.1. Also, external qualified contract services, through the competitive process, are selected for the performance evaluations for PM samplers and surface meteorology.

1.2 Problem Definition/Background

Between the years 1900 and 1970, the emission of air pollutants increased significantly. In 1970, Congress passed the Clean Air Act (CAA) which required the states to assess their attainment to the National Ambient Air Quality Standards (NAAQS) for air pollutants. CARB transferred air monitoring responsibilities to local air pollution control agencies where there were existing programs for which AQMD became the agency responsible for monitoring the air for the SCAB.

The CAA and its amendments provide the framework for all pertinent organizations to protect air quality. The CAA requires U.S. EPA to revise or update federal air quality standards based on

review of the latest scientific information on known and potential human health effects associated with concentrations of criteria pollutants typically found in the ambient air (40 CFR Part 50). In fulfilling these obligations, U.S. EPA reviews the air quality criteria and NAAQS for criteria pollutants and epidemiological range of serious health effects.

Since air pollution is not constrained within city and county boundaries, it is largely a regional issue. As the regional air quality agency for Orange County and portions of Los Angeles, Riverside, and San Bernardino Counties, including the Coachella Valley, AQMD is responsible for stationary sources with some limited mobile source and consumer product authority. AQMD also has the primary responsibility for the development and adoption of the AQMP which outlines the AQMD maintenance and control strategies with the goal of reaching compliance with the NAAQS.

Federal and State Standards

Current regulation defines the criteria pollutants as particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and lead (Pb). Ambient air quality standards for O_3, CO, NO_2, SO_2, PM_{10} and $PM_{2.5}$, and Pb have been set by both the State of California and the federal government. The state has also set standards for sulfates (SO_4) and visibility. The state and federal ambient air quality standards for each of the criteria pollutants and their effects on health are summarized in Table 1.2.

Regulation describes the minimum number of monitors for each pollutant, the type of monitors, the methodology for locating the monitors, the quality assurance needed for the monitors, and the schedule for reporting data to U.S. EPA. Ambient air monitoring data historically have been and will continue to be the basis for any decisions regarding the attainment or non-attainment of the NAAQS in the SCAB. In addition, other monitoring programs are operated to define population exposure to air contaminants known or suspected to cause adverse health effects and/or to cause damage to property or sensitive ecosystems.

Table 1.2
State and Federal Ambient Air Quality Standards for
Criteria Pollutants and Their Effects on Health

AIR POLLUTANT	STATE STANDARD	FEDERAL STANDARD (NAAQS)	RELEVANT HEALTH EFFECTS#
	Concentration, Averaging Time	Concentration, Averaging Time	
Ozone (O_3)	0.09 ppm, 1-Hour 0.070 ppm, 8-Hour	0.075 ppm, 8-Hour (2008) 0.08 ppm, 8-Hour (1997)	(a) Pulmonary function decrements and localized lung edema in humans and animals; (b) Risk to public health implied by alterations in pulmonary morphology and host defense in animals; (c) Increased mortality risk; (d) Risk to public health implied by altered connective tissue metabolism and altered pulmonary morphology in animals after long-term exposures and pulmonary function decrements in chronically exposed humans; (e) Vegetation damage; (f) Property damage
Carbon Monoxide (CO)	20 ppm, 1-Hour 9.0 ppm, 8-Hour	35 ppm, 1-Hour 9 ppm, 8-Hour	(a) Aggravation of angina pectoris and other aspects of coronary heart disease; (b) Decreased exercise tolerance in persons with peripheral vascular disease and lung disease; (c) Impairment of central nervous system functions; (d) Possible increased risk to fetuses
Nitrogen Dioxide (NO_2)	0.18 ppm, 1-Hour 0.030 ppm, Annual	100 ppb, 1-Hour 0.053 ppm, Annual	(a) Potential to aggravate chronic respiratory disease and respiratory symptoms in sensitive groups; (b) Risk to public health implied by pulmonary and extra-pulmonary biochemical and cellular changes and pulmonary structural changes; (c) Contribution to atmospheric discoloration
Sulfur Dioxide (SO_2)	0.25 ppm, 1-Hour 0.04 ppm, 24-Hour	75 ppb, 1-Hour	Bronchoconstriction accompanied by symptoms which may include wheezing, shortness of breath, and chest tightness during exercise or physical activity in persons with asthma
Suspended Particulate Matter (PM_{10})	50 µg/m^3, 24-Hour 20 µg/m^3, Annual	150 µg/m^3, 24-Hour	(a) Exacerbation of symptoms in sensitive patients with respiratory or cardiovascular disease; (b) Decline in pulmonary function or growth in children; (c) Increased risk of premature death
Suspended Particulate Matter ($PM_{2.5}$)	12.0 µg/m^3, Annual	35 µg/m^3, 24-Hour 12.0 µg/m3, Annual	
Sulfates-PM_{10} (SO_4^{2-})	25 µg/m^3, 24-Hour	N/A	(a) Decrease in lung function; (b) Aggravation of asthmatic symptoms; (c) Aggravation of cardio-pulmonary disease; (d) Vegetation damage; (e) Degradation of visibility; (f) Property damage
Lead (Pb)	1.5 µg/m^3, 30-day	0.15 µg/m^3, 3-month rolling	(a) Learning disabilities; (b) Impairment of blood formation and nerve conduction
Visibility-Reducing Particles	In sufficient amount such that the extinction coefficient is greater than 0.23 inverse kilometers at relative humidity less than 70 percent, 8-hour average (10am - 6pm)	N/A	Visibility impairment on days when relative humidity is less than 70 percent

ppm – parts per million by volume ppb – parts per billion by volume
State standards are "not-to-exceed" values; Federal standards follow the design value form of the NAAQS
More detailed health effect information can be found in the 2012 AQMP Appendix I or the U.S. EPA NAAQS documentation at http://www.epa.gov/ttn/naaqs/

NAAQS Attainment Status

The current status of NAAQS attainment for the criteria pollutants is presented in Table 1.3 for the SCAB and in Table 1.4 for the Riverside County portion of the SSAB (Coachella Valley).

Table 1.3
National Ambient Air Quality Standards (NAAQS)
Attainment Status South Coast Air Basin

CRITERIA POLLUTANT	AVERAGING TIME	DESIGNATION [a)]	ATTAINMENT DATE [b)]
1979 **1-Hour Ozone**[c)]	1-Hour (0.12 ppm)	Nonattainment (Extreme)	11/15/2010 (not attained)[c)]
1997 **8-Hour Ozone**[d)]	8-Hour (0.08 ppm)	Nonattainment (Extreme)	6/15/2024
2008 **8-Hour Ozone**	8-Hour (0.075 ppm)	Nonattainment (Extreme)	12/31/2032
CO	1-Hour (35 ppm) 8-Hour (9 ppm)	Attainment (Maintenance)	6/11/2007 (attained)
NO_2[e)]	1-Hour (100 ppb)	Unclassifiable/Attainment	Attained
	Annual (0.053 ppm)	Attainment (Maintenance)	9/22/1998
SO_2[f)]	1-Hour (75 ppb)	Designations Pending	Pending
	24-Hour (0.14 ppm) Annual (0.03 ppm)	Unclassifiable/Attainment	3/19/1979 (attained)
PM_{10}	24-hour (150 µg/m^3)	Nonattainment (Serious)[g)]	12/31/2006 (redesignation request submitted)[g)]
$PM_{2.5}$	24-Hour (35 µg/m^3)	Nonattainment	12/14/2014[h)]
	Annual (12.0 µg/m3)	Nonattainment	4/5/2015
Lead	3-Months Rolling (0.15 µg/m^3)	Nonattainment (Partial)[i)]	12/31/2015

a) U.S. EPA often only declares Nonattainment areas; everywhere else is listed as Unclassifiable/Attainment or Unclassifiable

b) A design value below the NAAQS for data through the full year or smog season prior to the attainment date is typically required for attainment demonstration

c) 1-hour O_3 standard (0.12 ppm) was revoked, effective June 15, 2005; however, the SCAB has not attained this standard based on 2008-2010 data and has some continuing obligations under the former standard

d) 1997 8-hour O_3 standard (0.08 ppm) was reduced (0.075 ppm), effective May 27, 2008; the 1997 O_3 standard and most related implementation rules remain in place until the 1997 standard is revoked by U.S. EPA

e) New NO_2 1-hour standard, effective August 2, 2010; attainment designations January 20, 2012; annual NO_2 standard retained

f) The 1971 annual and 24-hour SO_2 standards were revoked, effective August 23, 2010; however, these 1971 standards will remain in effect until one year after U.S. EPA promulgates area designations for the 2010 SO_2 1-hour standard. Area designations are expected in 2012, with SCAB designated Unclassifiable /Attainment

g) Annual PM_{10} standard was revoked, effective December 18, 2006; redesignation request to Attainment of the 24-hour PM_{10} standard is pending with U.S. EPA

h) Attainment deadline for the 2006 24-Hour $PM_{2.5}$ NAAQS is December 14, 2014

Partial Nonattainment designation – Los Angeles County portion of SCAB only

Table 1.4
National Ambient Air Quality Standards (NAAQS) Attainment Status
Coachella Valley Portion of the Salton Sea Air Basin

CRITERIA POLLUTANT	AVERAGING TIME	DESIGNATION [a)]	ATTAINMENT DATE [b)]
1979 **1-Hour Ozone**[c)]	1-Hour (0.12 ppm)	Nonattainment (Severe-17)	11/15/2007 (not timely attained[c)])
1997 **8-Hour Ozone**[d)]	8-Hour (0.08 ppm)	Nonattainment (Severe-15)	6/15/2019
2008 **8-Hour Ozone**	8-Hour (0.075 ppm)	Nonattainment (Severe-15)	12/31/2027
CO	1-Hour (35 ppm) 8-Hour (9 ppm)	Unclassifiable/Attainment	Attained
NO_2[e)]	1-Hour (100 ppb)	Unclassifiable/Attainment	Attained
	Annual (0.053 ppm)	Unclassifiable/Attainment	Attained
SO_2[f)]	1-Hour (75 ppb)	Designations Pending	Pending
	24-Hour (0.14 ppm) Annual (0.03 ppm)	Unclassifiable/Attainment	Attained
PM_{10}	24-hour (150 $\mu g/m^3$)	Nonattainment (Serious)[g)]	12/31/2006 (redesignation request submitted)[g)]

Table 1.4
National Ambient Air Quality Standards (NAAQS) Attainment Status
Coachella Valley Portion of the Salton Sea Air Basin (cont.)

CRITERIA POLLUTANT	AVERAGING TIME	DESIGNATION [a)]	ATTAINMENT DATE [b)]
$PM_{2.5}$	24-Hour (35 µg/m^3) Annual (12.0 µg/m3)	Unclassifiable/Attainment	Attained
Lead	3-Months Rolling (0.15 µg/m^3)	Unclassifiable/Attainment	Attained

a) U.S. EPA often only declares Nonattainment areas; everywhere else is listed as Unclassifiable/Attainment or Unclassifiable

b) A design value below the NAAQS for data through the full year or smog season prior to the attainment date is typically required for attainment demonstration

c) 1-hour O_3 standard (0.13 ppm) was revoked, effective June 15, 2005; the Southeast Desert Modified Air Quality Management Area, including the Coachella Valley, has not attained this standard based on 2005-2007 data and has some continuing obligations under the former standard (latest 2009-2011 data shows attainment)

d) 1997 8-hour O_3 standard (0.08 ppm) was reduced (0.075 ppm), effective May 27, 2008; the 1997 O_3 standard and most related implementation rules remain in place until the 1997 standard is revoked by U.S. EPA

e) New NO_2 1-hour standard, effective August 2, 2010; attainment designations January 20, 2012; annual NO_2 standard retained

f) The 1971 Annual and 24-hour SO_2 standards were revoked, effective August 23, 2010; however, these 1971 standards will remain in effect until one year after U.S. EPA promulgates area designations for the 2010 SO_2 1-hour standard. Area designations expected in 2012 with SSAB designated Unclassifiable /Attainment

g) Annual PM_{10} standard was revoked, effective December 18, 2006; redesignation request to Attainment of the 24-hour PM_{10} standard is pending with U.S. EPA

In 2011, the SCAB exceeded federal standards for either O_3 or $PM_{2.5}$ at one or more locations on a total of 124 days, based on the current federal standards for 8-hour O_3 and 24-hour $PM_{2.5}$. Despite substantial improvement in air quality over the past few decades, some air monitoring stations in the SCAB still exceed the NAAQS for O_3 more frequently than any other stations in the U.S. In 2011, three of the top five stations in the nation most frequently exceeding the 8-hour federal O_3 NAAQS were located within the SCAB (i.e., Central San Bernardino Mountains, East San Bernardino Valley and Metropolitan Riverside County). In

the year 2011, the former 1-hour[1] and current 8-hour average federal standard levels for O_3 were exceeded at one or more SCAB locations on 16 and 106 days, respectively.

$PM_{2.5}$ in the SCAB has improved significantly in recent years, with 2010 and 2011 being the cleanest years on record. In 2011, only one station in the SCAB (Metropolitan Riverside County at Mira Loma) exceeded the annual $PM_{2.5}$ NAAQS and the 98th percentile form of the 24-hour $PM_{2.5}$ NAAQS, as well as the 3-year design values for these standards. (Although other stations had 24-hour averages exceeding the federal 24-hour $PM_{2.5}$ standard concentration level in 2011, the 98th percentile concentration did not exceed.) SCAB-wide, the federal $PM_{2.5}$ 24-hour standard level was exceeded in 2011 on 17 sampling days[2].
The SCAB and the Coachella Valley have technically met the PM_{10} NAAQS and redesignation for attainment for the federal PM_{10} standard has been requested for both. These requests are still pending with U.S. EPA at this time[3].

The AQMD is currently in attainment for the federal standards for SO_2, CO, and NO_2. While the concentration level of the new 1-hour NO_2 federal standard (100 ppb) was exceeded in the SCAB at two stations (Central Los Angeles and Long Beach, on the same day) in 2011, the NAAQS NO_2 design value has not been exceeded (the 3-year average of the annual 98th percentile of the daily 1-hour maximums). Therefore, the SCAB remains in attainment of the NO_2 NAAQS. U.S. EPA requirements for future near-road NO_2 measurements are not a part of the current ambient NO_2 NAAQS determinations.

U.S. EPA designated the Los Angeles County portion of the SCAB (excluding the high desert areas, and San Clemente and Santa Catalina Islands) as nonattainment for the recently revised (2008) federal lead standard (0.15 $\mu g/m^3$, rolling 3-month average), due to the addition of source-specific monitoring under the new federal regulation. This designation was based on two source-specific monitors in Vernon and in the City of Industry exceeding the new standard in the 2007-2009 period of data used. For the most recent 2009-2011 data period, only one of these stations (Vernon) still exceeded the lead standard, with a maximum

[1] The federal 1-hour O_3 NAAQS has been revoked by U.S. EPA, although certain nonattainment areas, including the Basin, may be still required to demonstrate attainment of that standard based on recent court decisions.

[2] The number of PM exceedances may have been higher at some locations, since $PM_{2.5}$ samples are collected every 3 days at most sites. However, seven sites sample every day, including the SCAB maximum concentration stations. PM_{10} filter samples are collected every 6 days, except at the design value maximum sites in the SCAB and the Coachella Valley at which samples are collected every 3 days. Daily PM_{10} data for the SCAB maximum stations is provided by supplementing the filter measurements with Federal Equivalent Method (FEM) continuous monitors. The gaseous pollutants, including O_3, NO_2, SO_2, and CO, are sampled continuously.

[3] U.S. EPA has requested additional PM_{10} monitoring in the southeastern Coachella Valley for a 1-year period to further assess windblown dust in that area. This project is currently ongoing.

3-month rolling average of 0.67 $\mu g/m^3$ occurring in 2009. In 2011, the rolling 3-month average at that site was 0.46 $\mu g/m^3$.

The remainder of the SCAB, outside the Los Angeles County nonattainment area, and the Coachella Valley remain in attainment of the new standard and no ambient monitors that are not source-oriented exceed. For areas in attainment of the old 1978 standard (1.5 $\mu g/m^3$, as a quarterly average), the 1978 lead standard remained in effect until one year after an area was designated for the 2008 standard. While the entire SCAB and the Coachella Valley have remained in attainment of the 1978 lead standard, U.S. EPA's current lead designations for the new standard became effective on December 31, 2010; thus, the old standard is now superseded by the 2008 revised NAAQS. A separate SIP revision addressing the 2008 lead standard has been submitted to U.S. EPA.

1.3 Project Description

Criteria Pollutant Monitoring is a key component of the developing the NAAQS, development of annual averages, and provides information considered in the AQMD AQMP development. It is included in the monitoring requirements and principles set forth by the Federal Register (40 CFR Parts 50, 53, and 58) review completed in 1997.

In accordance with U.S. EPA (2008) the AQMD ambient air monitoring network is designed to collect data to meet three basic objectives:

1. provide air pollution data to the general public in a timely manner;
2. support compliance with air quality standards and emission strategy development; and
3. support air pollution research.

Additional programmatic objectives of the program, portions of which are adapted from the CARB annual network plan (2007), which support AQMD regulatory efforts include:

Objective #1: Background Level Monitoring
Data is used to determine general background levels of air pollutants before the air mass enters the SCAB.

Objective #2: High Concentration Monitoring
Monitoring is conducted at sites to determine the highest concentration of an air pollutant within the monitoring network. The monitoring network may have multiple high concentration sites which are due to varying environmental and anthropogenic factors year to year. The network is assessed every five years to determine the expected high concentration areas per pollutant so that the network plan can address the appropriate monitoring frequencies for the predicted areas of high concentration.

Objective #3: Pollutant Transport
Transport is the movement of pollutant between air basins or areas within an air basin. Transport monitoring is used to assess movement of pollutants and to provide data useful in development of strategies for mitigation in upwind areas when transported pollutant(s) adversely affect neighboring downwind areas. Transport monitoring is also used to determine the extent of regional pollutant transport among populated areas into rural areas.

Objective #4: Population Exposure Monitoring
Monitoring is conducted to measure the representative air pollutant concentrations which may be connected to health impacts to which populations are exposed.

Objective #5: Representative Concentration Monitoring
Monitoring is conducted to represent the air quality concentrations for a pollutant expected to be similar throughout a geographical area. These sites do not necessarily indicate the highest concentrations in the area for a particular pollutant.

Objective #6: Source Impact Monitoring
Monitoring is used to determine the impact of significant sources or source categories of air quality emissions on ambient air quality. The air pollutant sources may be stationary or mobile.

Objective #7: Trend Analysis Monitoring
Trend Analyses show air pollution concentrations over extended periods of time. Usually, trend analyses show the progress or lack of progress in improving air quality for an area over a period of years.

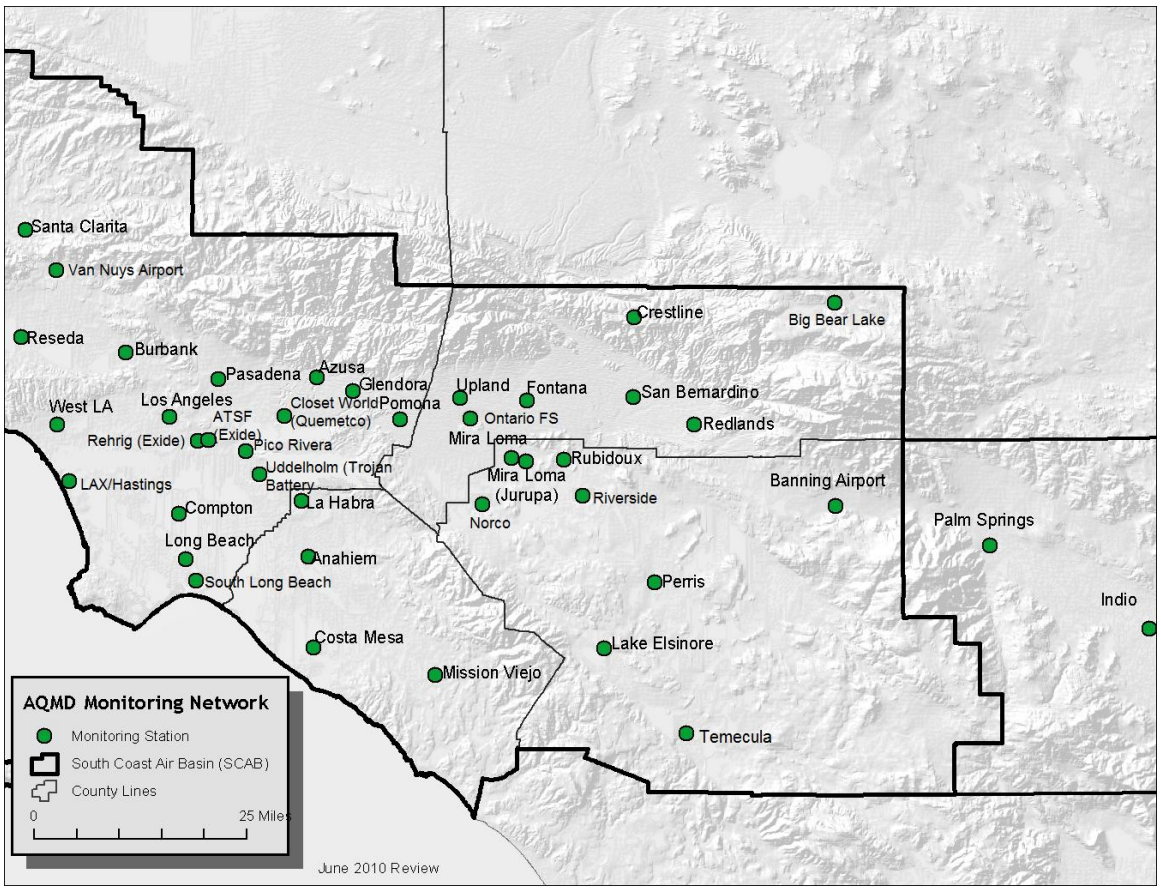
Objective #8: Site Comparison Monitoring
Site Comparisons are used to assess the effect on measured pollutant levels when relocating a monitoring location a short distance (usually less than two miles). Some monitoring locations can produce data that is no longer representative or is unusable due to land development, land usage changes, change of lease terms, or eviction from a monitoring site. In these cases, concurrent monitoring is ideally performed at the old and new site for a period of at least one year in order to assess pollutant measurement comparability.

Objective #9: Real Time Reporting/Modeling
Real time reporting is used to provide data to U.S. EPA's AIRNOW system which reports air pollutant conditions on a real time basis to the general public. Data is also used to provide accurate and timely air quality forecast guidance to residents of the SCAB. (http://www.airnow.gov/index.cfm?action=airnow.local_city&cityid=342).

Each year, AQMD AM Branch submits an air quality network plan to U.S. EPA Region 9 for review and approval of the current configuration of the air monitoring network, including State and Local Air Monitoring Stations (SLAMS), Photochemical Assessment Monitoring Stations

(PAMS), $PM_{2.5}$ Speciation, National Air Toxic Trend Site (NATTS), and NCORE monitors to make sure that the monitoring requirements are being held. Figure 1.1 shows the location of the spatial distribution of the fixed monitoring sites (2011).

Figure 1.1
Fixed Stations for Ambient Air Monitoring



The AQMD network is required to meet or exceed the minimum monitoring requirements for all criteria pollutants as shown in Table 1.5. The minimum number of monitors for each pollutant is based on Metropolitan Statistical Area (MSA) populations as described in 40 CFR Part 58 Appendix D. The actual number of monitors varies year by year and is updated through the AQMD annual network plan and the minimum number of monitors required is assessed every 5 years through the network assessment by the AM Branch and submitted to U.S. EPA Region 9.

Figure 1.2 shows the trend of maximum pollutant concentrations in the SCAB for the past two decades, as percentages of the corresponding federal standards. Most pollutants show significant

improvement over the years, with $PM_{2.5}$ showing the most dramatic decrease. Again, these are maximum concentrations and actual attainment of the standards is based on the design value.

Figure 1.2
Trends of South Coast Air Basin Maximum Pollutant Concentrations
(Percentages of Federal Standards)

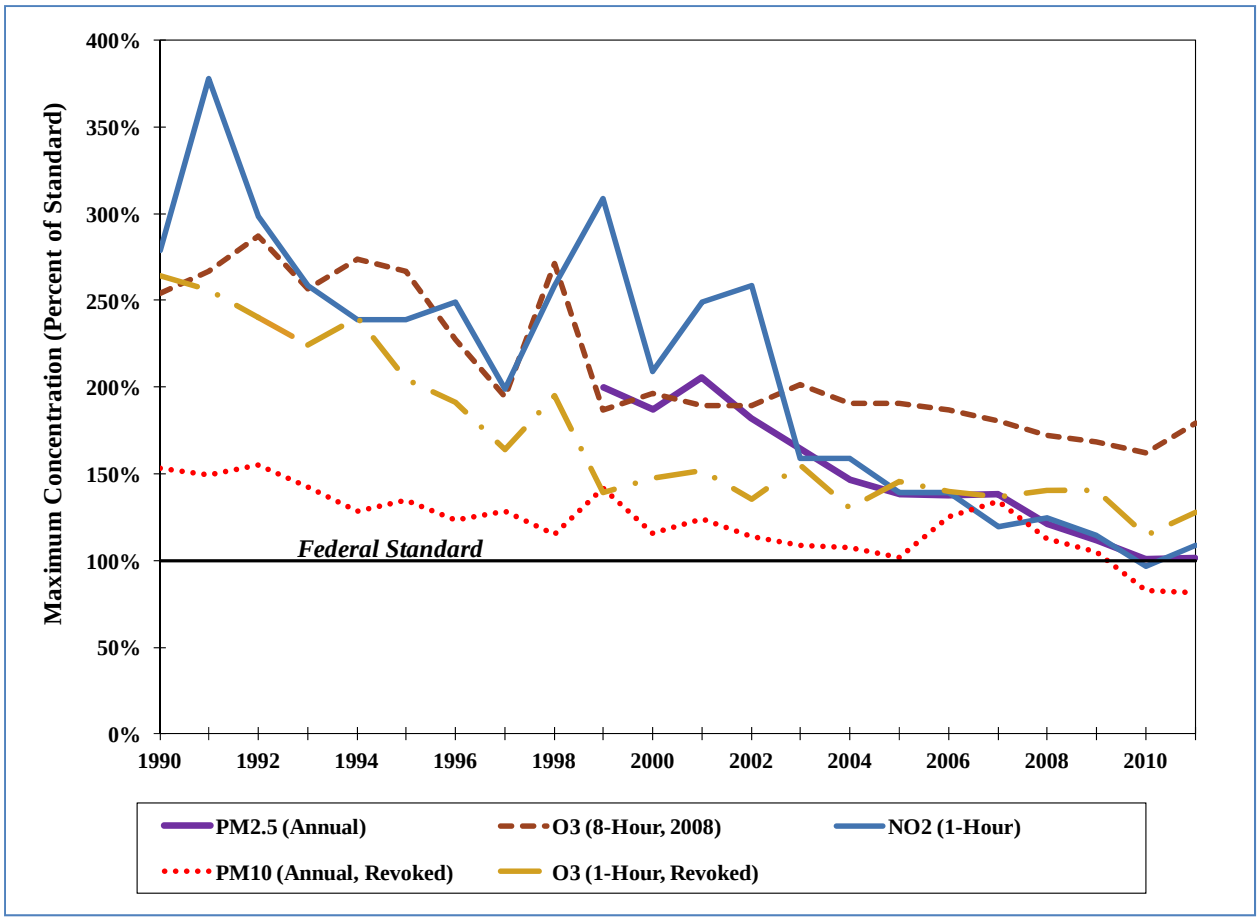


Table 1.5
Minimum Number of Monitors Required per MSA

Pollutant	31100 Los Angeles, Orange County	40140 Riverside, San Bernardino
O_3	4	2
$PM_{2.5}$	3	3
PM_{10}	4-8	6-10
NO_2	0	0
SO_2	0	0
CO	0	0
Pb	2	0

A brief description of the criteria pollutant monitoring network (2011) is listed below and the most current configuration is available online at the AQMD web site (www.aqmd.gov):

Ozone (O_3)
AQMD operates 30 sites where O_3 measurements are made as part of the Air Monitoring Network. O_3 sites (Figure 1.3) are spread throughout the SCAB with highest concentrations measured inland.

The maximum O_3 concentrations in Los Angeles, Riverside and San Bernardino Counties all exceeded the former 1-hour federal standard in 2011; Orange County and the Coachella Valley did not exceed that standard. Maximum O_3 concentrations in the SSAB areas monitored by the AQMD were lower than in the SCAB and were below the health advisory level. All counties of the SCAB and the Coachella Valley exceeded the current 8-hour O_3 standard in 2011. Tables 1.6 and 1.7 show maximum 1-hour and 8-hour O_3 concentrations by air basin and county.

Figure 1.3
O_3 Monitoring Locations (2011)

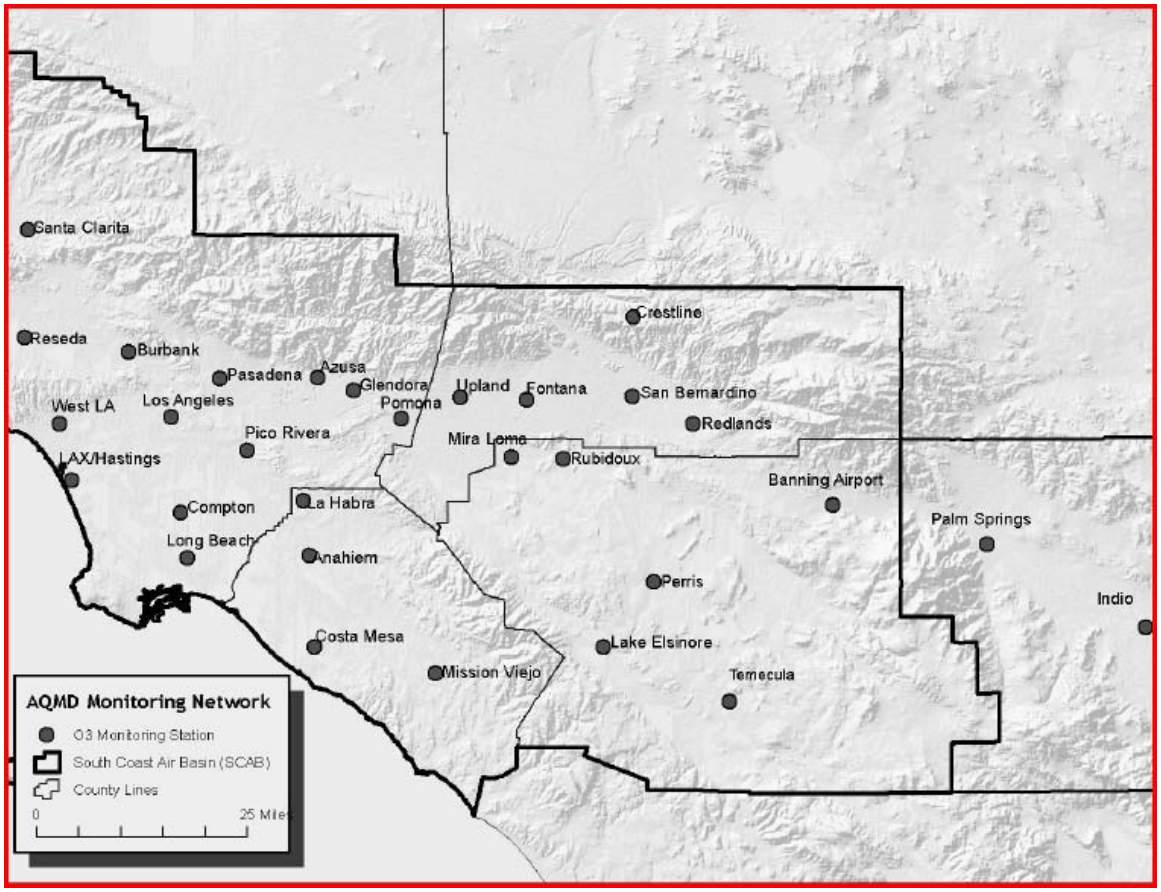


Table 1.6
2011 Maximum 1-Hour Average Ozone Concentrations by Basin and County

BASIN/COUNTY	MAXIMUM 1-HR AVERAGE (PPM)	PERCENT OF FEDERAL STANDARD (0.12 PPM)	AREA
South Coast Air Basin			
Los Angeles	0.144	115	Santa Clarita Valley
Orange	0.095	76	North Orange County
Riverside	0.133	106	Lake Elsinore
San Bernardino	0.160	128	Central San Bernardino Mountains
Salton Sea Air Basin			
Riverside	0.124	99	Coachella Valley

Table 1.7
2011 Maximum 8-Hour Average Ozone Concentrations by Basin and County

BASIN/COUNTY	MAXIMUM 8-HR AVERAGE (PPM)	PERCENT OF FEDERAL STANDARD (0.075 PPM)	AREA
South Coast Air Basin			
Los Angeles	0.122	162	Santa Clarita Valley
Orange	0.083	110	Saddleback Valley
Riverside	0.115	152	Metropolitan Riverside County
San Bernardino	0.136	180	Central San Bernardino Mountains
Salton Sea Air Basin			
Riverside	0.098	130	Coachella Valley

Particulate Matter (PM_{10})
Size-selective inlet manual high volume samplers are operated at 21 sites to meet the requirements for PM_{10} Federal Reference Method (FRM) sampling. The Indio, Los Angeles,

Ontario, and Rubidoux sites are designated as collocated sites as shown in the minimum monitoring requirements. All PM_{10} FRM monitors operate on a 1-in-6 day schedule, with the exception of Indio and Rubidoux which operate on 1-in-3 day schedule.

PM_{10} continuous analyzers are operated at 13 sampling sites. These real-time devices are capable of making hourly particulate concentration measurements. The network plan describes the monitor type, monitoring objective, purpose, and spatial scale for continuous particulate analyzers at each site and the spatial distribution of the sampling sites. Real-time monitors, for the most part, are clustered in the high concentration areas, with two located in the desert area where wind-blown crustal material has caused exceedances of the twenty-four hour standard during exceptional events. In downwind areas of the SCAB, a large fraction of particulate is formed in the atmosphere; PM_{10} reaches maximum levels during late summer through early winter months.

Where both size-selective inlet manual high volume samplers and PM_{10} continuous analyzers are deployed together, they are sited as collocated for data comparison purposes. The PM_{10} manual high volume sampler remains the primary analyzer used for attainment purposes and continuous analyzers are designated as audit collocated samplers and also to provide real time indications for exceptional events.

The highest annual PM_{10} concentrations were recorded in Riverside and San Bernardino Counties, in and around the metropolitan Riverside County area and further inland in the San Bernardino valley areas. The federal 24-hour standard was not exceeded at any of the locations monitored in 2011, although Riverside County came close with a 24-hour average concentration of 152 $\mu g/m^3$ (155 $\mu g/m^3$ is needed to exceed). The revoked annual average PM_{10} federal standard (50 $\mu g/m^3$) was not exceeded in either the SCAB or the Coachella Valley in 2011. The much more stringent state standards were exceeded in most areas of the SCAB and in the Coachella Valley.

Figure 1.4
PM_{10} Monitoring Locations (2011)

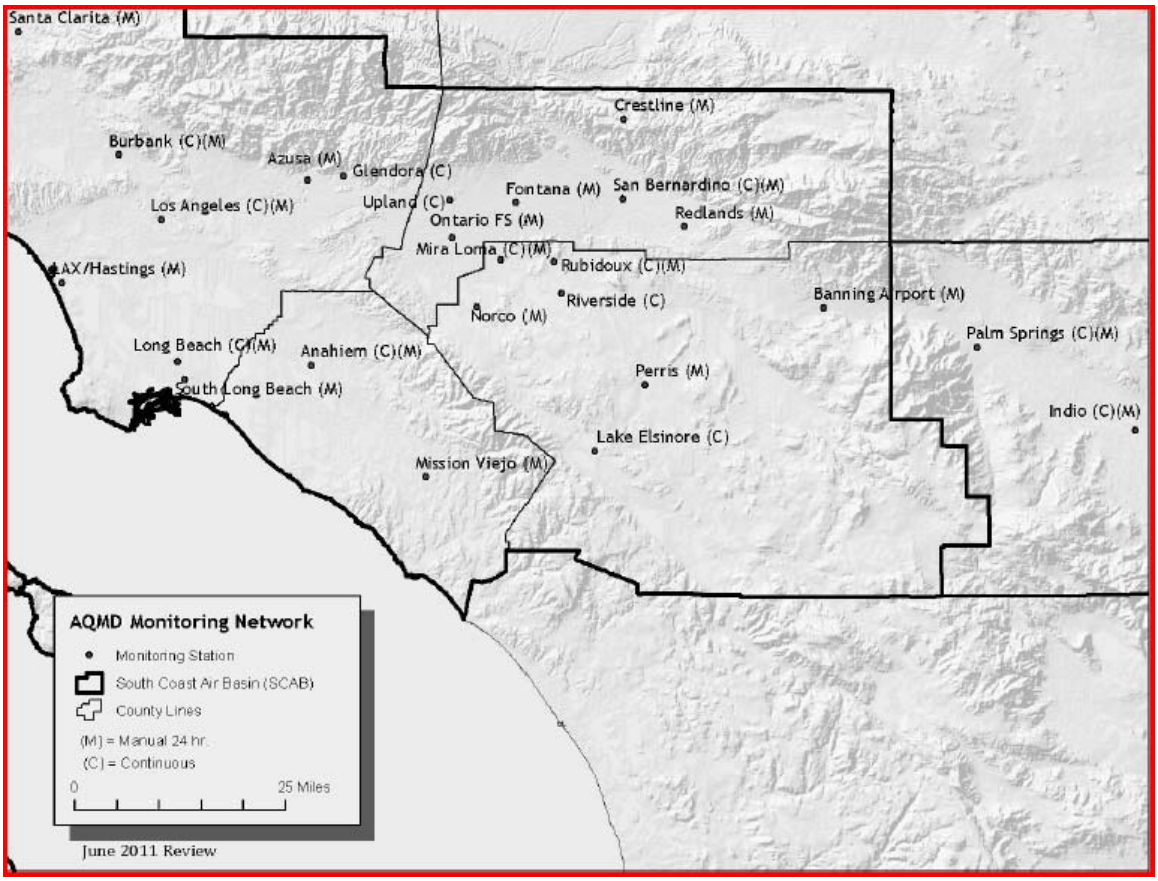


Table 1.8
2011 Maximum 24-hour Average PM_{10} Concentrations by Basin and County

BASIN/COUNTY	MAXIMUM 24-HR AVERAGE* ($\mu G/M^3$)	PERCENT OF FEDERAL STANDARD (150 $\mu G/M^3$)#	AREA
South Coast Air Basin			
Los Angeles	119	77	Central Los Angeles
Orange	79	51	Central Orange County
Riverside	152	98	Metropolitan Riverside County
San Bernardino	127	82	Central San Bernardino Valley
Salton Sea Air Basin**			
Riverside	120	77	Coachella Valley

* Based on the FRM and FEM data

** Higher concentrations were recorded for high wind events in the Coachella Valley which have been flagged for exclusion from NAAQS comparison in accordance with the U.S. EPA Exceptional Events Rule

155 $\mu g/m^3$ is needed to exceed the PM_{10} standard

Table 1.9
2011 Maximum Annual Average PM_{10} Concentrations by Basin and County

BASIN/COUNTY	ANNUAL AVERAGE* ($\mu G/M^3$)	PERCENT OF FEDERAL STANDARD** (50 $\mu G/M^3$)	AREA
South Coast Air Basin			
Los Angeles	32.7	64	East San Gabriel Valley
Orange	24.9	49	Central Orange County
Riverside	41.4	81	Metropolitan Riverside County
San Bernardino	31.8	62	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	32.6	64	Coachella Valley

* Based on the FRM and FEM data

** The federal annual PM_{10} standard was revoked in 2006

Particulate Matter ($PM_{2.5}$)

A network of 17 FRM samplers was first implemented in January 1999. On December 26, 1999, a second Coachella Valley $PM_{2.5}$ sampling site was established in Palm Springs. On June 20, 2003, $PM_{2.5}$ sampling began at the South Long Beach site. The final addition to the $PM_{2.5}$ FRM network occurred in October 2005, at the new Mira Loma site. This brings the total number of $PM_{2.5}$ FRM sampling sites to 20 (2011). The sites are depicted in Figure 1.5. Collocated sampling sites included Rubidoux, Central Los Angeles, and Indio. In March 2012, the collocated sampler located at Indio was moved to the $PM_{2.5}$ design value site, Mira Loma. All sites in the Network using FRM samplers are suitable for comparison against the annual $PM_{2.5}$ NAAQS.

During April 2009, AQMD completed minor changes to the FRM monitoring schedule to enhance Federal Equivalent Method (FEM) Beta Attenuation Monitor (BAM) comparisons. On April 16, 2009 the Burbank and Mira Loma (Van Buren) FRM samplers changed to daily sampling from the current 1-in-3 day schedule and the Azusa location changed from every day sampling to 1-in-3 day sampling. Federal minimum monitoring requirements for $PM_{2.5}$ are still being met and/or exceeded.

Continuous $PM_{2.5}$ Met One BAMs were first deployed in fiscal year 2001–02. Sixteen monitors are now operating in the SCAB, two at Rubidoux (collocated), and one each at Anaheim, Los Angeles, South Long Beach, Burbank, Mira Loma (Van Buren), and Banning. In January 2006, two additional samplers were added at Lake Elsinore and Glendora as part of the Children's Health Study. As proposed in the 2008 network plan, FEM BAM monitors were deployed during October 2008, at the Anaheim, Burbank, Long Beach (North), Los Angeles (Main), Mira Loma (Van Buren), Rubidoux, and South Long Beach sites. Relocated Non-FEM BAM samplers were installed at Reseda, Riverside Magnolia, Santa Clarita, Crestline, and Upland. A Non-FEM BAM was collocated with a FEM BAM at Rubidoux. An additional BAM sampler was deployed at Temecula during July, 2010. In 2011, all FEM BAMs with the exception of Temecula have been reclassified from special purpose monitors to SLAMS under 40 CFR Part 58.20.

Where both 24 hour FRM $PM_{2.5}$ samplers and FEM $PM_{2.5}$ continuous analyzers are deployed together, they are sited as collocated for data comparison purposes. The 24 hour FRM $PM_{2.5}$ sampler remains the primary analyzer used for attainment purposes and continuous analyzers are designated as audit samplers. Also, the $PM_{2.5}$ continuous analyzers provide indicators to air quality in the event of high wind, dust, wildfire, or other regional enhanced PM event.

The maximum 24-hour and annual average $PM_{2.5}$ concentrations in 2011 are shown in Tables 1.10 and 1.11. Similar to PM_{10} concentrations, $PM_{2.5}$ concentrations were higher in the inland valley areas of metropolitan Riverside County (highest at the Mira Loma station). $PM_{2.5}$ concentrations were also elevated in the metropolitan area of Los Angeles County, but did not exceed the level of the annual federal standard in 2011. Although maximum 24-hour concentrations exceed the standard, the 98th percentile form of the 2009-2011 design value only exceeded the standard at one station in Metropolitan Riverside County (Mira Loma).

The higher $PM_{2.5}$ concentrations in the SCAB are mainly due to the secondary formation of smaller particulates resulting from mobile, stationary and area source emissions of precursor gases (i.e., NOx, SOx, NH_4, and VOC) that are converted to PM in the atmosphere. In contrast to PM_{10}, $PM_{2.5}$ concentrations were low in the Coachella Valley area of SSAB. PM_{10} concentrations are normally higher in the desert areas due to windblown and fugitive dust emissions; $PM_{2.5}$ is relatively low in the desert area due to fewer combustion-related emissions sources.

Figure 1.5
$PM_{2.5}$ Monitoring Locations (2011)

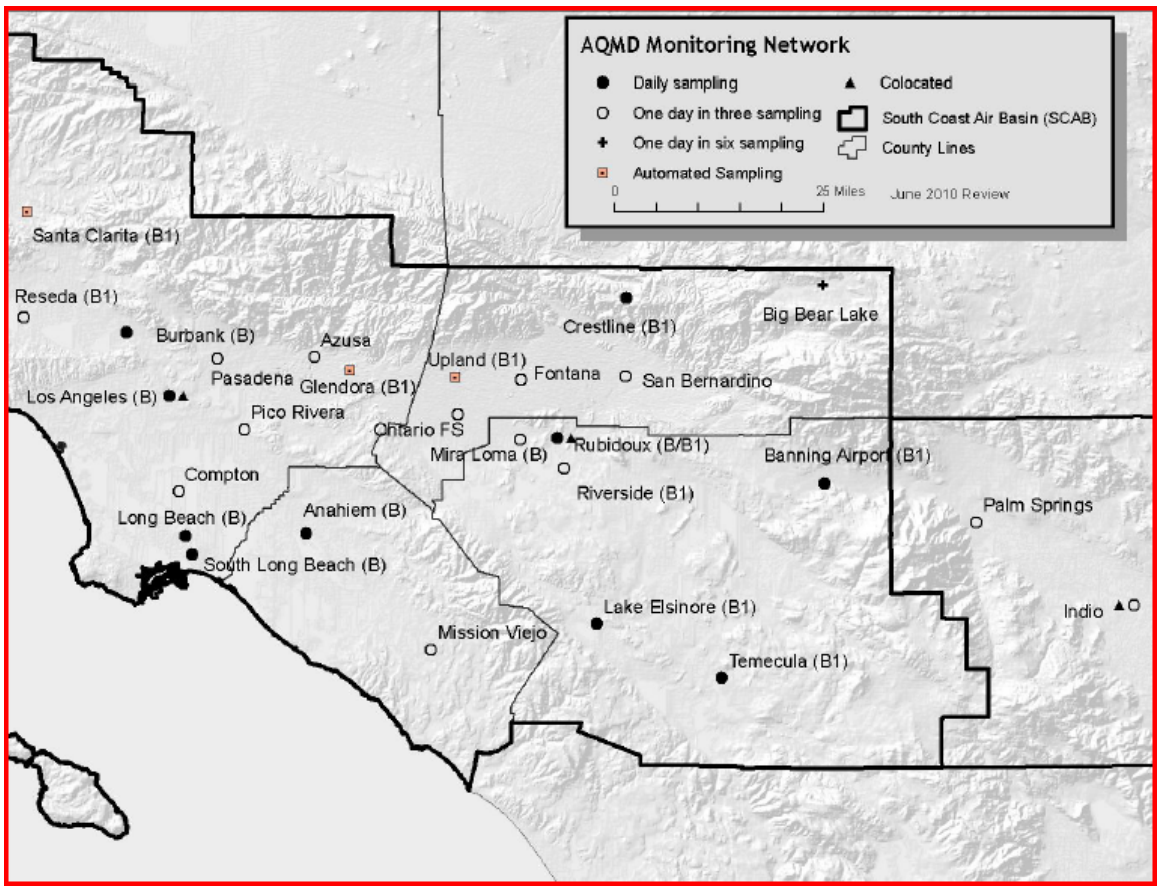


Table 1.10
2011 Maximum 24-hour Average $PM_{2.5}$ Concentrations by Basin and County

BASIN/COUNTY	MAXIMUM 24-HR AVERAGE# (µG/M^3)	PERCENT OF FEDERAL STANDARD* (35 µG/M^3)	AREA
South Coast Air Basin			
Los Angeles**	49.5	139	East San Gabriel Valley
Orange	39.2	110	Central Orange County
Riverside	60.8	171	Metropolitan Riverside County
San Bernardino	65.0	183	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside***	35.4	99.7	Coachella Valley

\# Based on FRM data

* Although maximum 24-hour concentrations exceed the standard, the 98th percentile form of the 2009-2011 design value only exceeded the standard at one station in Metropolitan Riverside County (Mira Loma)

** One higher concentration that was recorded due to "Independence Day" firework activities has been flagged for exclusion from NAAQS comparison in accordance with the U.S. EPA Exceptional Events Rule; with this data included, the 2009-2011 design value for East San Gabriel Valley would also exceed the federal standard

*** While this concentration of 35.4 µg/m^3 is near the level of the standard, it is technically not exceeding the standard (35.5 µg/m^3 exceeds); this concentration was associated with a high wind exceptional event

Table 1.11
2011 Maximum Annual Average $PM_{2.5}$ Concentrations by Basin and County

BASIN/COUNTY	ANNUAL AVERAGE* ($\mu G/M^3$)	PERCENT OF FEDERAL STANDARD (15 $\mu G/M^3$)	AREA
South Coast Air Basin			
Los Angeles	13.3	89	Central Los Angeles
Orange	11.0	73	Central Orange County
Riverside	15.3	101	Metropolitan Riverside County
San Bernardino	13.3	89	Southwest San Bernardino Valley
Salton Sea Air Basin			
Riverside	7.1	47	Coachella Valley

Nitrogen Dioxide (NO_2)
The NO_2 network consists of 25 sites. These sites are mostly located in areas of highest NO_2 concentration. The spatial distribution of NO_2 monitors is shown in Figure 1.6. Review of 1992 through 2010 data indicates that state and federal standards for NO_2 were not exceeded.

The SCAB has not exceeded the federal annual standard for NO_2 (0.0534 ppm) since 1991, when the Los Angeles County portion of the SCAB recorded the last exceedance of the standard in any U.S. county. The recently established 1-hour average NO_2 standard (100 ppb), however, was exceeded on one day in 2011 (but the 98th percentile form of the standard was not exceeded). The higher relative concentrations in the Los Angeles area are indicative of the concentrated emission sources, especially motor vehicles. The maximum 1-hour and annual average concentrations for 2011 are shown in Table 1.12, by basin and county.

Figure 1.6
NO_2 Monitoring Locations (2011)

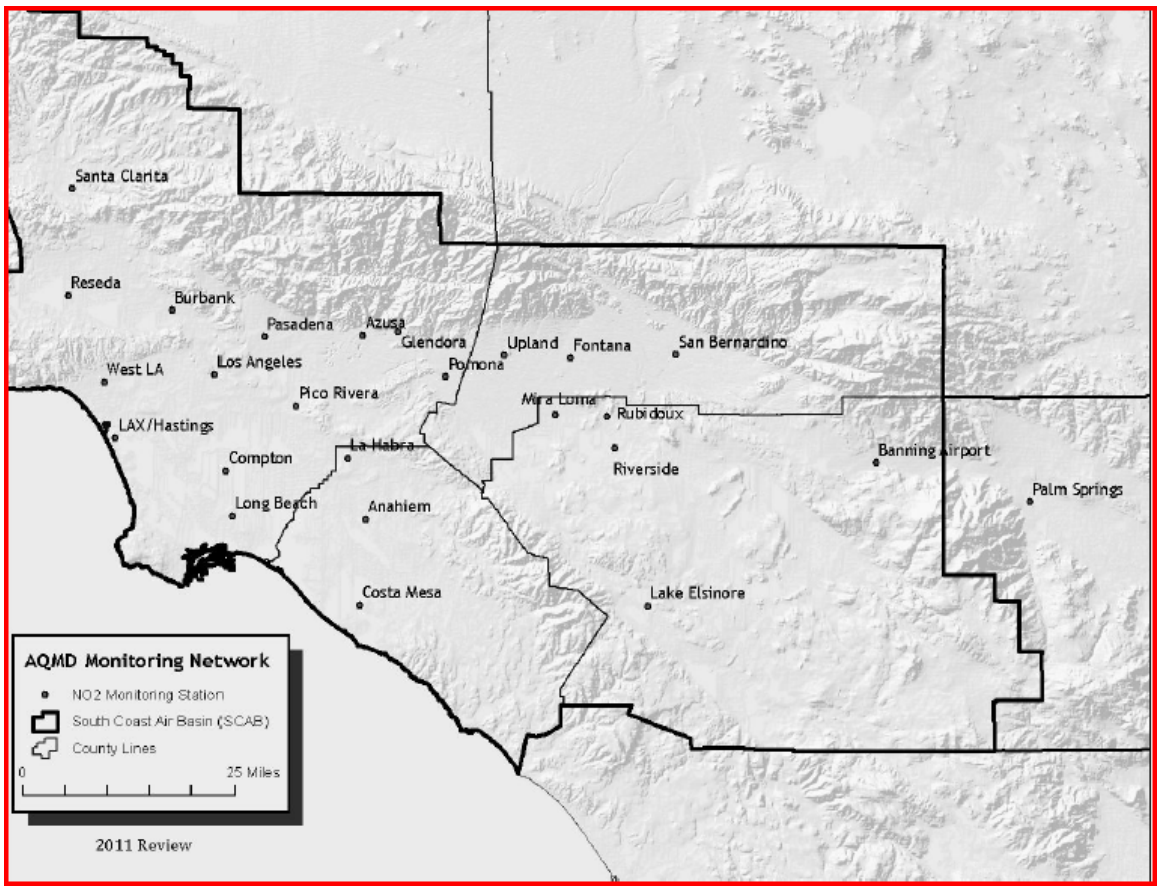


Table 1.12
2011 Maximum 1-Hour and Annual Average NO_2 Concentrations by Basin and County

BASIN/COUNTY	MAXIMUM 1-HOUR AVERAGE (PPB)	PERCENT OF FEDERAL STANDARD (100 PPB)	MAXIMUM ANNUAL AVERAGE (PPB)	PERCENT OF FEDERAL STANDARD (53 PPB)	AREA
South Coast Air Basin					
Los Angeles	109.6*	109	24.6	46	Central Los Angeles County; Pomona/Walnut Valley
Orange	73.8	73	17.7	33	Central Orange County
Riverside	63.3	63	16.9	32	Metropolitan Riverside County
San Bernardino	76.4	76	21.1	39	Central San Bernardino Valley
Salton Sea Air Basin					
Riverside	44.7	44	8.0	15	Coachella Valley

* Although the maximum 1-hour concentrations exceeded the standard, the 98th percentile form of the design value did not exceed the NAAQS

Carbon Monoxide (CO)

Ambient CO monitors measure concentrations at 25 locations. The network plan shows the most current spatial distribution of these sites. CO emissions, primarily from motor vehicles, show a pattern consistent with major freeway arteries.

Table 1.13 shows the 2011 maximum 8-hour and 1-hour average concentrations of CO by air basin and county.
In 2011, no areas exceeded the CO air quality standards. The highest concentrations of CO continued to be recorded in the areas of Los Angeles County where vehicular traffic is most dense, with the maximum 8-hour and 1-hour concentration (4.7 ppm and 6.0 ppm, respectively) recorded in the South Central Los Angeles County area. All areas of the SCAB have continued to remain below the federal standard level since 2003.

Figure 1.7
CO Monitoring Locations (2011)

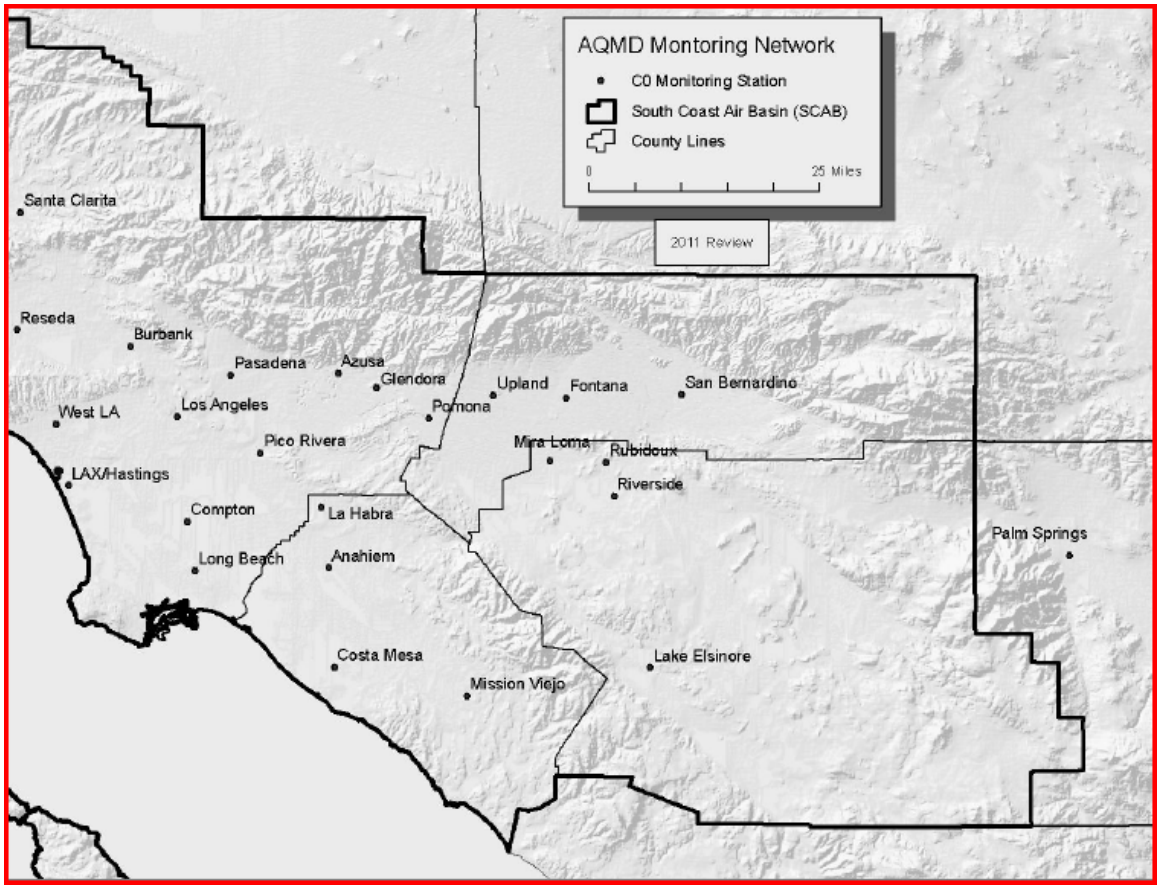


Table 1.13
2011 Maximum 8-Hour and 1-Hour CO Concentrations by Basin and County

BASIN/COUNTY	MAXIMUM 8-HR AVERAGE (PPM)	PERCENT OF FEDERAL STANDARD (9 PPM)	MAXIMUM 1-HR AVERAGE (PPM)	PERCENT OF FEDERAL STANDARD (35 PPM)	AREA
South Coast Air Basin					
Los Angeles	4.7	49	6.0	17	South Central L.A. County
Orange	2.2	23	3.4	10	North Coastal Orange County
Riverside	1.9	20	2.7	8	Metropolitan Riverside County
San Bernardino	1.7	18	1.8	5	Central San Bernardino Valley
Salton Sea Air Basin					
Riverside	0.6	6	3.0	8	Coachella Valley

Sulfur Dioxide (SO_2)

SO_2 monitors are located at 7 sites. Figure 1.8 shows the spatial distribution of the sites. Most SO_2 emissions come from federal transportation sources such as marine vessels. The monitors are clustered mostly in the areas where these sources are located.

On June 22, 2010, U.S. EPA strengthened the SO_2 NAAQS. Network design requirements included new minimum requirements be determined by the Population Weighted Emissions Index (PWEI).

The PWEI shall be calculated by states for each Core Based Statistical Area (CBSA) they contain or share with another state or states for use in the implementation of or adjustment to the SO_2 monitoring network. The PWEI shall be calculated by multiplying the population of each CBSA, using the most current census data or estimates, and the total amount of SO_2 in tons per year emitted within the CBSA area, using an aggregate of the most recent county level emissions data available in the National Emissions Inventory (NEI) for each county in each CBSA. The resulting product shall be divided by one million, providing a PWEI value, the units of which are

million persons-tons per year. For any CBSA with a calculated PWEI value equal to or greater than 1,000,000, a minimum of three SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 100,000, but less than 1,000,000, a minimum of two SO_2 monitors are required within that CBSA. For any CBSA with a calculated PWEI value equal to or greater than 5,000, but less than 100,000, a minimum of one SO_2 monitor is required within that CBSA.

No exceedances of federal or state standards for SO_2 occurred in 2011 at any of the seven AQMD locations monitored. Though SO_2 concentrations remain well below the standards, SO_2 is a precursor to sulfate, which is a component of fine particulate matter. Maximum concentrations of SO_2 for 2011 are shown in Table 1.14. SO_2 was not measured at the Coachella Valley sites in 2011. Historical measurements showed concentrations in the Coachella Valley to be well below state and federal standards and monitoring has been discontinued.

Figure 1.8
SO_2 Monitoring Locations (2011)

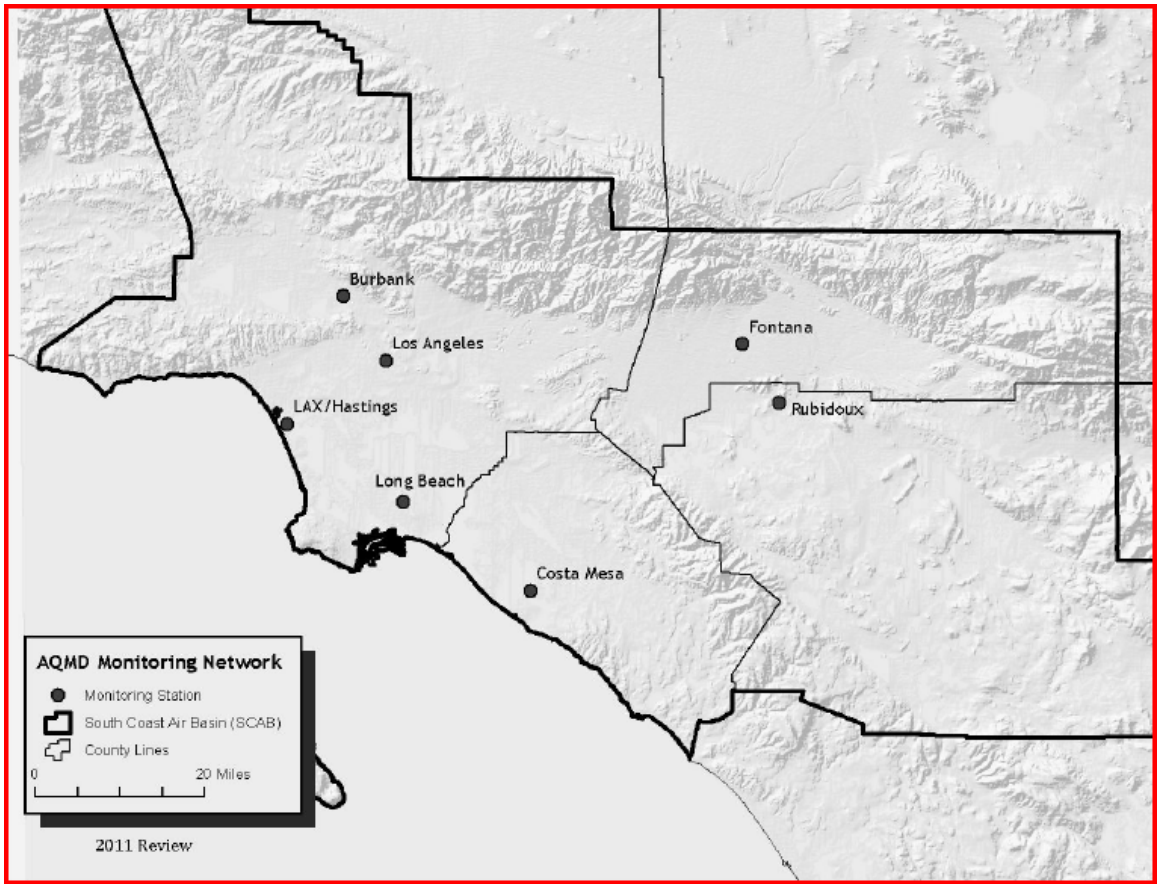


Table 1.14
2011 Maximum 1-Hour Average SO_2 Concentrations by Basin and County

BASIN/COUNTY	MAXIMUM 1-HR AVERAGE (PPB)	PERCENT OF FEDERAL STANDARD (75 PPB)	AREA
South Coast Air Basin			
Los Angeles	43.4	57	South Coastal LA County
Orange	7.8	10	North Coastal Orange County
Riverside	51.2	68	Metropolitan Riverside County
San Bernardino	12.4	16	Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	N.D.		Coachella Valley

N.D. = No Data. Historical measurements and lack of emissions sources indicate concentrations are well below standards

Particulate Lead (Pb)

Total Suspended Particulate (TSP) Pb measurements are collected at 15 sites as part of the network; 5 of the sites are Source Impact for Pb, and the remaining 10 sites measure ambient Pb, and Sulfates (SO_4). There are 4 additional sites which measure SO_4 only for a total of 19 TSP particulate sites. The Vernon (Rehrig), Long Beach, Los Angeles, and Riverside sites are designated as collocated sites as shown in the minimum monitoring requirements. The spatial distribution of these sites is shown in Figure 1.9.

In 1990, the EPA requested that the AQMD collect ambient air particulate samples near several large Pb handling (battery recycling) facilities. Long-term source impacted monitoring began in 1991. A facility in the City of Industry exceeded the federal ambient particulate Pb standard during the second quarter of Fiscal Year 1991-92. Pb monitoring at a facility in the City of Torrance ended in 1993 when measurements were consistently below the ambient standard. Sampling ended at a facility in the City of Commerce in 2006 when the business was closed. Out of the two facilities currently being monitored, the facility in the City of Vernon exceeded the old federal ambient particulate Pb standard (1.5 ug/m^3 quarterly average) during the first quarter of 2008; the other facility was found to remain below this level. These source-related Pb sites are also depicted in Figure 1.8.

On November 12, 2008, the EPA issued final revisions to the NAAQS for Pb which included a lowering of the NAAQS to 0.15 ug/m^3 quarterly average. Network design requirements included

monitoring for sources of Pb (source oriented monitoring) and urban Pb monitoring (non-source oriented). To meet this requirement, a source oriented site was established on January 1, 2010 at the Van Nuys Airport and monitoring will continue at the sites surrounding the Exide (Vernon), Quemetco (Industry), and the Trojan Battery facilities. Existing urban Pb monitoring conducted at Compton, LAX Hastings, Long Beach (North), Los Angeles (Main), Pico Rivera, Riverside Magnolia, Rubidoux, San Bernardino, South Long Beach, and Upland exceed the minimum monitoring requirements.

Based on the review of the NAAQS for lead, U.S. EPA has established a new standard of 0.15 $\mu g/m^3$ for a rolling 3-month average, effective October 15, 2008 (measured from total suspended particulates, TSP). Except for the source-specific monitoring that is now required under the new standard, there have been no violations of the lead standards at the AQMD's regular air monitoring stations since 1982, as a result of removal of lead from gasoline. However, monitoring at two stations immediately adjacent to stationary sources of lead have recorded exceedances of the standards in localized areas of the SCAB in more recent years. Table 1.15 shows the maximum 3-month rolling average concentrations recorded in 2011. In 2011, lead concentrations in the SCAB exceeded the new 3-month rolling average standard (0.15 $\mu g/m^3$) at one source-specific monitoring site in Los Angeles County, located immediately downwind of a stationary lead source. The federal rolling 3-month and state 30-day standards for lead were not exceeded in any other area of the AQMD in 2011.

Figure 1.9
TSP Monitoring Locations (2011)

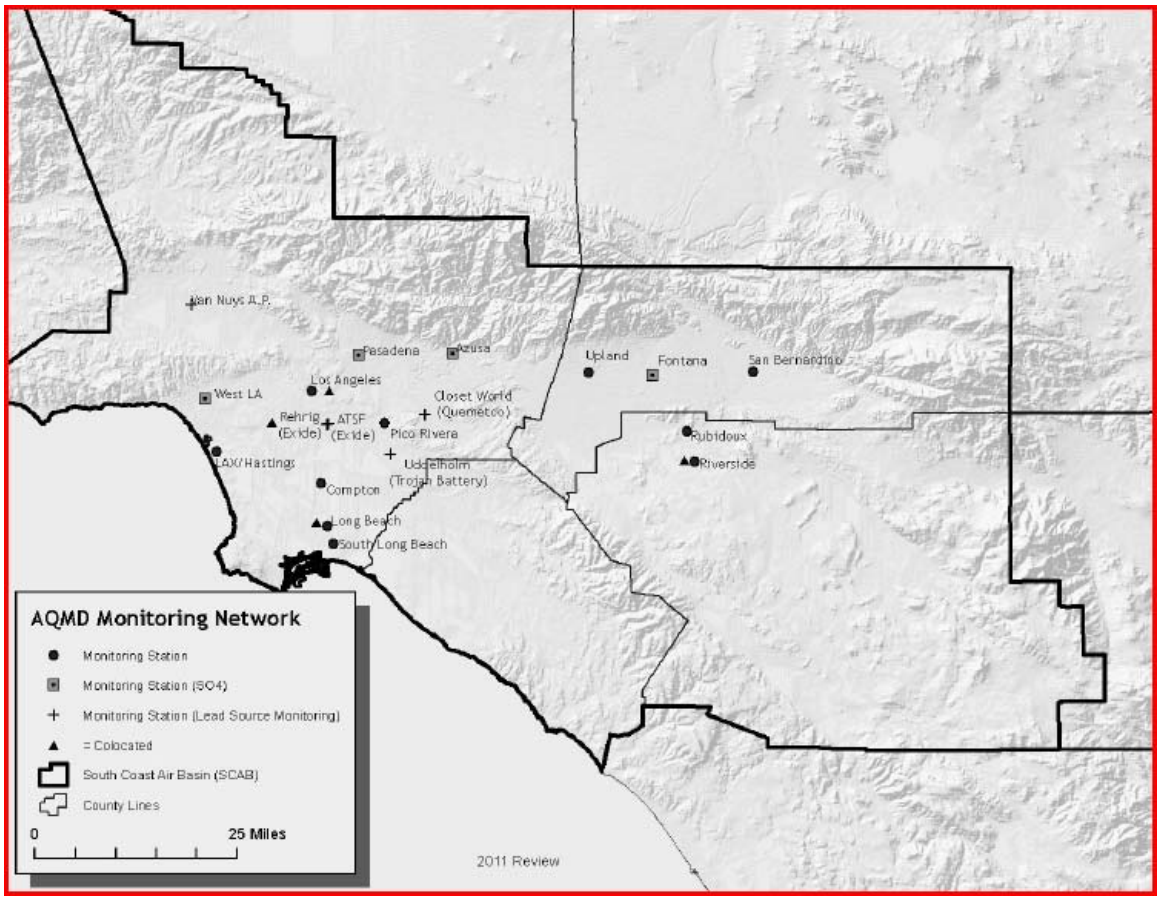


Table 1.15
2011 Maximum 3-Month Rolling Average Lead Concentrations by Basin and County

BASIN/COUNTY	MAXIMUM 3-MONTH ROLLING AVERAGE ($\mu G/M^3$)	PERCENT OF FEDERAL STANDARD (0.15 $\mu G/M^3$)	AREA
South Coast Air Basin			
Los Angeles*	0.46	297	Central Los Angeles
Orange	N.D.		
Riverside	0.01	6	Metropolitan Riverside County
San Bernardino	0.01	6	Northwest San Bernardino Valley, Central San Bernardino Valley
Salton Sea Air Basin			
Riverside	N.D.		Coachella Valley

* This high lead concentration was measured at a site immediately downwind of a lead source.
N.D. = No Data. Historical measurements indicate concentrations are well below standards.

1.4 Quality Objectives and Criteria for Measurement Data

1.4.1 Data Quality Objectives

Generally, data quality objectives (DQO) and acceptability criteria define factors critical for producing data of a known and acceptable precision and accuracy. The DQO process is a strategic planning approach used to prepare for a data collection activity in order to achieve data of adequate quality to support decision-making. The DQO process helps to ensure that the type, quantity, and quality of environmental monitoring data will be sufficient for the data's intended use, while simultaneously ensuring that resources are not wasted collecting unnecessary, redundant, or overly precise data. The formal DQO process consists of seven steps that allow an experimental design to be developed to meet specific decision criteria specified by stakeholders in the decision, as described in EPA QA/G-4, *Guidance for the Data Quality Objectives Process* (EPA, 1994), and in Section 3 of the *Quality Assurance Handbook for Air Pollution Measurement Systems* (EPA, 2008). The seven steps are:

- State the Problem
- Identify the Decision
- Identify the Inputs to the Decision
- Define the Study Boundaries

- Develop a Decision Rule
- Specify Tolerable Limits on the Decision Errors
- Optimize the Design for Obtaining Data

1.4.1.1 State the Problem

Criteria pollutants can impact human health and the environment. U.S. EPA established the NAAQS as the levels that ensure adequate protection. The AQMD attainment status of the gaseous NAAQS is determined by comparing monitoring results for the most recent three year period for O_3 and for the most recent one year period for NO_2, SO_2, and CO with the applicable NAAQS, as specified in 40 CFR Part 50. U.S. EPA uses a formal process to designate AQMD as attainment, nonattainment, or unclassifiable for the criteria pollutants, which includes reviewing the recommendations made by California and the monitoring data. The attainment determination may impact activities related to the regulation of the particular pollutant.

Criteria pollutant data are also used for trend analyses, to assess the effects of national, state, and local emission control programs and to assess population weighted exposure to levels above the NAAQS for O_3 to track progress toward attaining the California State O_3 standards as required by the California CAA.

1.4.1.2 Identify the Decision

The primary decision that criteria pollutant monitoring is intended to provide a basis for determining the attainment status of AQMD for the applicable NAAQS (Table 1.16). Other decisions include declaring an air pollution health advisory, alert, warning or emergency, and implementing air pollution abatement actions. Monitoring is performed to provide data of sufficient quantity and quality to determine the attainment status of AQMD for the applicable NAAQS, particularly for the criteria pollutants for which AQMD is not in attainment: 8-hour O_3, annual average $PM_{2.5}$, and annual average PM_{10}.

1.4.1.3 Identify the Inputs to the Decision

Inputs required for the decision specific to the NAAQS include:

- Annual Monitoring Network Plan that demonstrates the monitoring network meets the requirements of 40 CFR Part 58
- Three years of one-hour average of continuous gaseous pollutant (O_3, NO_2, CO, SO_2) monitoring data
- Three year average of the 4th highest 8-hour average O_3 value for each O_3 monitoring site
- Annual average NO_2 values for each NO_2 monitoring site
- Annual 2nd highest 1-hour and 2nd highest 8-hour CO levels for each monitoring site

- Annual 2nd highest 24-hour average and annual average SO_2 values for each SO_2 monitoring site
- Three years of annual mean and 98th percentile of three year $PM_{2.5}$ values for each $PM_{2.5}$ monitoring site.
- Three years of annual average PM_{10} values for each PM_{10} monitoring site.
- Rolling three month average Pb values.

Non-NAAQS related inputs that affect the design and function of the network include:

- Pollutant model requirements and objectives
- Pollutant distribution changes
- Pollution history and trends
- Meteorology
- Topography
- Budget and Staffing
- Maintenance Plan and State Implementation Plan Requirements
- AQMD Rules (403.1, 444, 445, 701)
- Community Feedback

1.4.1.4 Define the Study Boundaries

The study boundary is defined as the area under the jurisdiction of AQMD. The AQMD jurisdictional boundary encompasses two MSAs as defined by the U.S. Office of Management and Budget and the U.S. Census Bureau. The Los Angeles-Long Beach-Santa Ana MSA (Code 31100) had a population of 12,365,627 based on the year 2000 U.S. Census. The Riverside-San Bernardino-Ontario MSA (Code 40140) had a population of 3,254,821 in 2000.

1.4.1.5 Develop a Decision Rule

NAAQS Related Decisions

Non-attainment is determined if the Decision Input for a specific pollutant exceeds the acceptable level in the NAAQS (Table 1.3). If the monitoring data for the gaseous NAAQS show that AQMD is non-attainment for a specific NAAQS, then EPA will designate the AQMD as non-attainment for that NAAQS. If AQMD is designated as non-attainment for one of the NAAQS, then AQMD is required to prepare and submit a course of action in a Non-Attainment Plan (NAP) or AQMP submitted to the U.S. EPA that demonstrates how the AQMD will attain the specified NAAQS by the required attainment date.

Attainment status is determined if the Decision Input for a specific pollutant is under the acceptable level in the NAAQS (Table 1.16). If AQMD is designated as attainment for one of the NAAQS, then AQMD is required to prepare and submit a maintenance plan or specify in the AQMP submitted to the U.S. EPA that demonstrates how AQMD will remain in attainment with the specified NAAQS.

A minimum of 75% completeness value per calendar quarter is an indicator if there is sufficient data for NAAQS determination. If there is not sufficient data to determine attainment status of AQMD for a specified NAAQS, then the U.S. EPA will designate the AQMD as unclassifiable for the specified NAAQS, and AQMD would be required to collect more data. This will trigger an action for determining the cause of the low completion and addressing any findings to improve completion percentages.

Table 1.16
Table of NAAQS (2011) with Decision Inputs

	Averaging Time	Level	Decision Input
O_3	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
NO_2	1-hour	100 ppb	98th percentile, averaged over 3 years
	Annual	53 ppb	Annual Mean
CO	8-hour	9 ppm	Not to be exceeded more than once per year
	1-hour	35 ppm	
SO_2	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	3-hour	0.5 ppm	Not to be exceeded more than once per year
$PM_{2.5}$	Annual	15 $\mu g/m^3$	Annual mean, averaged over 3 years
	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
PM_{10}	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Pb	Rolling 3 month average	0.15 µg/m3	Not to be exceeded

Non-NAAQS Related Decisions

Non NAAQS related actionable results may include:

- Alerting the public when levels of pollutants impact regional air quality
  - Air pollution emergency contingency actions (Rule 701)

        - Health advisory, Stage 1, 2 or 3 (Rule 701, Attachment 2)
    - Advisories (based on imminent or occurring conditions):
        - Smoke advisories
        - Windblown dust advisories:
            - South Coast Air Basin
            - Coachella Valley (associated with Rule 403.1 high wind and windblown dust forecasts)
        - Wind Blown Ash Advisories
    - Air Alerts: Public air pollution alerts based upon measured real-time AQI thresholds over 100 (Unhealthy for Sensitive Groups or above)
- Air Quality Forecasts (forecast rely on current and historical air monitoring data)
    - Criteria pollutant concentration and AQI forecasts
    - Residential wood burning restrictions (Rule 445)
    - Open burning restrictions (agricultural and prescribed burning – Rule 444)
    - Coachella Valley high wind and windblown dust forecasts (Rule 403.1)
- Public outreach mechanisms (forecasts, advisories, and current air quality conditions):
    - AQMD web maps and data;
    - U.S. EPA AirNow web maps and data;
    - CARB Web Data;
    - Cellular phone applications;
    - Email, social media and FAX-based forecasts and alerts (AirAlerts/EnviroFlash, twitter, etc.);
    - Interactive Voice Response (IVR) automated telephone system;
    - Media outreach;
    - School flag program
- Identifying potential sources of pollutants
    - Source apportionment
    - Emissions inventory reconciliation

1.4.1.6 Specify Tolerable Limits on the Decision Errors

For NAAQS purposes and AQMD planning purposes that use annual data (i.e. modeling, trends analysis, etc.), the acceptable limits for measurement uncertainty for O_3 are an upper 90 percent confidence limit for the coefficient of variation (CV) of 7 percent for precision and an upper 95 percent confidence limit for the absolute bias of 7 percent for accuracy. The acceptable limits for measurement uncertainty for NO_2, SO_2, and CO are an upper 90 percent confidence limit for the coefficient of variation of 10 percent for precision and an upper 95 percent confidence limit for the absolute bias of 10 percent for accuracy. For automated and manual $PM_{2.5}$ methods, the acceptable limits for measurement uncertainty is defined as 10 percent CV for total precision and plus or minus 10 percent for total bias. The acceptable limits for measurement uncertainty for Pb measurements is defined for precision as an upper 90 percent confidence limit for the CV of 20 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 15 percent.

For non-NAAQS objectives that are on shorter timescales for reporting such as forecasting and alerts, the tolerances are based upon balancing data reporting time frames and control checks that are capable of being done in that time frame. Therefore, the uncertainty is defined by a subset of quality control checks presented in Section 2.2 that can be conducted in real time. There are many automatic quality control checks as well as threshold concentrations that alert Atmospheric Measurements staff to check the instrumentation to ensure proper operation. These thresholds are based on station location and parameter. Additional measures include comparing to historical air data for season and location and if data look unusual from historical comparisons and current expectations, to investigate the data further.

1.4.1.7 Optimize the Design for Obtaining Data

The primary design objective of the criteria pollutant monitoring network is to meet the requirements of 40 CFR Part 58 Appendix C, including areas of high population, highest concentrations, downwind of major point sources, and near transport corridors (2013). Design also considers impending decisions which may be based upon the data with higher priority measurements receiving quality control that exceeds the CFR requirements such as design value sites on pollutants that have an ambient concentration near the NAAQS such as $PM_{2.5}$ in the SCAB. AQMD optimizes quality control and quality assurance criteria as outlined in the *Quality Assurance Handbook Volume II, Appendix D* (2009) and is detailed more in Sections 2.3 and 4.1. Also, criteria established and agreed in the National Quality Assurance Group that may address gaps in the validation templates in *Appendix D* or supersede the validation templates are documented and implemented.

AQMD establishes local DQOs based upon the federal data quality requirements if the objective is intended to be comparable to the NAAQS. This may mean that objectives, including those with less stringent requirements, may still meet the requirements for the NAAQS where applicable. This ensures that decision makers could make comparisons to the NAAQS within the required certainty of the measurements if intended. Design considerations such as pollutant attainment status, projected pollutant attainment designation, proximity of the ambient concentrations to the NAAQS, instrument reliability, and special studies objectives may affect the level of data quality practices above the requirements for criteria pollutant measurements.

Other air monitoring objectives not related to the criteria pollutants require different DQOs and are beyond the scope of this document. However, other AQMD QAPPs may address those other DQOs, especially if related to other federal programs such as $PM_{2.5}$ Speciation, NATTS, PAMS, and NCORE. If the objectives do not match any of the federal programs, then it may be addressed in the Special Monitoring Projects QAPP.

1.4.2 Data Quality Indicators

Data quality indicators (DQIs) describe the general framework for ensuring that network data are of known and documented quality and available in a timely manner to meet the DQOs. These indicators include precision, accuracy, bias, completeness, representativeness, comparability, and other related criteria. Appendix F contains detailed descriptions for criteria pollutant DQIs including applicable formulae for determination of DQIs. Data quality indicators are calculated in the AQS reports AMP255, AMP430 and AMP450 reviewed quarterly as part of the validation process and annually for the QA certification process.

1.4.3 Measurement Performance Criteria

Measurement Performance Criteria were developed and organized in the form of validation templates for each pollutant listed in the *Quality Assurance Handbook for Air Pollution Measurement Systems* (EPA, 2008) and are summarized in Section 2.3. AQMD measurements are expected to meet or exceed these guidelines. AQMD conducts activity to verify the criteria are satisfied and performs corrective action(s) if the acceptance criteria are not met. If activities are conducted at the QC level that are outside the criteria for field operations, work orders are issued from the operations group to the support group for instrumentation issues or to the Information Management division for telemetry or software issues; Work orders and other documented activity are reviewed by the data validations group who perform data flagging and/or invalidation as appropriate. If activities are conducted at the QA level, actions are documented and followed to completion through the corrective action process as described in Section 11.5 of the AQMD QMP (2009).

1.5 Special Training/Certification

AQMD general training practices are documented in the AQMD QMP. AQMD implements the appropriate training of all staff involved in the Criteria Pollutant Monitoring Program, including laboratory personnel, field operations and support personnel, QA personnel, temporary and contract personnel, and supervisory and management personnel. This ensures that staff has sufficient knowledge for adequately performing assigned duties under the criteria pollutant monitoring program including ability to satisfy program and agency QA requirements. Mandatory quality assurance training is conducted within the first year of being hired and periodically thereafter.

AQMD staff conducting work in the Criteria Pollutant Monitoring Program must satisfy class specifications for each position performing a function related to the program. The class specifications identify the job duties for each position and the minimum requirements for education and experience, knowledge, skills, and abilities necessary to be able to perform those job duties. Temporary staff assigned tasks under the Criteria Pollutant Monitoring Program are

required to meet the minimum requirements of the classification specification typically assigned to these tasks.

Staff is required to be experienced in the tasks to which they are assigned. Newly hired or assigned staff to the Criteria Pollutant Monitoring Program are required to be trained with the basic measurement techniques relevant to the tasks that they perform. A staff member experienced in the method serves as a mentor to the trainee. Typically, a trainee is assigned study of the relevant portions of instrument manuals, Standard Operating Procedures (SOP), QAPPs, and other available documentation. The mentor trains the trainee on operation methodology and to practice good techniques and also focusing to avoid contamination of equipment, samples, and supplies. The mentor instructs and queries the understanding of the trainee on the basic requirements of their assigned tasks, instrument operation, the contents of the SOP(s), and other relevant documents before commencing "hands on" training. The mentor trains the trainee on the task(s) to be performed and whom to contact for assistance. After training is complete, the mentor observes the trainee perform the assigned tasks including checking performance of operations such as calibration, data treatment, system maintenance, and record keeping. Once satisfied the trainee has mastered the assigned tasks, the mentor completes a Training Record Form (Appendix G) and submits it to the QA Branch for review and filing. This document is filed as a PDF in a centralized location and a hard copy is filed in the employee's training file. Once this document is filed, the trainee is deemed qualified to perform the assigned tasks independently. Even then, the trainee works under the direction of the mentor and supervisor until the mentor is satisfied the analyst is ready to work independently. Ongoing performance is monitored by the work group senior and/or principal level staff through review of analytical data from samples and both internal and external auditing. Project staff is encouraged to attend courses such as manufacturer's training sessions or method-specific courses that are relevant to the assigned tasks.

For training involving field and laboratory analytical instrumentation under the direction of the mentor, the trainee is typically required to analyze reference samples including, when available, samples that have been previously analyzed by the mentor. The trainee is required to demonstrate acceptable measurement quality objectives for recovery (or bias), accuracy, and precision before being deemed ready to perform analysis independently. In the AM Operations group, routine training sessions are held in conjunction with regular work group meetings. These meetings occur quarterly or as needed to address issues that occur under this program.

Data reviewers are trained and mentored as per above in the operational properties and expectations of monitoring instrumentation, data acquisition systems, and calibration and maintenance procedures. The data reviewers are trained on all data collection, DataView, validation, reporting software tools used in network data management, and in AQS data submission procedures. Their primary expertise resides in their ability to review data for quality and completeness in advance of submission to AQS.

In addition to operations training, field staff are required to undergo safety and First Aid/CPR training as per requirements in the Station Safety Manuals.

1.6 Documentation and Records

Table 1.17 lists AQMD QA/QC record keeping requirements, and Tables 1.18 and 1.19 list general laboratory and air monitoring station record keeping requirements. The AM Branch implements a Data Management System (DMS) for processing data streams from the continuous instruments. As of January 2010, Laboratory Services implemented the Promium Element® LIMS Data System for data centralization and sample tracking.

Table 1.17
QA/QC Records

Document Name	Brief Description	Format	Storage Location
Training Files	Records substantiating the training and proficiency of staff relevant to this program	Hard copy	AM Branch: File Cabinet in "Bullpen" in AM Area; LSST Branch: Training Binder at Laboratory Front Desk, PDF copies: e:\astd\quality assurance\laboratory \training\scanned forms
QAPP	Master version of QAPP, including pending revisions	Hard copy or electronic	QA Branch Records or MAD online resources and e:\astd\quality assurance\ current_documentation \QAPP_SOPs
SOPs	Current version of all SOPs	Hard copy or electronic	QA Branch Records or MAD online resources and e:\astd\quality assurance\ current_documentation \QAPP_SOPs
Performance Evaluations and Audits	Results of internal and external assessments	Hard copy and/or electronic	QA Branch Records; AM Branch: Principal AQIS Operations; LSST Branch: Laboratory Report Binder and e:\astd\quality assurance\quality assurance branch\audits
Corrective Action Reports	Results or identified QA problems and their resolution	Electronic	Program Office, QA Office and e:\astd\quality assurance\quality assurance branch\QA CAR

Table 1.18
Laboratory Records

Document Name	Brief Description	Format	Location
Laboratory Notebooks	Includes the following types of notebooks and bound data sheets: - analysts' notebooks - instrument maintenance logs - reagent preparation logs - materials acceptance tests	Hard copy	Next to Instrument on Laboratory Bench; Archived in Laboratory Library after tracked in central database
Calibration Certificates and Records	Includes certificates of NIST traceability and similar records	Hard copy	Next to Instrument on Laboratory Bench; Removed as per the AQMD Document Retention Policy
Control Charts or Equipment	QC information displayed in sequence to help diagnose problems with analytical instruments. Usually includes acceptance limits that are periodically recomputed.	Hard copy or spreadsheet	Hardcopies: Next to Instrument on Laboratory Bench; Removed as per the AQMD Document Retention Policy. Electronic: instrument control PCs.
SOPs	Current copies of SOPs relevant to the analyses performed in a particular laboratory	Hard copy	Next to Instrument on Laboratory Bench, MAD online resources and e:\astd\quality assurance\ current_documentation \QAPP_SOPs
QAPP	A current copy of this QAPP. The Principal Chemist must ensure that each analyst has access to a current copy of the QAPP	Hard copy	QA Branch Records or MAD online resources and e:\astd\quality assurance\ current_documentation \QAPP_SOPs
Analytical Results Database	Results for each chemical analysis with identifying information	Spreadsheet or LIMS	Analyst computer/ LIMS Server
Analytical QC Database	Includes all QC information for each weighing session including standard weights, duplicates, field blanks, and laboratory blanks.	Spreadsheet or LIMS	Analyst computer/ LIMS Server

Table 1.19
Station Records

Document Name	Brief Description	Format	Location
Station Notebooks	Logs station activity	Hard copy	Station
Instrument User's Manual and/or Manufacturer's Instructions	Information for setting up, using, and troubleshooting the continuous gaseous monitors	Hard copy	Station
Calibration Certificates and Records	Includes certificates for gases and other chemicals used for calibration	Hard copy/ Electronic	Station/ Shared Drive
QC Records	Results of instrument blanks, calibrations, standard recoveries, and replicate precision	Computer files and hard copy	Maintenance Sheets/ Calibration Sheets/ Database
Raw Data Records	Results of instrument analyses (including supporting data that is not uploaded to the database)	spreadsheets; hard copy; and DMS, chessell, custom database	Database/ Server

SECTION 2. DATA GENERATION AND ACQUISITION

2.1 Monitoring Process Design (Experimental Design)

Air is sampled at each of the fixed air monitoring stations. Tables 2.1 and 2.2 list the identification of the station locations along with corresponding pollutant network, sampling network design and rationale, and sampling frequency for discrete methods.

Figure 2.1 shows the overall operations process for the criteria pollutant monitoring program. The FRM PM measurements (PM_{10}, $PM_{2.5}$, and TSP) are discrete sample methods and require preparation of filters in the laboratory, deployment and collection of filters in the field by an Air Quality Instrument Specialist (AQIS), and then post-collection analysis in the laboratory (Figure 2.2). The data for the discrete samples is validated by laboratory staff and then submitted to the U.S. EPA database, AQS.

In addition, at most air monitoring stations, the air is analyzed in real time by continuous instruments for gaseous criteria pollutants and also PM (FEM). The data is transmitted via telemetry to a server located at AQMD (Figure 2.1) where it is validated and then submitted to AQS.

Operations Group within the AM Branch has the primary responsibility for maintaining instrumentation that is at the air monitoring stations, checking and recording data from continuous instruments, collecting discrete samples and delivering them to the appropriate destination for analysis.

The Support Group within the AM Branch is responsible for providing calibration for all samplers and air monitoring instrumentation in the AQMD air monitoring network. The Support Group maintains schedules for following up on completed repairs and providing timely calibrations.

The Data Management Group within the AM Branch is responsible conducting the 2nd level data review of the continuous pollutant measurements (O_3, CO, NO_x, SO_2, and continuous PM) and submission of the data to AQS.

The Aerosol Analysis Group within the LSST Emissions Branch conducts the mass analysis for the FRM PM_{10} and $PM_{2.5}$ samples and is responsible for the 2nd level data review and submission of data to AQS.

The QA Branch conducts/ designates station performance and system evaluations of the continuous monitors to be conducted to meet or exceed the assessment requirements. Also, it coordinates with CARB and U.S. EPA on the implementation of state and federal performance and technical system evaluations. Prior to May 1st of the following year, the QA Branch conducts the certification process of the data that has been submitted to AQS.

Table 2.1
List of Monitoring Sites (AQMD, 2011)

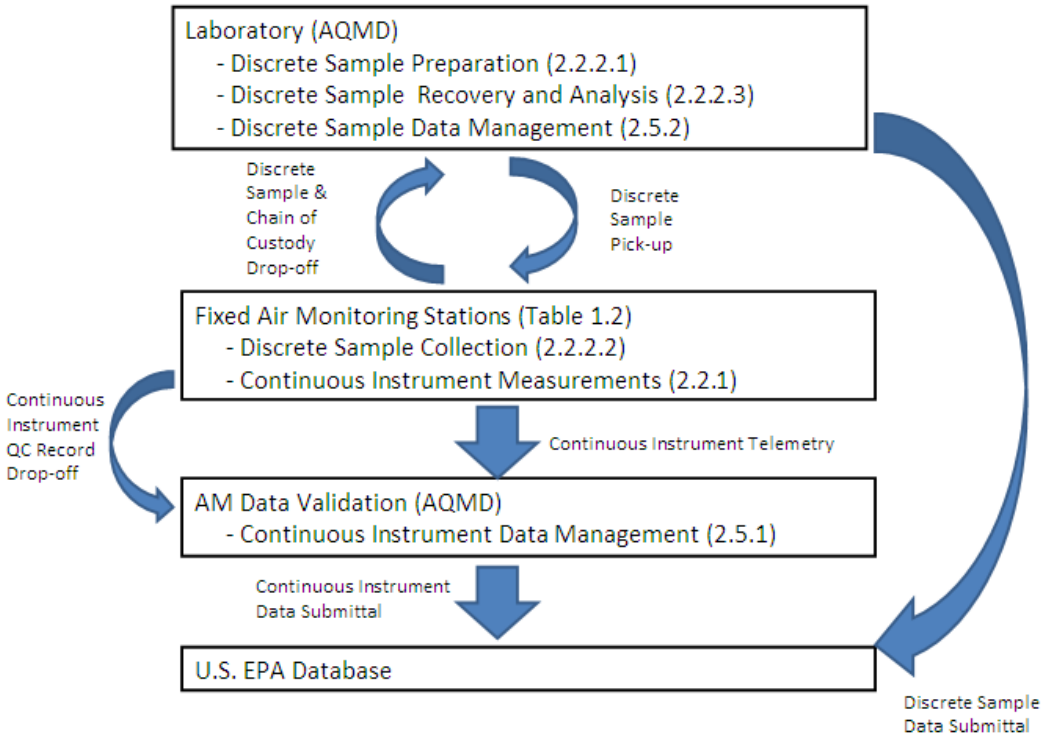
Location	AQS No.	Pollutants Monitored	Start Date
Anaheim	060590007	CO, NO_2, O_3, PM_{10}, $PM_{2.5}$	08/01
ATSF (Exide)	060371406	Pb	01/99
Azusa	060370002	CO, NO_2, O_3, PM_{10}, $PM_{2.5}$, SO_4	01/57
Banning Airport	060650012	NO_2, O_3, PM_{10}, $PM_{2.5}$	04/97
Big Bear	060718001	$PM_{2.5}$	02/99
Burbank	060371002	CO, NO_2, SO_2, O_3, PM_{10}, $PM_{2.5}$	10/61
Closet World (Quemetco)	060371404	Pb	10/08
Compton	060371302	CO, NO_2, O_3, Pb, $PM_{2.5}$	01/04
Costa Mesa	060591003	CO, NO_2, SO_2, O_3	11/89
Crestline	060710005	O_3, PM_{10}	10/73
Fontana	060712002	CO, NO_2, SO_2, O_3, PM_{10}, $PM_{2.5}$, SO_4	08/81
Glendora	060370016	CO, NO_2, O_3, $PM_{2.5}$, PM_{10}	08/80
Indio	060652002	O_3, PM_{10}, $PM_{2.5}$	01/83
La Habra	060595001	CO, NO_2, O_3	08/60
Lake Elsinore	060659001	CO, NO_2, O_3, $PM_{2.5}$, PM_{10}	06/87
LAX Hastings	060375005	CO, NO_2, O_3, PM_{10}, Pb, SO_4	04/04
Long Beach (North)	060374002	CO, NO_2, SO_2, O_3, PM_{10}, $PM_{2.5}$, Pb, SO_4	10/62
Los Angeles (Main St.)	060371103	CO, NO_2, SO_2, O_3, PM_{10}, Pb, $PM_{2.5}$, SO_4	09/79
Mira Loma (Jurupa) [1]	060650004	CO, NO_2, O_3, PM_{10}	10/93
Mira Loma (Van Buren)	060658005	CO, NO_2, O_3, PM_{10}, $PM_{2.5}$	11/05
Mission Viejo	060592022	CO, O_3, PM_{10}, $PM_{2.5}$	06/99
Norco	060650003	PM_{10}	12/80
Ontario Fire Station	060710025	PM_{10}, $PM_{2.5}$	01/99
Palm Springs	060655001	CO, NO_2, O_3, PM_{10}, $PM_{2.5}$	04/71
Pasadena	060372005	CO, NO_2, O_3, $PM_{2.5}$, SO_4	04/82
Perris	060656001	O_3, PM_{10}	05/73
Pico Rivera #2	060371602	CO, NO_2, O_3, Pb, $PM_{2.5}$, SO_4, PM_{10}	09/05
Pomona	060371701	CO, NO_2, O_3	06/65
Redlands	060714003	O_3, PM_{10}	09/86
Rehrig (Exide)	060371405	Pb	11/07
Reseda	060371201	CO, NO_2, O_3, $PM_{2.5}$	03/65
Riverside (Magnolia)	060651003	CO, Pb, $PM_{2.5}$, SO_4	10/72
Rubidoux	060658001	CO, NO_2, SO_2, O_3, PM_{10}, Pb, $PM_{2.5}$, SO_4	09/72
San Bernardino	060719004	CO, NO_2, O_3, PM_{10}, Pb, $PM_{2.5}$	05/86
Santa Clarita	060376012	CO, NO_2, O_3, PM_{10}, $PM_{2.5}$	05/01
South Long Beach	060374004	PM_{10}, Pb, $PM_{2.5}$, SO_4	06/03
Temecula	060650016	O_3, $PM_{2.5}$	06/10
Uddelholm (Trojan Battery)	060371403	Pb	11/92
Upland	060711004	CO, NO_2, O_3, Pb, $PM_{2.5}$, PM_{10}, SO_4	03/73
Van Nuys Airport	060371402	Pb	01/10
West Los Angeles	060370113	CO, NO_2, O_3, SO_4	05/84

[1]Site closed in Fiscal Year 2010-2011

Table 2.2
Sampling Frequency for the FRM $PM_{2.5}$, FRM PM_{10} and TSP Measurements

Station	AQS No.	$PM_{2.5}$ FRM	PM_{10} FRM	TSP
Anaheim	060590007	Daily	1 in 6 Day	
ATSF (Exide)	060371406			1 in 6 Day (Source)
Azusa	060370002	1 in 3 Day	1 in 6 Day	1 in 6 Day
Banning	060650012		1 in 6 Day	
Big Bear	060718001	1 in 6 Day		
Burbank	060371002	Daily	1 in 6 Day	
Closet World (Quemetco)	60371404			1 in 6 Day (Source)
Compton	060371302	1 in 3 Day		1 in 6 Day
Crestline	060710005		1 in 6 Day	
Fontana	060712002	1 in 3 Day	1 in 6 Day	1 in 6 Day
Glendora	060370016			
Indio	060652002	1 in 3 Day-c	1 in 3 Day-c	
LAXH	060375005		1 in 6 Day	1 in 6 Day
Long Beach (North)	060374002	Daily	1 in 6 Day	1 in 6 Day-c
Los Angeles (Ncore)	060371103	Daily-c	1 in 6 Day-c	1 in 6 Day-c
Mira Loma (Van Buren)	060658005	1 in 3 Day	1 in 6 Day	
Mission Viejo	060592022	1 in 3 Day	1 in 6 Day	
Norco	060650003		1 in 6 Day	
Ontario F.S.	060710025	1 in 3 Day	1 in 6 Day-c	
Palm Springs	060655001	1 in 3 Day	1 in 6 Day	
Pasadena	060372005	1 in 3 Day		1 in 6 Day
Perris	060656001		1 in 6 Day	
Pico Rivera	060371602	1 in 3 Day		1 in 6 Day
Redlands	060714003		1 in 6 Day	
Rehrig (Exide)	060371405			Daily (Source)
Reseda	060371201	1 in 3 Day		
Riverside-Mag	060651003	1 in 3 Day		1 in 6 Day – c
Rubidoux (Ncore)	060658001	Daily-c	1 in 3 Day-C	1 in 6 Day
San Bernardino	060719004	1 in 3 Day	1 in 6 Day	1 in 6 Day
Santa Clarita	060376012		1 in 6 Day	
So. Long Beach	060374004	Daily	1 in 6 Day	1 in 6 Day
Uddelholm (Trojan Batt)	60371403			1 in 6 Day (Source)
Upland	060711004			1 in 6 Day
West L.A.	060370113			1 in 6 Day
Van Nuys (Airport)	06371402			1 in 6 Day (Source)

Figure 2.1
Flow Diagram of Criteria Pollutant Monitoring Program



2.2 Criteria Pollutant Monitoring Methods

This section identifies the SOPs which contain sample collection procedures and methods. SOPs lists equipment needed; identifies support facilities; identifies individuals responsible for corrective action; describes process for preparation and decontamination of sampling equipment; describes selection and preparation of sample containers and sample volumes; describes preservation methods and presents maximum holding times. SOPs are listed in Appendix E. The master log of SOPs, version control, and review history are maintained by the QA Branch.

2.2.1 Continuous Monitoring

Continuous monitoring of the gaseous criteria pollutants (O_3, CO, Nitrogen Oxides (NOx), and SO_2) is performed according to FRMs. Continuous particulate matter ($PM_{2.5}$ and PM_{10}) monitoring is performed in accordance with FEMs for those designated as SLAMS monitors. Continuous PM monitors designated special purpose monitors (SPM) in AQS are used to provide real time data in enhanced PM events.

2.2.1.1 Standard Operating Procedures for Continuous Monitoring

This section identifies the procedures and methods for operating and maintaining instruments and support equipment used to conduct continuous criteria pollutant measurements. SOP0016 (General AMS Operations) and individual SOPs provide detailed guides for duties expected for a field operator and presents the QC needed to satisfy program requirements as listed in the *QA Handbook for Ambient Air Quality Measurement Systems, Volume II*, Section 10 (2008). The SOP for Data Management of Continuous Instruments (SOP00083) serves as a guide for staff in the Data Validation group. The remaining SOPs are instrument specific technical guidance. SOPs lists equipment; identifies scheduled activities; identifies QC criteria, and provides corrective action guidance.

Table 2.3
Standard Operating Procedures for Continuous Instruments

SOP#	Topic
SOP00116	General AMS Station Operations
SOP00117	Calibrations Systems Operations
SOP00118	Data Collection Systems Operations
SOP00058	Ozone (O_3), API Teledyne
SOP00109	Ozone (O_3), Thermo
SOP00051	Carbon Monoxide (CO), Horiba 370
SOP00051A	Carbon Monoxide (CO), Horiba 360
SOP00055	Nitrogen Oxides (NO, NO_2, NO_x), API Teledyne 200E
SOP0055A	Nitrogen Oxides (NO, NO_2, NO_x), API Teledyne 200A
SOP00075	Nitrogen Oxides (NO, NO_2, NO_x), Thermo
SOP00057	Sulfur Dioxide (SO_2), Thermo
SOP00062	Continuous PM_{10}, TEOM
SOP00063	Continuous PM_{10}, BAM
SOP00072	Continuous $PM_{2.5}$, BAM
SOP00070	Meteorological Systems
SOP00083	Data Management of Continuous Instruments

2.2.1.2 Quality Control for Continuous Monitoring

This section identifies Criteria Pollutant Monitoring Program QC procedure, sampling frequency, and analytic procedures as well as associated acceptance criteria. The station operator, an AQIS, performs initial checks.

Zero and span checks are performed six days per week and precision checks are performed weekly on the continuous gaseous instruments. Acceptance criteria are listed in Table 2.4.

Table 2.4
Acceptance Criteria for Gaseous Criteria Pollutant Weekly Span Checks

Pollutant	Warning Limit	Invalidating Limit
O_3	5%	7%
CO	7%	10%
SO_2	7%	10%
NO_x	7%	10%

Flow checks are performed on continuous PM monitors as shown in Table 2.5.

Table 2.5
Continuous $PM_{2.5}$ and PM_{10} Flow Tolerances

Variable	Frequency	Flow	Acceptance Criteria
PM_{10} Continuous	Monthly	16.67 L/Min	7% of standard 10% of design
$PM_{2.5}$ Continuous	Monthly	16.67 L/Min	4% of transfer standard
$PM_{2.5}$ Continuous	Biweekly	16.67 L/Min (average)	5% of design

Shelter temperature is recorded and the data is automatically flagged if the temperature is outside the criteria (20-30 +/- 2°C).

If checks reveal measurements do not satisfy criteria, the AQIS records the observations on the maintenance sheets and/or downtime logs and informs his or her Senior AQIS to assess needed action(s) and to generate an AM work order (SOP00116). With agreement that repair is necessary, the Senior AQIS issues an e-mail to the AM Support Sub-Group using the AM Work Orders Distribution List. In this e-mail, the problem is described and a request is made to have the issue addressed by the Support Group. Once the work order has been created utilizing the Work Order Data Base, the Support Group schedules the repair and/or calibration and prepares the repair documentation. The work order is assigned to the appropriate Support Group AQIS

for work. The work order is tracked until the responsible Support Group AQIS reports the problem has been addressed. The details of the work performed are then entered in the Work Order Data Base. At that point, the AQIS who reported the problem is required to submit an email to their Senior AQIS stating whether or not the problem has been corrected. Once the Senior AQIS is satisfied with the outcome, they will then send an email giving the approval to close the work order. The work order is then archived upon completion. Status of work orders are followed up weekly by the Office Assistant in the Operations Group.

Air monitoring instrumentation requires calibration work at regular intervals. Generally, AQMD follows 40 CFR or defers to instrument manufacturer recommendations with regard to calibration frequency. AM Support is responsible for performing calibrations of all samplers and air monitors within these recommended calibration intervals. The Support Group maintains a spreadsheet recording the latest calibration date for each instrument within the AQMD's air monitoring network. Page two of the spreadsheet calculates "days since last calibration". This spreadsheet toggles the background of items approaching a scheduled calibration or requiring calibration in orange. This spreadsheet toggles the background of items exceeding the scheduled calibration time window to red. Calibration personnel are responsible for monitoring assigned stations and keeping instruments within recommended calibration intervals.

Additional calibration activity beyond scheduled calibrations can be initiated by issuance of a work order. Typically, a work order asking for instrument calibration is filed whenever instrument drift is beyond control limits, and when an instrument either fails an audit or data approaches an audit acceptance limit. A request for a calibration work order can be generated by the Station Operator, Senior AQIS, or in response to a QA Branch Corrective Action Request (CAR). Once created, it is assigned to the appropriate calibration technician. These work orders are tracked using the AM Work Order Data Base from issuance through completion and is closed by the responsible Senior AQIS. The work order is then archived upon completion. Status of work orders are followed up weekly by the Office Assistant in the Operations Group.

Table 2.6 presents the Criteria Pollutant Monitoring Program sampler and instrumentation calibration schedule including acceptance criteria for acceptable calibration. The frequency for activity stated in the table is the minimum required. Additional calibration activity occurs after major repair or when controls, checks, and audits indicate a need.

Table 2.6
Calibration Schedule for Samplers and Continuous Monitors

Instrument or Equipment	Calibration Item	Frequency	Acceptance Criteria
Gas Dilution System	Flow controller	1/6 months	± 3% true flow
O_3: Single Analyzer	Calibration	1/6 months	All points within 2% full scale of best fit straight line. Linearity error <5%
CO: Single Analyzer	Calibration	1/6 months	All points within 2% full scale of best fit straight line (0 and four upscale points)
NO_2: Single Analyzer	Calibration	1/6 months	Instrument residence time < 2 min.; Dynam. Parameter > 2.75 ppm-min; All points within 2% of full scale of best-fit straight line (0 and four upscale points)
	Converter Efficiency	During multipoint calibrations, span, audit, and 1/2 weeks	≥96%
SO_2: Single Analyzer	Calibration	1/6 months	All points within 2% full scale of best fit straight line (0 and four upscale points)
PM_{10} Sampler	- System Leak Check	Precalibration check	Inspection with faceplate blocked
	- Multipoint Calibration	annually	10% of Design (multipoint, four points)
$PM_{2.5}$ Sampler	Pressure	annually	10 mm Hg
	Temperature	annually	2° C
	Flow Rate	annually	2% of transfer standard
	Design Flow Rate	annually	2% of design flow rate

Equipment certification is also maintained by the support group. Table 2.7 shows the equipment and the schedule for certifications. If acceptance criteria are not met after multiple attempts, then the device is inspected and repaired if necessary. If there is a reason that sample data potentially would be affected, a Quality Assurance Alert (QAA) is generated to the QA Branch.

Table 2.7
Equipment Certification Schedule

Calibration Task	Frequency	Acceptance Criteria
Ozone Transfer Standard	1/3 months	RSD of six slopes < 3.7%; Std. Dev. Of 6 intercepts 1.5; New slope within 0.05 of previous
Level 1 (Local Primary) Ozone	Annually	Regression slope = 1.00 +/- 0.01 and intercept < 3 ppb
Thermometer	Annually	0.1 ^{o}C resolution, 0.5 ^{o}C accuracy
Barometer	Annually	1 mm Hg resolution, 5 mm Hg accuracy
Flow Rate Transfer Standard	Annually	2% NIST traceable standard
Gas Dilution System	1/6 months	Accuracy +/- 2%
Gaseous Standards	≥ 500 ppm 36 months 40 to 499 ppm 24 months	+/- 2.0 percent uncertainty as per EPA-600/R-97/121, 1997. NIST Traceable, Participation in EPA PGVP

Accurate gaseous criteria pollutant measurements are dependent on the accuracy of calibration gases used. The U.S. EPA has established a traceability protocol for the assay and certification of compressed gas calibration standards used for federal monitoring programs including the Criteria Pollutant Monitoring program (Protocol 1 gases). Specifically, Parts 50, 58, 60, and 75 of the monitoring regulations require that gaseous pollutant concentration standards used for calibration and audit of ambient air quality analyzers and continuous emission monitors be traceable to either a National Institute of Standards and Technology (NIST) Standard Reference Material (SRM) or a NIST Traceable Reference Material (TRM). U.S. EPA is in the process of developing a requirement that all Protocol 1 gases used in support of federal programs be from suppliers that participate in the U.S. EPA Protocol Gas Verification Program (PGVP) and demonstrate a minimum competency in the quality of Protocol 1 Gases. The AQMD only accepts Protocol 1 gases minimally conforming to criteria in EPA-600/R-97/121, 1997. Table 2.8 presents the Protocol 1 gas certification frequency and acceptance criteria as per EPA-600/R-97/121, 1997.

Table 2.8
U.S. EPA Protocol 1 Gaseous Criteria Pollutant Certification Frequency and Acceptance Criteria

Gaseous Criteria Pollutant	Mixture	Certification Frequency	Acceptance Criteria
CO	Nitrogen or air	≥ 8 ppm 36 months	+/- 2.0 percent uncertainty
NO_2	Nitric oxide in oxygen-free nitrogen	≥ 4 ppm 24 months	+/- 2.0 percent total uncertainty
	Nitrous oxide in air	≥ 300 ppb 36 months	+/- 2.0 percent uncertainty
	Oxides of nitrogen in air	≥ 80 ppm 24 months	+/- 2.0 percent uncertainty
SO_2	Sulfur dioxide in air	40 to 499 ppm 24 months	+/- 2.0 percent uncertainty
	Sulfur dioxide in air	≥ 500 ppm 36 months	+/- 2.0 percent uncertainty
Miscellaneous	Nitrogen or air	≥ 500 ppm 36 months 40 to 499 ppm 24 months	+/- 2.0 percent uncertainty

2.2.2 Discrete Sample Monitoring

FRM criteria pollutant monitoring for PM_{10}, $PM_{2.5}$, and Pb requires discrete sampling methods. These methods describe the preparation of sampling media, transport of the media to stations, collection of media after sampling, and return of media to the laboratory for recovery and analysis. Table 2.9 summarizes elements for each type of measurement.

Table 2.9
Summary of Criteria Pollutant Monitoring Discrete Measurement Methodologies

PM_{10}	
Sampling Media	Quartz Fiber Filters (Received from U.S. EPA Region 9)
Media Preparation	Light inspection, conditioning, taring
Media Storage	Envelopes
Type of Sample	Air sample selectively sized cut to PM_{10} or smaller, integrated over 24-hr period
Sample Delivery	Downstream pump and flow controller; SSI head
Sample Line	N/A
Sample Manifold	N/A
Sample Flow Rate	40 CFM
Sampler Make-Model	SSI PM_{10}
Sample Storage	Envelopes
Sample Recovery	24 Hour conditioning
Sample Analysis	Analytical Balance
$PM_{2.5}$	
Sampling Media	Filters, 46.2 mm, Teflon (Received from U.S. EPA Region 9)
Media Preparation	Light inspection, conditioning, taring
Media Storage	Petrislides/ Filter cassettes
Type of Sample	Air sample through cyclone cut to $PM_{2.5}$ or smaller, integrated over 24-hr period
Sample Delivery	Downstream pump and flow controller, cyclone head
Sample Line	N/A
Sample Manifold	N/A
Sample Flow Rate	16.67 LPM
Sampler Make-Model	Anderson RAAS
Sample Storage	Petrislides/ Filter cassettes
Sample Recovery	24 Hour Conditioning
Sample Analysis	Analytical Balance
TSP Pb (Hi Vol)	
Sampling Media	Filters, 8”x10” glass fiber filter (Received from U.S. EPA Region 9)
Media Preparation	Light inspection, conditioning, taring
Media Storage	Envelopes
Type of Sample	Whole Air sample, integrated over 24-hr period
Sample Delivery	Downstream pump and flow controller (Hi Q mass flow control)
Sample Line	N/A
Sample Manifold	N/A
Sample Flow Rate	42 CFM
Sampler Make-Model	Anderson/ Hi Q
Sample Storage	Envelopes
Sample Analysis	ICP-MS

2.2.2.1 Discrete Sample Preparation

2.2.2.1.1 Standard Operating Procedures for Discrete Sample Preparation

Table 2.10 identifies the SOPs for handling criteria pollutant monitoring program filters prepared in the AQMD laboratory.

Table 2.10
Standard Operating Procedures for Discrete Sample Preparation

SOP #	Topic
SOP00104	$PM_{2.5}$ Gravimetric Laboratory (Mass Room) Operations
SOP00112	PM_{10} Mass Analysis
SOP00113	Selection, Preparation & Extraction of Glass Fiber & Quartz Filters for Metal Analysis

2.2.2.1.2 Quality Control for Discrete Sample Preparation

Figure 2.2 shows the process for the quartz filters, and Figure 2.3 provides a flow chart for the filter acceptance process for the Teflon filters. Filters are received from the vendor, and a subset of the lot is tested for acceptance in accordance with the analytical method SOP. Filters are accepted or rejected in accordance with the filter acceptance criteria (Table 2.11). Accepted filters are assigned a unique Lab ID number or filter number before distribution to the AQIS.

Figure 2.2
Flow Diagram of Quartz Filter Acceptance Process

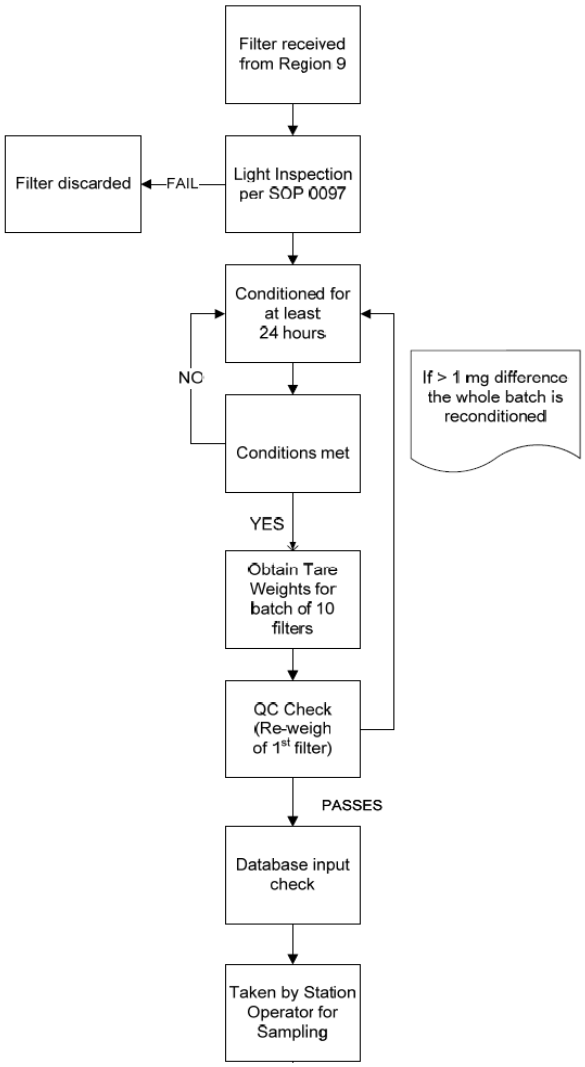


Figure 2.3
Teflon Filter Acceptance Process Flowchart

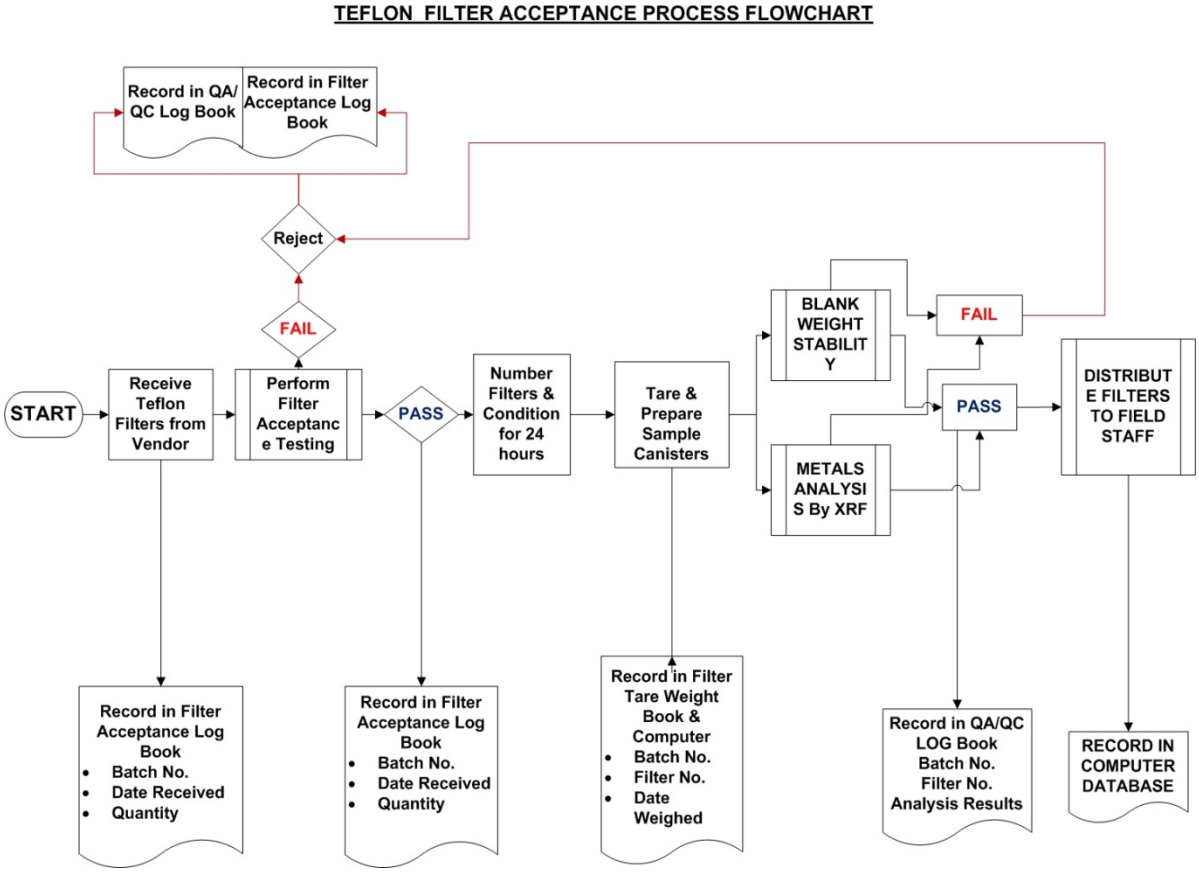


Table 2.11
Quality Control Activities for Discrete Sample Collection

Discrete Sample Preparation				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Filter Inspection	Pre-sample	Laboratory Technician	No Pinhole(s) or tearing	1) If additional filters have been brought, use one of them. Void filters with pinholes or tears. 2) Use new field blank filters as sample filters. 3) Obtain a new filters from lab.

2.2.2.2 Discrete Sample Collection

Field AQIS picks up prepared filters and chain of custody forms from a pre-designated place in the AQMD laboratory, collects the samples at the assigned field stations according to the sampling schedule, and returns the samples to the AQMD laboratory.

2.2.2.2.1 Standard Operating Procedures for Discrete Sample Collection

Table 2.12 lists the SOPs for the collection of PM_{10}, $PM_{2.5}$, and TSP samples in support of the Criteria Pollutant Monitoring Program.

Table 2.12
Standard Operating Procedures for Discrete Sample Collection

SOP #	**SOP Topic**
SOP00081	PM_{10} FRM Sampler, SSI
SOP00061	$PM_{2.5}$ FRM Sampler, RAAS
SOP00082	TSP Sampler

2.2.2.2.2 Quality Control for Discrete Sample Collection

This section identifies Criteria Pollutant Monitoring Program discrete sampling collection QC procedures, sampling frequency, and analytic procedures as well as associated acceptance criteria. If corrective action proves ineffective and significant data loss has occurred, a QAA is issued to be tracked, documented, and to receive attention from the QA Branch.

Table 2.13
Quality Control Activities for Discrete Sample Collection

PM_{10} FRM Sampler				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Sampling Period	Each Sample	AQIS/ Operations	24 +/- 1 Hour	Investigate/ Invalidate
Average Flow Rate	Each Sample	AQIS/ Operations	10% of 40 CFM	Investigate/ Invalidate
Flow Verification	Monthly	AQIS/ Operations	7% standard 10% design	Inform Senior AQIS/ AM Work Order
Multi-Point Verification/ Calibration	Yearly	AQIS II/ Support	5 points, .999 CV; 10% design	Investigate, note in downtime log; Inform QA
$PM_{2.5}$ FRM Sampler				
Sampling Period	Each Sample	AQIS/ Operations	24 +/- 1 Hour	Investigate/ Invalidate
Average Flow Rate	Each Sample	AQIS/ Operations	5% of 16.67 LPM	Investigate/ Invalidate
Flow Rate Variability	Each Sample	AQIS/ Operations	CV < 2%	Investigate/ Invalidate
Filter Inspection	Post-sample	AQIS/ Operations	Torn or otherwise suspect particulate by-passing 46.2 mm filter	1) Determine if air stream is bypassing the filter by inspecting area downstream of filter holder in the sampler 2) Inspect the in-line filter mounted before the sample pump and determine if excessive loading has occurred. Replace as necessary.
Flow Rates	1 per 5 samples	AQIS/ Operations	+/- 5% for > 5 min	Flag data
Leak Test	Each Sample	AQIS/ Operations	< 0.080 LPM	1) Remove the leak check adaptor, re-connect and re-perform the leak test. 2) Inspect all seals and O-rings, replace as necessary and re-perform leak test

Table 2.13
Quality Control Activities for Discrete Sample Collection (cont.)

$PM_{2.5}$ FRM Sampler (cont.)				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Sample Flow Rate Verification	Monthly	AQIS/ Operations (Check); AQIS II/ Support (Repair)	± 4% of transfer standard and ±5% of design flow rate	1) Remove the flow rate device, re-connect and re-perform flow rate check. 2) Perform leak test. 3) Check flow rate at 3 points (15.0 LPM, 16.7 LPM, and 18.3 LPM) to determine if flow rate problem is with a zero bias or slope. 4) Re-calibrate the flow rate.
Cyclone	Monthly	AQIS/ Operations	Free from dirt, debris or oil	Clean
Multi-Point Verification/ Calibration	Yearly	AQIS II/ Support	2% of transfer standard/ 2% design	Investigate, note in downtime log; Inform QA
Leak Checks	Yearly	AQIS/ Operations	<0.08 LPM	Investigate/ Repair
Temperature Verification/ Calibration	Yearly	AQIS II/ Support	± 2 °C	1) Make certain thermocouples are immersed in the same liquid at the same point without touching sides or bottom of container. 2) Use ice bath or warm water bath to check at a different temperature. If acceptable, re-perform ambient temperature verification. 3) Connect new thermocouple. 4) Check ambient temperature with another NIST traceable thermometer.
Pressure Verification/ Calibration	Yearly	AQIS II/ Support	±10 mm Hg	1) Make certain pressure sensors are each exposed to the ambient air and are not in direct sunlight. 2) Call local Airport or other source of ambient pressure data and compare that pressure to pressure data from monitor's sensor. Pressure correction may be required. 3) Connect new pressure sensor.
TSP Sampler				
Sampling Period	Each Sample	AQIS/ Operations	24 ± 1 Hour	Investigate/ Invalidate
Average Flow Rate	Each Sample	AQIS/ Operations	10% of 45 CFM	Investigate/ Invalidate

Quality Control Activities for Discrete Sample Collection (cont.)

TSP Sampler (cont.)				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Flow Verification	Monthly	AQIS/ Operations	7% standard 10% design	Inform Senior AQIS/ AM Work Order
Flow Multi-Point Verification/ Calibration	Yearly	AQIS II/ Support	5 points; Within 5% of calibration curve	Investigate, note in downtime log; Inform QA

2.2.2.2.3 Sample Handling and Custody

In general, PM_{10}, $PM_{2.5}$, and TSP filter sampling media are prepared in the AQMD laboratory and are placed in a designated place along with a chain of custody form containing information needed in advance of sampling for pick up by an AQIS. The AQIS installs the appropriate filter for the date and sampling location based upon information in the associated chain of custody. After sampling, the AQIS completes relevant portions of the chain of custody including field operator comments (e.g. Fire in area, High Winds, etc.) and, when necessary, notification if the sample is invalid and the reason for the invalidation. The sample and chain of custody are transported back to the AQMD laboratory for analysis and data submission.

2.2.2.2.4 Trip Blanks and Field Blanks

Discrete samples require trip and field blanks at scheduled frequencies. This is necessary for determining bias (if any) for all the process post media preparation through AQMD laboratory drop off. Trip and field blanks are handled without air sampling through the sampling media. Trip blanks are transported but not placed on the sampler. Field blanks are transported to the monitoring site, placed on the sampler, and then retrieved without sampling. If acceptance criteria are exceeded, the sampler and sample transportation methods are investigated. An optional quarterly field blank schedule may be implemented for PM10 and TSP and will be considered for implementation in 2013 on a quarterly schedule. Acceptance criteria will be determined with discussion with U.S. EPA and other air monitoring organizations.

Table 2.14
Trip and Field Blank Schedule

Sample	Description	Frequency	Acceptance Criteria
$PM_{2.5}$	Trip Blank	Monthly	< 30 ug between weighings
$PM_{2.5}$	Field Blank	Monthly	< 30 ug between weighings

2.2.2.2.5 Collocated Samples

Collocated samples are collected by placing a sampler in the same location as the primary sample as specified in 40 CFR Part 58 Appendix A. Collocated PM samples are collected typically on a 1-in-6 day schedule, but two stations, Indio and Rubidoux collect collocated PM_{10} samples on a 1-in-3 day schedule. If the primary sampler does not operate correctly or collected data was invalid, valid collocated data can be substituted for the particular samples missed by the primary sampler. If the CV values exceed the criteria, then sample and analysis techniques are investigated to determine the cause of the high variability.

Table 2.15
Collocated Sampling Schedule

Sample	Description	Frequency	Criteria
PM_{10}	2 Stations	1 in 3 days	< 10% CV for samples > 15 ug/m^3
PM_{10}	1 Station	1 in 3 days	< 10% CV for samples > 15 ug/m^3
$PM_{2.5}$	3 Stations	1 in 6 days	<10% CV for samples >3 ug/m^3
TSP	3 Stations	1 in 6 days	<15% CV

2.2.2.3 Discrete Sample Recovery and Analysis

The AQMD uses a Promium Element® LIMS Data System to track laboratory prepared samples, samples taken into the field, and samples returned/ awaiting analysis. Filters from each sample set are distributed to one or more analysts for analysis (e.g. PM_{10}, $PM_{2.5}$, and TSP).

2.2.2.3.1 Standard Operating Procedures for Discrete Sample Recovery and Analysis

Table 2.16 identifies the methods used for the analysis of AQMD Criteria Pollutant Monitoring Program discrete method samples.

Table 2.16
Standard Operational Procedures for Discrete Sample Recovery and Analysis

SOP #	SOP Topic
SOP00005	Metals Analysis by ICP-MS
SOP00104	$PM_{2.5}$ Gravimetric Laboratory (Mass Room) Operations
SOP00112	PM_{10} Mass Analysis
SOP000113	Selection, Preparation & Extraction of Glass Fiber & Quartz Filters for Metal Analysis

2.2.2.3.2 Quality Control for Discrete Sample Recovery and Analysis

This section identifies QC procedures and frequency for each sampling, analysis, or measurement technique, as well as associated acceptance criteria and corrective action which are based upon the *QA Handbook for Ambient Air Quality Measurement Systems, Volume II*, Section 10 (2009). Individual SOPs listed in 2.11 provide detailed information on these activities.

Upon receipt of the samples, filters are inspected according to the inspection criteria in Table 2.17.

Table 2.17
Quality Control Activities for Discrete Sample Recovery

Recovery				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Filter Inspection	post-sample receipt	Laboratory Technician	No Pinhole(s) or tearing	1) If additional filters have been brought, use one of them. Void filters with pinholes or tears. 2) Use new field blank filters as sample filters. 3) Obtain a new filter from the lab.

The filters are stored for at least 24 hours in the PM conditioning room which meets criteria as outlined in Table 2.18.

Table 2.18
Quality Control Activities for Discrete Sample Recovery and Analysis

PM Conditioning Room				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Room Temperature	Before and during each weighing session	Balance Analyst	20 – 23ºC	Wait for correct temperature to be achieved; contact SAQ Chemist and the QA SAQ Chemist; Call Service provider that holds maintenance agreement; Document in weigh room log book; Notify PAQ Chemist and Principal AQIS of Operations Group
Room Temperature Control	Each Filter	Balance Analyst	2°C SD over 24 hour	Wait for correct temperature to be achieved; contact SAQ Chemist and the QA SAQ Chemist; Call Service provider that holds maintenance agreement; Document in weigh room log book; Notify $PM_{2.5}$ PAQ Chemist and Principal AQIS of Operations Group
Room Humidity	Before and during each weighing session	Balance Analyst	30 – 40%	Wait for correct humidity to be achieved; contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist; Call Service provider that holds maintenance agreement; Document in weigh room log book; Notify $PM_{2.5}$ PAQ Chemist and Principal AQIS of Operations Group

Table 2.18
Quality Control Activities for Discrete Sample Recovery and Analysis (cont.)

PM Conditioning Room (cont.)				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Room Humidity Control	Each Filter	Balance Analyst	5% SD over 24 hour	(Wait for correct humidity to be achieved; contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist; Call Service provider that holds maintenance agreement; Document in weigh room log book; Notify $PM_{2.5}$ PAQ Chemist and Principal AQIS
Multi-point Microbalance Internal Calibration Maintenance External calibration	Daily Yearly or as needed Yearly or as needed	Balance Analyst Mettler Toledo service representative	± 2µg	Contact Mettler Toledo service Representative, notify the $PM_{2.5}$ SAQ Chemist, and the QA SAQ Chemist
Comparison of NIST Standards to laboratory working and primary standards	Yearly or as needed	SAQ Chemist	± 3µg	Contact Mettler Toledo service Representative, notify the $PM_{2.5}$ SAQ Chemist, and the QA SAQ Chemist
Cleaning weigh room	Monthly	Balance Analyst	No visible dust or particles	Clean according to SOP00104
Sticky floor mat (just outside weight room)	Monthly or as needed	Balance Analyst	Floor mat covered in particulate matter/dirt	Replace mat
Polonium Strips	Semi-Annually	SAQ Chemist	6 Months	Replace Polonium Strips
HVAC system preventive maintenance	Yearly	SAQ Chemist		Contract for maintenance

Quality control measures for analyses are indicated in Table 2.19.

Table 2.19
Quality Control Activities for Discrete Sample Recovery and Analysis

PM_{10} Mass				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Balance Check	Beginning, 10th sample, end	Balance Analyst	± 0.5 mg of true zero and ± 0.5 mg of the 5g check weight	Reweigh; Document in Weigh room log book; Contact SAQ Chemist
Duplicate Weighing	Tare Weights Final Weights	Balance Analyst	± 1 mg change from original value ± 2 mg change from original value	Document in Weigh room log book; Contact SAQ Chemist
Collocated Samples	1 per 6 days at 15% of sites	PM_{10} SAQ Chemist	CV < 10% of samples >15 µg/m^3	Notify PM PAQ Chemist, QA SAQ Chemist
$PM_{2.5}$ Mass				
Blanks Lot Blanks Lab Blanks	12 per lot 1 per weigh session	Balance Analyst	± 5µg mean difference ± 15µg difference	(1) Contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist (2) Document in weigh room log book
Calibration/Verification Balance Calibration Temp. Calibration RH Calibration	1/yr	Balance Analyst	Manufacturers spec. ± 2º C ± 2%	(1) Contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist (2) Document in weigh room log book
Accuracy Balance Audit Balance Check (100 and 200µg standards)	1/year beginning, every 10th sample, end	Balance Analyst	± 15µg for unexposed filters # 3µg	(1) Contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist (2) Check weights (3) Document in weigh room log book
Calibration standards Working Mass Stds. Primary Mass Stds.	1/yr 1/yr	Balance Analyst	25µg 25µg	Contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist; Document in weigh room log book

Table 2.19
Quality Control Activities for Discrete Sample Recovery and Analysis (cont.)

$PM_{2.5}$ Mass (cont.)				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Precision Duplicate filter weighings	Every filter (tare sessions) Every 3rd filter (final sessions)	Balance Analyst	± 15µg difference	Contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist; Document in weigh room log book
Lot Stability Test Filters	Ten filters are repeatedly weighed to determine the minimum necessary equilibration time for filters from the same lot.	Balance Analyst	Weight trend approaches zero	Contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist; Document in weigh room log book
Laboratory Blank Filters	One laboratory blank filter is weighed for every weighing session.	Balance Analyst	Weight loss < 15 µg	Contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist; Document in weigh room log book
Field Blank Filters	Unexposed filters from each sampling site are collected monthly.	Balance Analyst	weight gain < 30 µg	
Replicate Filter Weighings	Every tenth filter (both preweighing and postweighing) is reweighed.	Balance Analyst	Weight difference < 15 µg	Contact $PM_{2.5}$ SAQ Chemist and the QA SAQ Chemist; Document in weigh room log book
Lead Analysis				
Initial Calibration (IC)	Daily, at least 4 calibration points	AQ Chemist	Correlation coefficient > 0.995	1) Repeat analysis of calibration standards. 2) Re-prepare calibration standards and reanalyze.
Initial Calibration Verification (ICV)	Immediately after IC	AQ Chemist	Recovery 90-110%	1) Repeat analysis of calibration check standard. 2) Repeat analysis of calibration standards. 3) Re-prepare calibration standards and reanalyze

Table 2.19
Quality Control Activities for Discrete Sample Recovery and Analysis (cont.)

Lead Analysis (cont.)				
Activity	**Frequency**	**Responsible Staff/Section**	**Acceptance Criteria**	**Corrective Action**
Initial Calibration Blank (ICB)	Immediately after ICV	AQ Chemist	Analytes below MDL	1) Locate and resolve contamination problems before continuing. 2) Reanalyze
High Standard Verification (HSV)	Following the ICB analysis	AQ Chemist	Recovery 95%-105%	1) Repeat analysis of HSV. 2) Re-prepare HSV.
Lab Control Standard (LCS)	Following the ICB, before the first sample and at the end of each run	AQ Chemist	Recovery 85-115%	1) Repeat analysis of ICS. 2) Re-prepare ICS.
Continuing Calibration Verification (CCV)	Analyze before the 1st sample, after every 10 samples, and at the end of the run	AQ Chemist	Recovery 85-115%	1) Repeat analysis of continuing calibration verification sample. 2) Re-prepare continuing calibration. 3) Reanalyze samples since last acceptable continuing calibration verification.
Reagent Blank (RB)	1 per 20 samples, a minimum of 1 per batch	AQ Chemist	Analytes below MDL	1) Reanalyze. 2) Re-prepare blank and reanalyze. 3) Repeat analyses of all samples since last clean blank.
Method Blank Spike	1 per 20 samples, a minimum of 1 per batch	AQ Chemist	Recovery 80-120%	1) Re-prepare sample batch. 2) Reanalyze.
Sample Spike	1 per 20 samples, a minimum of 1 per sample batch	AQ Chemist	Recovery 75-125%, with the exception of Ag and Sb	1) Re-prepare sample batch. 2) Reanalyze.
Duplicate Samples	1 per batch	AQ Chemist	RPD < 15%	1) Repeat analysis. 2) Re-prepare.
Collocated samples	Once every ten samples	AQ Chemist	$\pm$ 30 % for > 5 x MDL	1) Investigate and discuss with Ambient Monitoring and QA Branch

2.3 Instrument/Equipment Testing, and Inspection

Acceptance testing of continuous monitoring instrumentation and sampling systems is conducted by the Support Group within the AM Branch. Laboratory instrumentation analytic systems are acceptance tested by laboratory staff.

AQMD has an established policy and procedure for the procurement of equipment, supplies and services (AQMD QMP, 2009) in which specifications and criteria for acceptance are documented. The purchase of fixed assets such as monitoring equipment, instruments, and other equipment used under PAMS are governed by this policy. Equipment specifications are prepared by staff, approved by supervisors, management, and, when of significant fiscal impact, by the Governing Board. Final purchases are also approved similarly. Fixed asset equipment purchases are subject to the requirements of a formal Request for Quotations (RFQ) procedure. Specifications for equipment, evaluation criteria for rating each quotation, acceptance criteria, schedules for delivery, and actions that may be taken when acceptance criteria are not met, are contained in each RFQ. The RFQ, at the minimum, contains requirements established by U.S EPA for criteria pollutant monitoring and sampling instrumentation.

All instrumentation and equipment procured for the Criteria Pollutant Monitoring Program undergo inspection and acceptance testing as appropriate. Any inconsistencies related to the quality of manufacturing or system performance are resolved with the manufacturer before final payment is made. All equipment, instrumentation, and supplies must pass inspection, and acceptance testing before deployment and usage. An inventory of all procured capital equipment is maintained electronically on the AQMD Inventory Database. Acceptance testing documentation are accessible to staff and are located on instrument benches, QA Branch files, and Network drives.

2.4 Inspection/Acceptance of Supplies and Consumables

Acceptance criteria for supplies and consumables vary with the operation being conducted and are generally described in the relevant SOPs. In general, the specifications are checked to ensure the adequate criteria for supplies and consumables are met and appropriate for use for the operation.

2.5 Data Management

This section describes standard record keeping, data handling procedures, and equipment used to acquire, process, compile, store, retrieve, and analyze data. Since all data is either acquired digitally (e.g. computer work stations, data loggers, digital chart recorders) or entered into digital storage from Sample Logs or instrument printouts, and eventually reside in a computer database,

computer hardware and software are an important aspect of this discussion. Also described are procedures for detecting and correcting errors/loss during data processing and processes for assuring that applicable information resource management requirements are satisfied, including the identification of the location of applicable spreadsheets, databases, and reports.

2.5.1 Data Management for Continuous Monitoring Methods

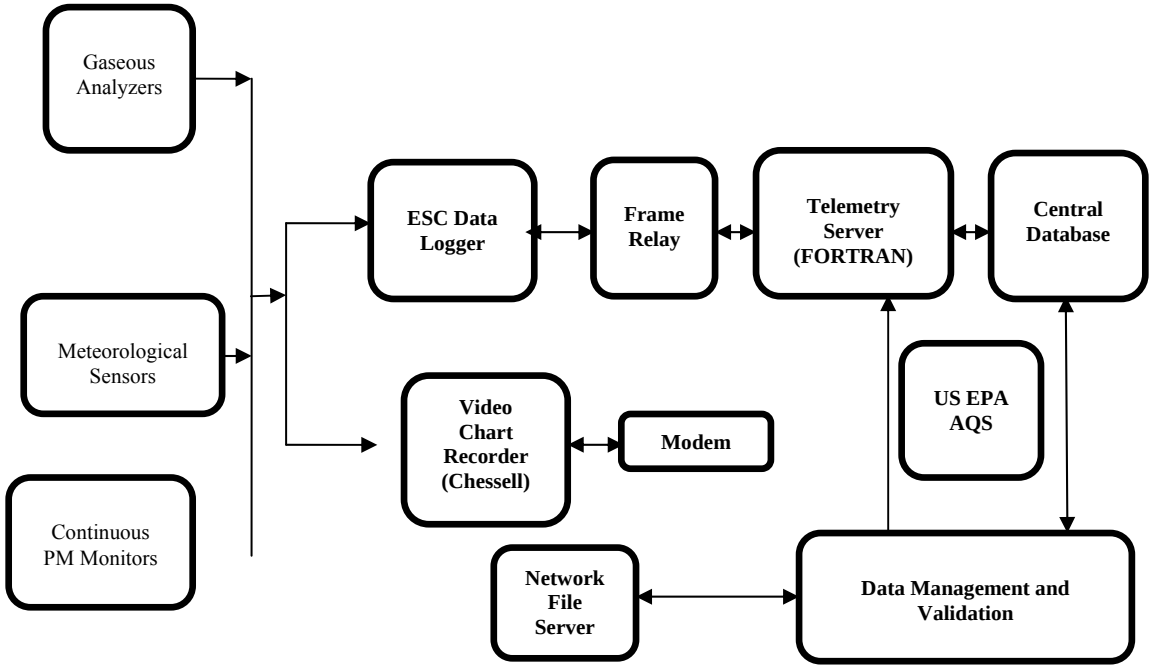
The telemetry system polls each air monitoring station once every minute and the hourly averages are generated from the minute data. The overall process is outlined in Figure 2.4.

Field continuous instrument data recording devices consist of an Environmental System Corporation (ESC) data logger and an Eurotherm Chessell electronic chart recorder. The ESC data logger is the primary data acquisition system while the Chessell chart recorder provides a secondary record of continuous monitor analog output based data. Chessell chart recorder records are used to augment ESC data and provide additional information needed to evaluate suspect data points recorded in the data base. The ESC data logger collects and computes the minute and hourly averages but only the hourly averages are stored by the ESC. Some of the gaseous pollutant analyzers and PM monitors have their own internal data loggers which can be accessed manually to download data into a laptop and transferred to a central storage location at AQMD.

Data transmittal is accomplished using a private internet protocol (IP) data network which links the primary ESC data logger through a router and terminal server at the air monitoring sites with the telemetry data acquisition server designated FORTRAN at AQMD headquarters. All data edits are performed on the central database server. In addition, data from the Eurotherm Chessell Video chart recorder at each monitoring station is downloaded monthly via an analog modem. Data from internal data loggers is also used to back-fill missing data.

All data is stored in a central relational database on site and on magnetic tape once it gets too large, a backup copy is also stored at an offsite storage location. Magnetic tape is used to store data downloaded from the database when the database capacity is approached. Magnetic tape provides a backup copy of the data which is stored at an offsite storage location. Data storage is managed in accordance to the AQMD QMP Section 8 (2009).

Figure 2.4
Data Management for Continuous Monitors



2.5.2 Data Management for Discrete Monitoring Methods

Discrete measurements require the integration of information and data from Field Operations and Laboratory. Sample information is recorded on sample logs, chain of custody sheets, sampler printouts, and sampler digital outputs and transferred to the laboratory database. Laboratory analysis produces raw data, processed data, data collected from the field. Laboratory hand records consist of written entries in instrument logbooks, chain of custody sheets, and hard copy instrument printouts.

2.5.2.1 Data Management Resources for Discrete Monitoring Methods

The resources needed to manage discrete measurement data are the following:

- Dedicated computers for analytic instruments (PC-1), to control and monitor sample analyses; acquire and store raw analytical and QC data; convert raw data into concentrations of analyzed species; and create secondary data files of calculated results
- Laboratory work station computers accessible via LAN (PC-2), to convert raw data into concentrations of analyzed species; and create secondary data files of calculated results

- Personal computers assigned to staff (PC-3) to review secondary data files and convert data to AQS format and upload into AQS database via internet
- Laboratory server (designated I-Drive), accessible via WAN, maintained by Information Management to store and transfer secondary files and reports
- Laboratory information system (Promium Element® LIMS Data System), maintained by Information Management
- Document Scanner to convert paper documents into digital form for electronic storage

2.5.2.2 Data Flow and Processing

This section describes the flow of data from the analytical instrument to the final archiving, and identifies points where data may be modified and/or reformatted.

Analytical instrumentation includes computer systems (PC-1) that, at a minimum, acquire the raw analytical data. Typically, these same computer systems control the analysis cycle. This can include control of automated samplers for unattended operation. The raw data file that is created at the PC-1 level is either non-editable or, if editable, data is flagged when deleted or modified. Modified files include information on the changes made to the file. Raw data is retained on the PC-1 level computer for the period specified in the AQMD Records Retention Policy. PC-1 level computers have the ability to display data such that the operator can determine whether the analytical process is proceeding appropriately. When the PC-1 level computer is not capable of processing data while carrying out the analyses, raw data files are copied via LAN to a PC- 2 level computer which is also located near the analytical instrument. The copied file becomes the data file for editing and further processing.

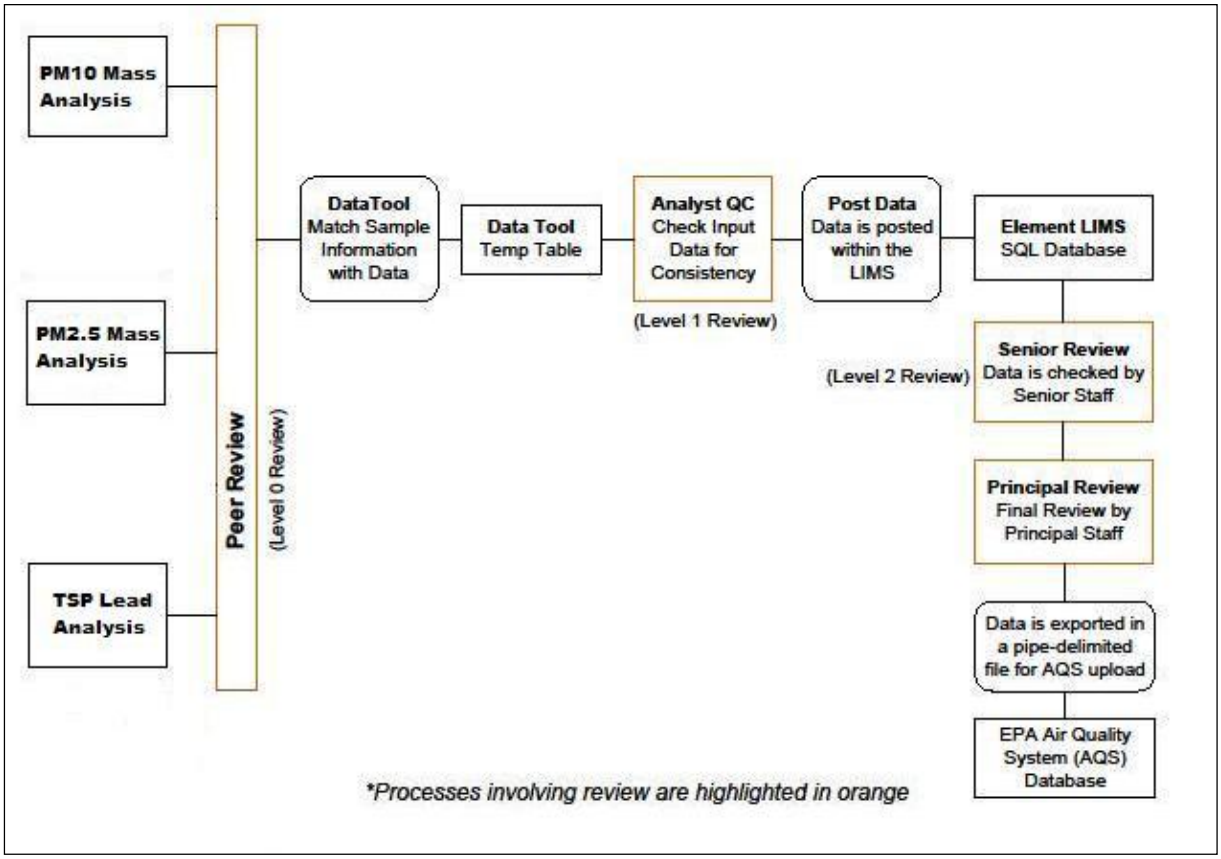
Raw data files (or copies) are processed and transformed into an electronic format, typically MS-Excel spreadsheet, from which the information is streamlined for data validation and submission. Streamlined data includes concentrations, sample volumes, sampler flow rates, and sampling period. This transformed, secondary data file on the PC-1 (or PC-2) level computer is traceable back to the primary data file retained on the PC-1 level computer. These transformed data files are copied to the laboratory server (I-Drive) to enable multiple user access, and are reviewed by the Senior Air Quality (SAQ) Chemist responsible for the data with hardcopy printouts of data and information related to the analyzed samples.

After the transformed data file is approved by the SAQ Chemist or Senior AQIS responsible for the data, it is transformed once more into a format compatible with uploading to the AQS database. The upload process is carried out by an AQ Chemist or SAQ Chemist in the section responsible for the review and submission of data to AQS. The transformed data file is retained for the period of time specified in the AQMD Records Retention Policy.

Data from each assay is input into the database for each sample from the various instrumental computers. Lab assay data is combined with field data to produce quarterly reports and a pipe delimited text document that is submitted to the U.S. EPA.

Beginning January 2010, the $PM_{2.5}$ Speciation Database was folded into the new Promium Element® LIMS Data System for centralization and were ran in parallel. Data management has been transferred to the LIMS Data System as shown in Figure 2.5 and described in detail in SOP00121. SOP00121 (Standard Operating Procedure For Data Processing and Validation) details the processes and procedures used to collect, transmit, store, validate, and report discrete sample data for the criteria pollutant measurement program.

Figure 2.5
Laboratory Operations Data Flow Diagram



SECTION 3. DATA VALIDATION, USABILITY AND REPORTING

3.1 Data Review, Verification and Validation

Data validation is necessary to identify data with errors, biases, and physically unrealistic values before they are used for identification of exceedances, for analysis, or for modeling. Data validation is a combination of checking that data processing operations have been carried out correctly and of monitoring the quality of laboratory and field operations. Data validation can identify problems in these areas. Once problems are identified, the data can be corrected or invalidated, and corrective actions can be taken for field or laboratory operations. Data validation goals are to:

- Produce a database with values that are validated to a level that meets or exceeds program requirements.
- Evaluate the internal, spatial, temporal, and physical consistency of the data.
- Compare data to identify errors, biases, or outliers.

The following validation functions are incorporated to ensure quality of data entry and data processing operations:

3.1.1 Completeness Checks – When data are processed, certain completeness criteria must be met. For example, each sample must have a start time, an end time, an average flow rate, dates analyzed, and operator and technician names. The minimum valid data recovery objective for the program is greater than 75% per calendar quarter or all possible hours.

3.1.2 Data Retention – Raw data and data sheets are retained on file as per the AQMD Records Retention Policy and for a minimum of five years after collection, and are available for audits and data verification activities.

3.1.3 Statistical Data Checks – Errors found during statistical screening are traced back to original data entry files and to the raw data, as necessary. These checks are performed prior to data submission to AQS. Data validation is the process by which raw data are screened and assessed before they can be included in the main data base.

3.2 Process for Data Review, Verification and Validation

This section describes an overview of the processes accepting, rejecting, or qualifying data. More detailed description of the processes can be found in the SOPs listed in Table 3.1

Table 3.1
Standard Operating Procedures for Data Validation Processes

SOP #	SOP Topic
SOP00083	Data Management of Continuous Instruments
SOP00124	Data QC using Data Management System (DMS)
SOP00104	$PM_{2.5}$ Gravimetric Laboratory (Mass Room) Operations
SOP00121	Data Processing and Validation
SOP00112	PM_{10} Mass Analysis

3.2.1 Data Review, Verification and Validation for Continuous Monitoring Methods

There are four data validation levels within the data screening process.

- **Level 0** is performed by the FORTRAN and the ESC data logger which flags data for the following:
    - Times that the instrument was down due to calibration, repair or auditing activity
    - Data over the warning and acceptance limits as noted in Table 2.3
    - Hourly data containing less than 45 minutes
    - Negative values
    - Exceedences to typical maximum ambient values
    - Flow Rate (average rate, CV)
- **Level I** is performed by the station operation staff
    - Meteorology sensor checks
    - Maintenance Sheet checks and observations
    - Filling out Downtime Log
    - Review telemetry data
    - Instrument zeroing
    - Shelter temperature checks
    - Exceptional event observations

- **Level II** is performed by the data validation staff.

    - Review chart data, identify extreme values and outliers, constant values, block of zeros or missing values and investigate the validity of values
    - Invalidating data that are outside the acceptable criteria according to Table 2.3
    - Invalidating data if the shelter temperature criteria were exceeded
    - Adjust or invalidate data if $NO + NO_2 > NO_X$
    - Adjust for zero drift
    - Check for consistency with season, week, day, hour

- **Level III** is performed by the data validation staff

    - Compare pollutant data to meteorology (wind direction, wind speed)
    - Compare data from nearby sites

Data validation staff review graphs of the tabular data and data from the Chessell chart recorder when the data is suspect. Anomalies or indications of systematic issues (low completeness, unusual data points, etc.) are reported to the QA Branch.

Once all the edits on the data in the central database are completed for a month, an AQS formatted data file is generated by Information Management for submittal to EPA-AQS and a copy of the file is archived on the E:\drive for future reference. A Scan Report is run on AQS and reviewed by data validation staff to identify values that exceed the historical maximum readings in AQS for investigation. If data are found to be invalid or need editing, the changes are done in AQS. The AQS database documents these changes in a log which states the time period for the data in question, the action taken and the reason for the edit.

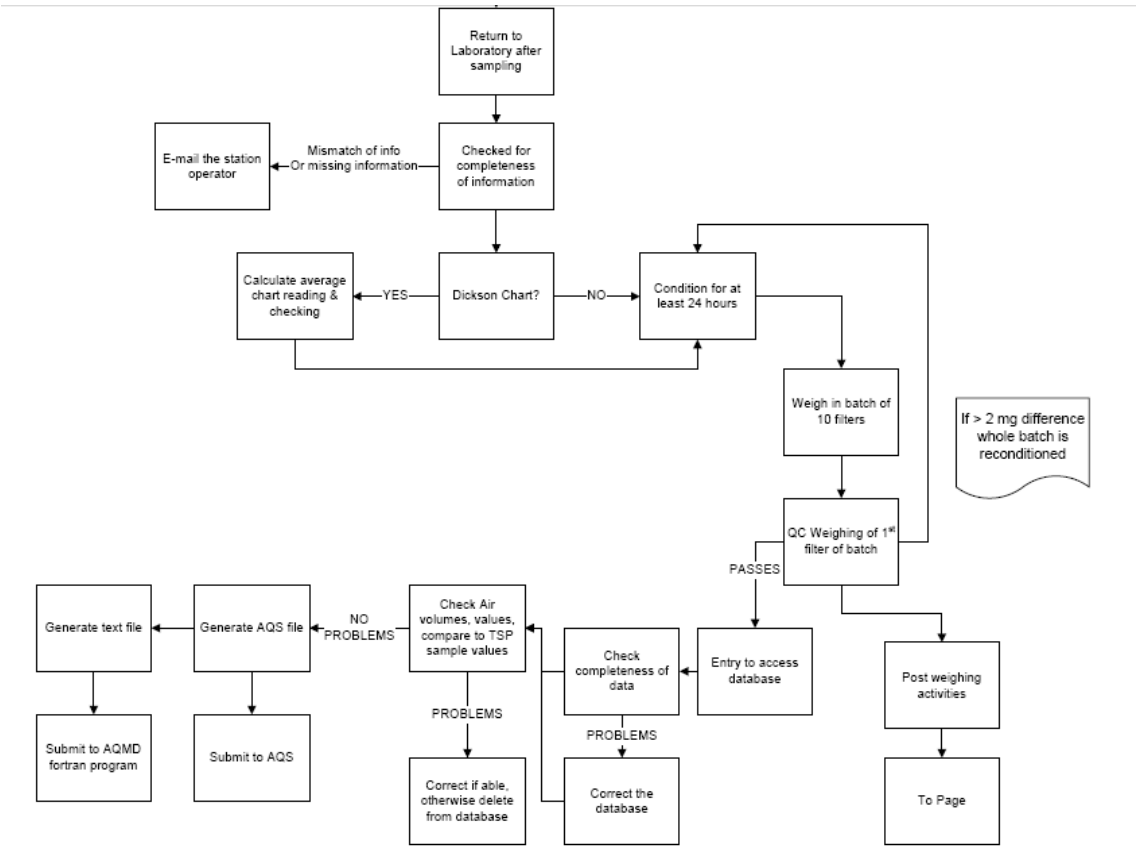
At the end of every quarter, data validation staff submits to the EPA AQS bi-weekly precision data for all gaseous instruments and quarterly QA field auditor audit results.

3.2.2 Data Review, Verification and Validation for Discrete Monitoring Methods

3.2.2.1 PM_{10} and TSP Data Validation

Figure 3.1 shows the PM_{10} validation starting after the laboratory receives the filter after collection.

Figure 3.1
PM_{10} and TSP Analysis and Data Validation Processes



Level 0 validation is performed by the station operations staff AQIS who checks the chain of custody sheet on the envelope against criteria listed in Table 3.2 for the following:

- Filter number
- Date
- Station
- Start and Stop times of collection
- Elapsed time of collection
- Flow rate (average rate, CV)

Table 3.2
Summary of Requirements for PM_{10} Sample Acceptance

Criteria	Acceptance Tolerance	Corrective Action
Filter number	Envelope number and filter number must match	Check the previous and next samples from the impacted site, then e-mail the station operator to confirm when cannot resolve
Sample date	Sample date should correspond to set schedule	When there is no note in the comment section as to a reason for an unscheduled sample, e-mail the station operator to confirm the sampling date
Run time	1440 min. ± 60 min.	E-mail the station operator to confirm the time, as the timer tumblers may be sticky. Place their reply in the envelope and make notes in the comments section of the envelope.
Run time	1440 min. ± 60 min.	Use the information on the back of Dickson chart to determine whether it is a copying error. In updated samplers, check the timer setup.
Start/stop time	Midnight ± 30 min.	E-mail the station operator to confirm the record. There are many styles of Dickson charts and the station operators need to be made aware of that fact. Place a copy of their reply in the envelope and make comments on the envelope. In updated samplers, check the timer setup.
Air volumes (for samples with no Dickson charts)	Air volumes must be written on the envelopes	E-mail the station operator requesting the missing information. Write the air volumes on the envelope and place a copy of the e-mail in the envelope.

Level 1 validation from assigned laboratory staff is performed to verify the level 1 information when the samples are received and before post-sampling conditioning.

Level 2 and **Level 3** validation is performed by the Senior Air Quality (SAQ) Chemist responsible for the data

- Check for data completeness
- Check flow rate acceptance information

- Check calibration coefficients
- Compare TSP and PM_{10} mass data
- Check Laboratory Analysis QC data
- Compare collocated samples
- Check for exceptional events and results of corrective action from QA Branch

3.2.2.2 $PM_{2.5}$ Data Validation

Figure 3.2 illustrates the entire $PM_{2.5}$ mass sample analysis and data validation process flow.

Level 1 validation from the assigned laboratory staff is performed to verify the level 0 information when the samples are received and before post-sampling conditioning.

Level 2 and **Level 3** validation is performed by the SAQ Chemist and Principle Air Quality (PAQ) Chemist or his/her designee responsible for the data

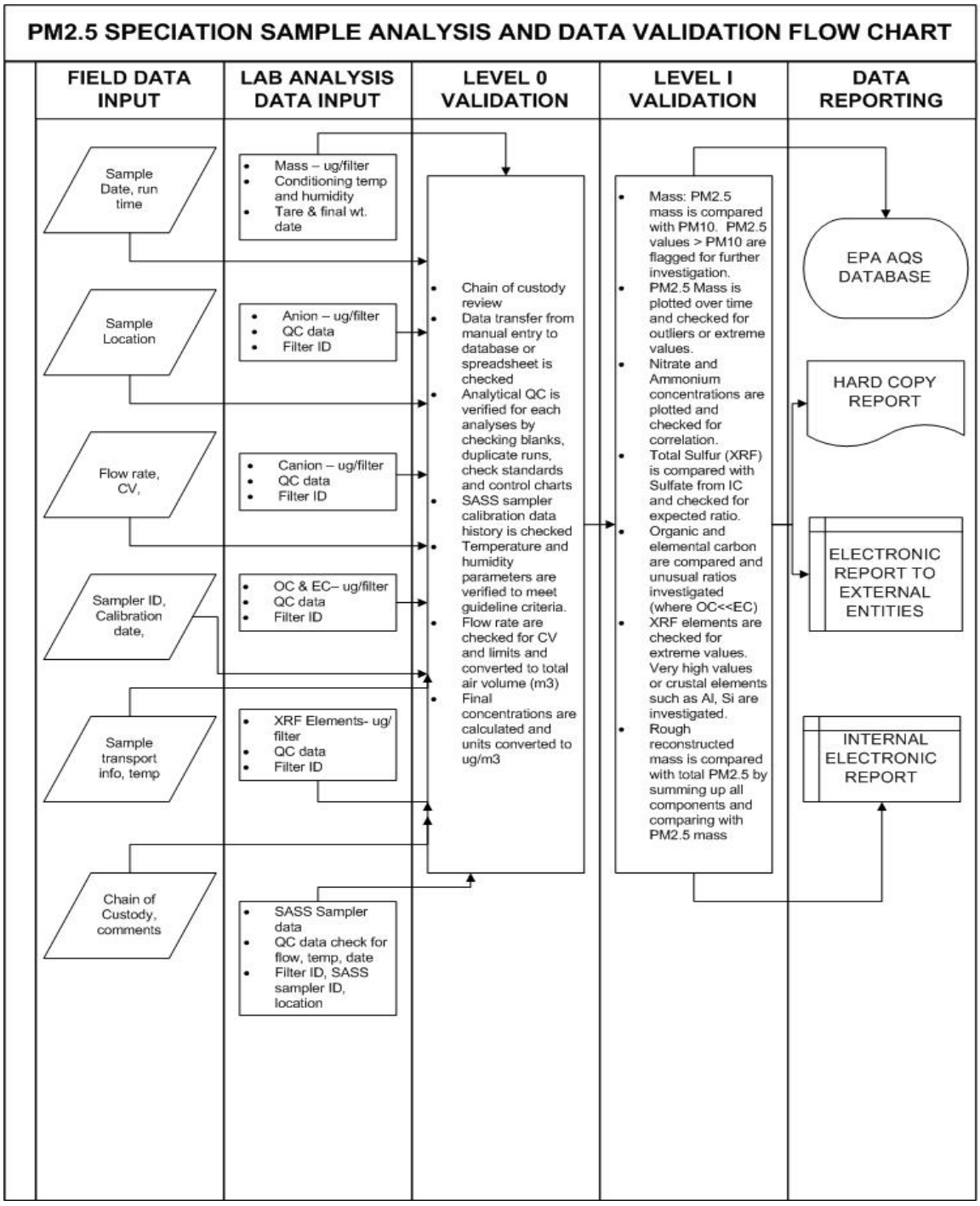
- Check for data completeness
- Check flow rate information (CV, actual flow rate)
- Compare $PM_{2.5}$ and PM_{10} mass data
- Compare collocated samples
- Check for exceptional events and results of corrective action from QA Branch

Validation that data has been uploaded into the AQS data base correctly and accurately is performed as a Level 3 review by data validation staff. Common data validation queries, acceptance criteria, and corrective actions for $PM_{2.5}$ are presented in Table 3.3.

Table 3.3
Data Validation Queries

Check	Acceptance Criteria	Corrective Action
Missing Sampler Data	Query returns nothing	Determine why data is missing. Input data values, or invalidate sampling day
Duplicate Data	Query returns nothing	Determine why duplicate data exists. Check data and remove duplicate data point.
Mass data analysis and null data check	All fields are populated or invalidated and values are within historical max and min	If data point is missing determine why, populate or invalidate. Otherwise, determine why value exceeds historical max or min, either flag or invalidate

Figure 3.2
Data Validation Pathway for $PM_{2.5}$ and Lead Analysis



3.3 Data Submission

Sections 3.2.2.1 and 3.2.2.2 describe activity from data validation to submission to AQS. Once in AQS, the data is loaded into AQMD screening files where it can be corrected if necessary. Screening file listings are created to assure that errors do not occur during data formatting and transmission.

3.4 Verification and Certification

Data validation staff review the AQS data summary sheet to input flags/invalidations that have been identified by Planning staff (exceptional events) or QA (results from corrective action or performance evaluation etc.).

Every year before the data certification deadline, the QA Branch reviews the data from the U.S. EPA AQS data summary reports along with internal and external performance evaluation and audit reports to check that the data meets or exceeds the required criteria (Section 4). Completeness, precision, data flagging, anomalous points, and responses to corrective action are reviewed. Also, random samples may be selected for data tracking review. Data of concern are documented and discussed with the appropriate groups until resolution of the concerns are addressed.

Upon completion of the Quality Assurance Manager (QAM) review, the data is certified by submitting a certification letter to U.S. EPA Region 9 specifying which data satisfies program requirements to the best of the QAM's knowledge. The letter is submitted before the annual May 1st deadline.

3.5 Reconciliation with User Requirements

U.S. EPA conducts assessments based upon guidelines for establishing the assessment of DQOs on a national scale as depicted in the QA Handbook (EPA, 2009) for NAAQS designations. AQMD will work with U.S. EPA if there are findings or implementations that impact AQMD Criteria Monitoring Program data based upon these assessments. The criteria for the U.S. EPA meet or exceed AQMD criteria required for forecasting, modeling and AQMP development. If the data quality criteria for the Criteria Pollutant Monitoring Program are not acceptable to the AQMD purpose, then a special monitoring project QAPP may be developed with appropriate DQOs and Measurement Quality Objectives (MQO) and under guidelines of the AQMD QMP.

SECTION 4. ASSESSMENT AND OVERSIGHT

4.1 Assessments and Response Actions

AQMD participates in air monitoring station and laboratory assessment or proficiency programs maintained by the AQMD QA Branch, U.S. EPA or CARB (Table 4.1). The AQMD is committed to maintaining all staffing, hardware, and facility certifications required for performance of the Criteria Pollutant Monitoring Program.

The QAM, or designee, performs or arranges performance of periodic technical systems audits of AQMD activities. These audits cover all aspects of AQMD's work, including safety, sample receipt, custody, calibration standards, conditioning, weighing, chemical/speciation analysis, shipping, data reduction, and reporting. These audits are scheduled at least annually. In addition, the accuracy of gaseous criteria pollutants determinations are measured at least once a year by QA Branch staff and once a year by CARB. Prior to each audit, a checklist is prepared, based on this QAPP, SOPs, and applicable guidance documents. The QAM summarizes each set of audit results in a memorandum to the AM Manager and/or the LSST Engineering Manager within 16 work days. These memoranda clearly specify areas in which corrective action is necessary; the memoranda may be in the form of a CAR issued and tracked by the QA Branch. When an audit or inspection identifies a serious issue requiring immediate action, the QAM informs the responsible manager or designee about the matter verbally and through electronic mail. This is followed by issuance of a CAR for documentation. Corrective action activity and administration follows the Corrective Action Process as described in the AQMD QMP (2009).

Table 4.1
Criteria Pollutant Monitoring Program Assessments

Audit Name	Description	Frequency	Agency
National Performance Evaluation Program	$PM_{2.5}$ collected on appropriate filters from FRM samplers and analyzed by independent, certified, EPA approved laboratory (Region 9 Laboratory).	$PM_{2.5}$: 8 Collocated Audits Annually	U.S EPA OAQPS/ Region 9
National Performance Evaluation Program-Pb	TSP collected on appropriate filters from FRM samplers and analyzed by independent, certified, EPA approved laboratory (Region 9 Laboratory).	2 Collocated Audits, 6 Filter strips collected by AQMD (4 from one site, 2 from another, alternating between three sites over two years) and filters sent to Region 9 Lab	U.S EPA OAQPS/ Region 9

Table 4.1
Criteria Pollutant Monitoring Program Assessments (cont.)

Audit Name	Description	Frequency	Agency
National Performance Audit Program – Pb Analysis	Technical evaluation of Pb Analysis from strips; Quarterly audit strip analysis	Quarterly	U.S. EPA Region 9; AQMD, QA Branch
National Performance Evaluation Program – $PM_{10-2.5}$		Annual: Minimum of 15% of the National Network	U.S EPA OAQPS/ Region 9
National Performance Audit Program for Criteria Gaseous Air Pollutants	Through the probe (TTP) Performance Evaluation of Continuous Criteria Pollutant Monitors	Annual; 20% of the network	CARB, Quality Assurance Branch
CARB Audit Program for Discrete Sample Monitors	Performance Evaluation (Flow) of FRM $PM_{2.5}$ PM_{10}, and TSP Field Samplers	Annual; 20% of the network	CARB, Quality Assurance Branch
Semi-Annual Performance Evaluation	Technical evaluation on continuous gaseous monitors and continuous PM monitors. In addition, safety, documentation, and other QA elements are checked.	25% of pollutant network per calendar quarter for gaseous; Semi-Annual; 5 months apart for continuous FEM PM	AQMD, QA Branch
Quarterly Pb Performance Evaluation	Technical evaluation on manual filter samplers (TSP)	Quarterly	AQMD, QA Branch
Annual Performance Evaluation	Technical evaluation on manual filter samplers ($PM_{2.5}$, PM_{10})	Annually, 25% of the sites quarterly, minimum 2 quarters apart	AQMD, QA Branch
Meteorological Evaluation	Technical evaluation on surface meteorology instruments	PAMs stations; Annually	AQMD, Planning and Rules
SRP Certification Program	Level 1 AQMD SRP compared to Level 0 SRP in accordance to EPA methods.	Annually	U.S. EPA Region 9; Richmond Laboratory
PM_{10} and $PM_{2.5}$ Weighing Room Evaluation	Conditioning Room Audit	Annually	AQMD, QA Branch
PM_{10} and $PM_{2.5}$ Weighing Room Evaluation	Gravimetric Mass Analysis performance evaluation and Conditioning Room Audit	Annually	CARB
U.S. EPA Systems Audit	All lab and field instrumentation, practices and procedures used to collect data for Federal Programs	Every 3 years	U.S. EPA Region 9

4.1.1 Systems Audits

The QA Branch is responsible for performing an annual systems audit of the monitoring network including an evaluation of data quality. Due to the size of the monitoring network, the systems audit is conducted as an on-going process. This systems audit includes inspections of one fourth of all monitoring sites each quarter, an audit of the Laboratory once per year, and periodic audits of the data validation systems from the initial source of the data through the archiving and reporting of the data. The various aspects of the annual systems audit may be conducted by QA staff or under contract with an independent consulting firm working under the oversight of the QAM and subject to AQMD Procurement Policy (Appendix D).

External systems audits are carried out by the U.S. EPA and CARB, at their discretion and using either agency staff or through independent consultants working under the oversight of the U.S. EPA or CARB. AQMD also contracts with independent consultants to conduct an external audit of selected systems in addition to the annual internal audit.

The U.S. EPA Region 9 performs a comprehensive Federal Programs Total Systems Audit (TSA) every three (3) to five (5) years and program groups perform TSA of specific monitoring programs from time to time. The CARB performs annual $PM_{2.5}$ FRM laboratory and field audits. CARB also performs comprehensive Total Systems Audits (TSA) as their budget allows. In addition, the QA Branch performs annual program specific TSAs.

4.1.2 Performance Evaluations

Performance evaluations (PE) are conducted for determining the accuracy and precision of monitoring and analytical instrumentation and procedures. All performance audits whether performed by AQMD QA staff, independent consultants or other entities are required to satisfy requirements under the appropriate QAPPs and SOPs. These audits may be internal and/or external.

Internal performance audits may be conducted by QA staff or through independent consultants under the oversight of the QAM and subject to AQMD Procurement Policy (Appendix D). Details as to how audits are conducted are documented in the Request for Proposal (RFP). Performance evaluations are conducted on an on-going basis due to the large number of stations and programs the AQMD administers. Performance audits include auditing one fourth of the monitoring instruments and samplers each quarter. Annual laboratory audit activity targets evaluation of the combined instrument-analyst-analysis-data submission system.

External performance evaluations are carried out by U.S. EPA and CARB, at their discretion and using either agency staff or through independent consultants working under the oversight of U.S. EPA or CARB. AQMD may also contract with independent consultants to conduct an external audit of selected systems in addition to the regular annual internal audit.

Consultants wishing to apply non-AQMD SOPs are required to demonstrate the equivalency of their SOPs to the comparable AQMD SOPs and to submit documentation confirming that these SOPs are referenced in the consultants' QAPP before a performance audit is conducted. Final approval for use of alternate SOPs rests with the QAM with the concurrence of the impacted operations manager.

4.1.3 Standard Operating Procedures for Corrective Action and Performance Evaluations

Critical to the quality system is the process of independent review and implementing corrective action. The independent review may include scheduled periodic review and assessments such as performance evaluations and technical system audits or just on a day to day basis through interactions with staff and observations. If there is a finding that could potentially affect data quality, systems are in place for review and documentation of the finding. If the review indicates that data quality has been affected, then the process of corrective action to address the data impacted and also the long term process are implemented. Table 4.2 identifies the documentation for methods used for implementing the corrective action processes, documentation formatting, and also for conducting performance evaluations by the QA Branch and/or approved qualified contractor.

Table 4.2
Standard Operational Procedures for Quality Assurance

OAG/ SOP #	OAG/ SOP Topic
QA0001	Operational Assistance Guide for Corrective Action Request Process
QA0002	Operational Assistance Guide for Quality Assurance Alert Process
QA0003	Operational Assistance Guide for OAG Formatting
SOP0100	Standard Operating Procedure for SOP Process
SOP00135	Standard Operating Procedure for Field Station Criteria Pollutant Ambient Air Instrument Performance Evaluation
SOP00160	Standard Operating Procedures for Performance Audit of Met One SASS Sampler
SOP00161	Standard Operating Procedures for Performance Audits of High-Volume Total Suspended Particulates (TSP) and PM10 Samplers
SOP00162	Standard Operating Procedures for Performance Audits of the Andersen Model RAAS2.5-300 PM2.5 Sampler and Rupprecht & Patashnick Partisol-FRM Model 2000 PM2.5 Sampler

4.2 Reports to Management

The QA Branch produces and distributes reports to management that summarizes audit activity (systems, performance), QA Alert status, recommendations for non-critical quality assurance improvements, and any quality improvements implemented. The Annual Quality Assurance Assessment Report is issued through the QAM's office documenting QA activities carried out during the year, results of systems audits, comparison to DQOs, quality improvements, QAA summary statistics, QMP/QAPP/SOP document control actions, training summary, and recommendations for future consideration to improve data quality. The annual report is made available to all staff in MAD who are informed when it is released, and two copies are distributed to the Deputy Executive Officer/Science & Technology Advancement (DEO/STA). This annual report is due 30 days after the close of the AQMD fiscal year.

Reports from external technical systems audits are distributed to impacted staff including the manager(s) of the appropriate branch. Meetings are held to discuss findings, if any, and resolutions are proposed and implemented to address the findings.

4.3 General, Reconciliation with DQOs & Program Improvement

The reconciliation with the DQOs occurs using the data quality assessment process.

Part of the process includes the review of the DQOs with the sampling design and network configuration to assure that the sampling design and data collection methods are consistent with the needs for the DQOs. This is initiated annually with the annual network plan development by the Atmospheric Measurements Branch. Since national requirements for monitoring may change as per U.S. EPA or local monitoring needs may develop, the annual network plan will reflect the sampling design to address those changes, this developing program improvement with obtaining data that is required and relevant to acquire. A more thorough analysis is conducted through the 5 year network assessment where statistical tools are conducted to conduct station correlations, review of station objectives and scales, etc. for which analyses conclusions may affect the DQOs.

The reconciliation process with DQOs also involves a review of the MQOs through the QA certification as outlined in Section 3.4 and from the certification process, if findings indicate that certain MQOs have not been met, then a review of the impacted measurements will be conducted and actions taken to improve the MQOs.

APPENDIX A. GLOSSARY OF TERMS

Acceptance Criteria — Specified limits placed on characteristics of an item, process, or service defined in requirements documents.

Bias — The difference between the sample value of the test results and an accepted reference value.

Blank — A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value. Sometimes used to adjust or correct routine analytical results. A sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Certification — The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Chain of Custody — An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Collocated Sampling — Samples collected at the same time but using two completely separate collection systems. 40 CFR Part 58 Appendix A defines collocated sampling.

Comparability — A measure of the confidence with which one data set or method can be compared to another.

Completeness — A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions.

Criteria Pollutant — The six pollutants (ground level O_3, particulate matter, CO, SO_2, NO_x, and Pb) regulated by the Clean Air Act.

Data Quality Indicators (DQI) — An aggregate of properties that provide an assessment of measurement systems assuring they are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring the results are of quality acceptable for the intended use. The principal DQIs for the criteria pollutant measurement program are precision, bias, representativeness, completeness, comparability, and sensitivity.

Document — Any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

National Ambient Air Quality Standards (NAAQS) — Established by the Clean Air Act to set two types of national air quality standards. ***Primary standards*** set limits to protect public health,

including the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Particulate Matter (PM) — means any material, except uncombined water, which exists in a finely divided form as a liquid or solid at standard conditions. PM_{10} means the particulate matter with an aerodynamic diameter smaller than or equal to 10 microns as measured by applicable state and federal reference test methods. $PM_{2.5}$ means the particulate matter with an aerodynamic diameter smaller than or equal to 2.5 microns as measured by applicable state and federal reference test methods.

Precision — A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions expressed generally in terms of the standard deviation. Other measures, such as Relative Percent Difference, are typically used when there are too few data points to determine a valid standard deviation.

Procedure — A specified way to perform an activity.

Process — A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Quality Assurance (QA) — An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Control (QC) — The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against “out of control” conditions and ensuring the results are of acceptable quality.

Quality Assurance Alert (QAA) — An AQMD report generated from staff to inform the QA Branch of an issue that affects or potentially affects data quality. The QA Branch may issue a corrective action report (see CAR) as a result to resolve the finding.

Quality Assurance Project Plan (QAPP) — A formal document describing in comprehensive detail the necessary quality assurance, QC, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. The QAPP components are divided into four classes: 1) Project Management, 2) Measurement/Data Acquisition, 3) Assessment/Oversight, and 4) Data Validation and Usability. Guidance and requirements on preparation of QAPPs can be found in EPA QA/R-5 and QA/G-5.

Representativeness — Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Standard Operating Procedure (SOP) — A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and that is officially approved as the method for performing certain routine or repetitive tasks.

Uncertainty — A parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurand.

APPENDIX B. REFERENCES

U.S. EPA, *Guidance for the Data Quality Objectives Process: EPA QA/G-4*, Report No. EPA/600/R-96/055, U.S. EPA, Washington, DC, 1994.

US, EPA (2*008) Quality Assurance Handbook for Air Pollution Measurement Systems Volume II, Ambient Air Methods*, Report No. EPA-454/B-08-003 U.S. EPA, Washington, DC.

U.S. EPA (1987) *On-Site Meteorological Program Guidance for Regulatory Modeling Applications.* Report No. EPA-450/4-87-013, Research Triangle Park, NC, 1987

US, EPA (1994*) Quality Assurance Handbook for Air Pollution Measurement Systems Volume* IV, Meteorological Measurements Report No. EPA-454/D-06-001 U.S. EPA, Washington, DC.

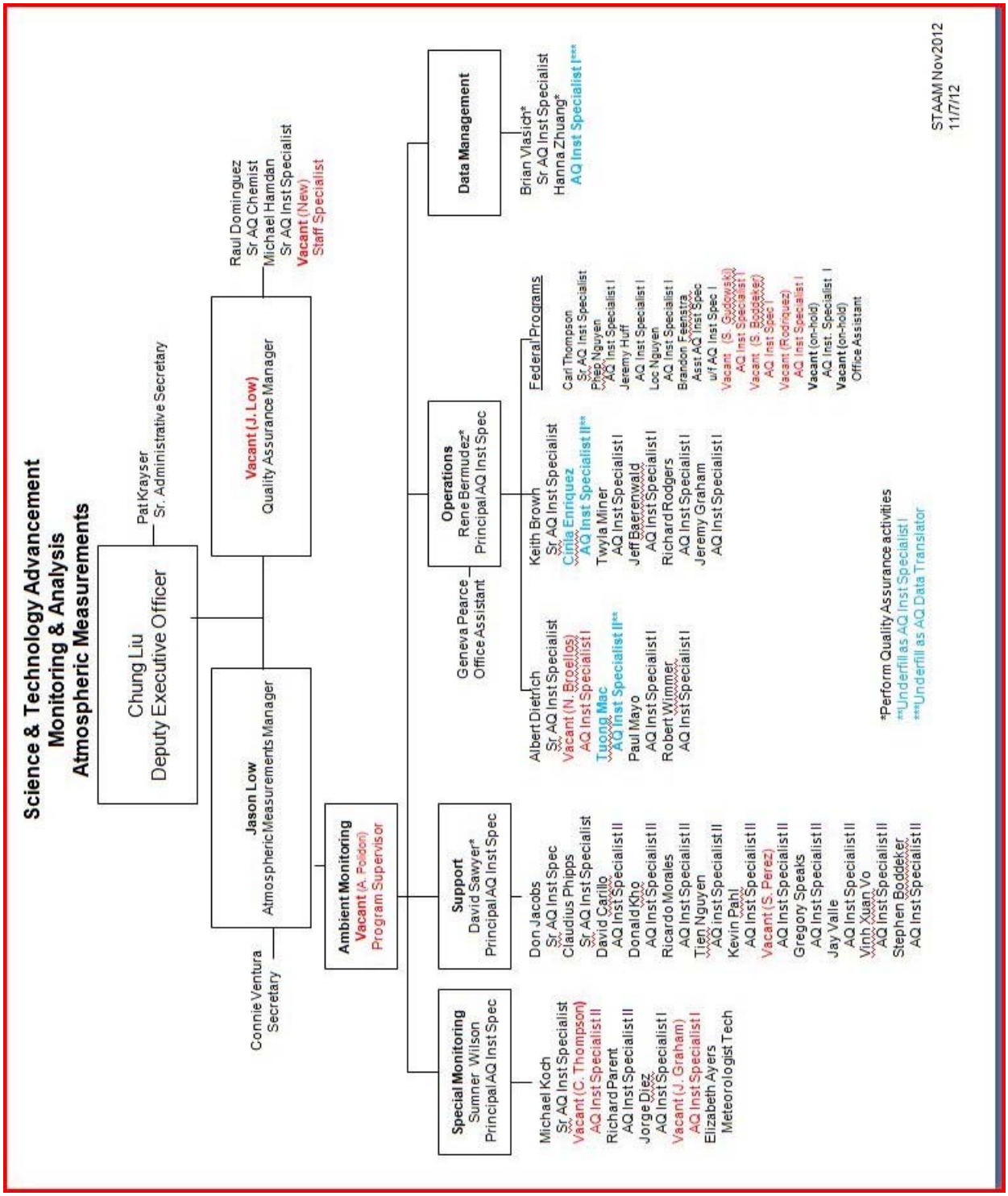
US, EPA (1997) *Traceability Protocol for Assay and Certification of Gaseous Calibration Standards,* EPA Publication No. EPA-600/R-97/121 U.S. EPA, Washington, DC.

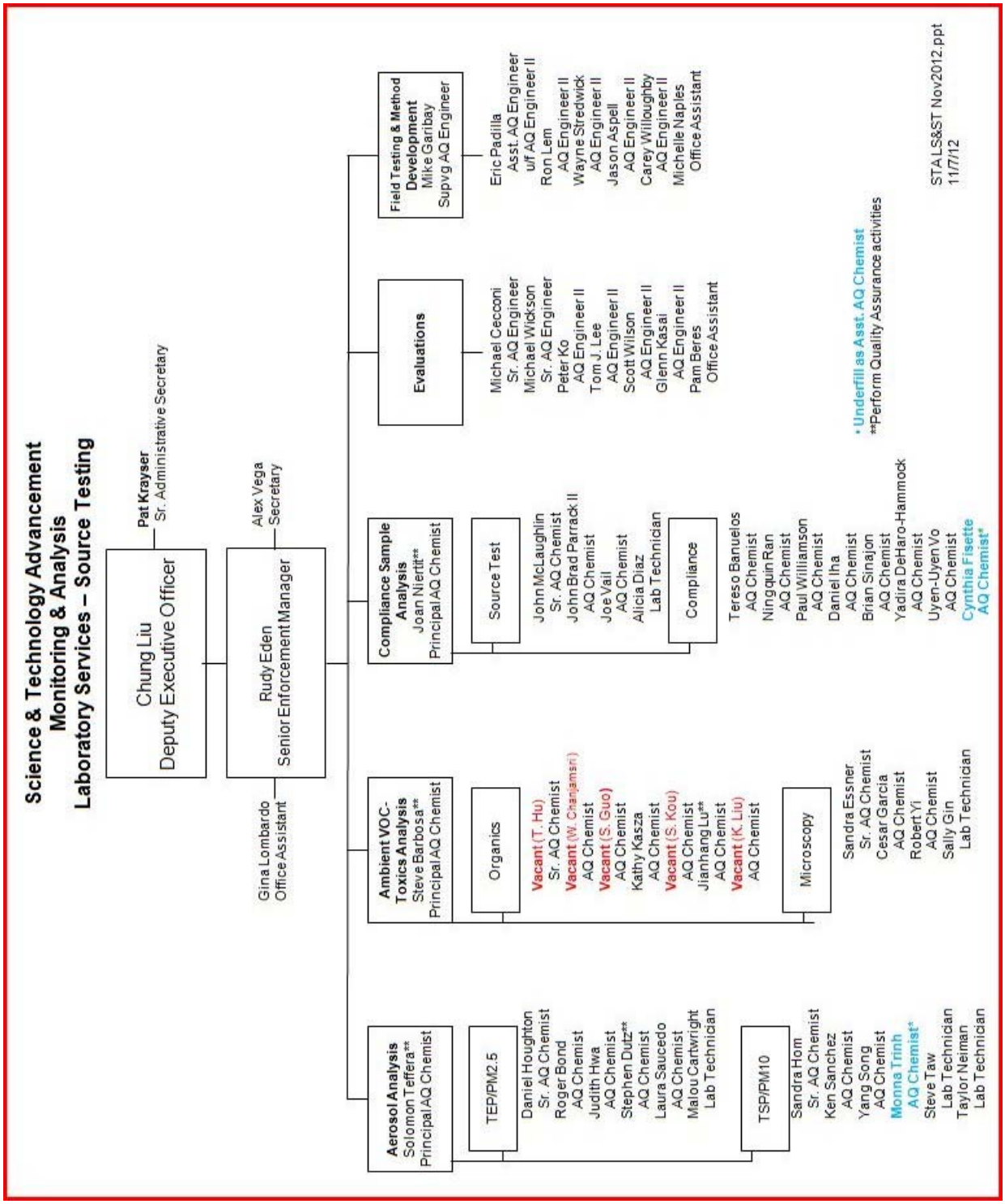
AQMD (2009) *South Coast Air Quality Management District Annual Air Quality Monitoring Network Plan* AQMD. Diamond Bar, CA

EPA Compendium Method IO-3.5A for the Determination of Metals in Ambient Particulate Matter using Inductively Coupled Plasma/Mass Spectrometry (ICP-MS).

40 CFR Parts 50/53/58). *Revised Requirements for Designation of Reference and Equivalent Methods for $PM_{2.5}$ and Ambient Air Quality Surveillance for Particulate; Final Rule,* Volume 62, Number 138, 1997.

APPENDIX C. ORGANIZATION CHARTS




Science & Technology Advancement
Monitoring & Analysis
Laboratory Services – Source Testing
Chung Liu
Deputy Executive Officer
Pat Krayser
Sr. Administrative Secretary
Rudy Eden
Senior Enforcement Manager
Alex Vega
Secretary
Gina Lombardo
Office Assistant
Aerosol Analysis
Solomon Teffera**
Principal AQ Chemist
TEP/PM2.5
Daniel Houghton
Sr. AQ Chemist
Roger Bond
AQ Chemist
Judith Hwa
AQ Chemist
Stephen Dutz**
AQ Chemist
Laura Saucedo
AQ Chemist
Malou Cartwright
Lab Technician
TSP/PM10
Sandra Hom
Sr. AQ Chemist
Ken Sanchez
AQ Chemist
Yang Song
AQ Chemist
Monna Trinh
AQ Chemist*
Steve Taw
Lab Technician
Taylor Neiman
Lab Technician
Ambient VOC-Toxics Analysis
Steve Barbosa**
Principal AQ Chemist
Organics
Vacant (T. Hu)
Sr. AQ Chemist
Vacant (W. Chanjamsri)
AQ Chemist
Vacant (S. Guo)
AQ Chemist
Kathy Kasza
AQ Chemist
Vacant (S. Kou)
AQ Chemist
Jianhang Lu**
AQ Chemist
Vacant (K. Liu)
AQ Chemist
Microscopy
Sandra Essner
Sr. AQ Chemist
Cesar Garcia
AQ Chemist
Robert Yi
AQ Chemist
Sally Gin
Lab Technician
Compliance Sample Analysis
Joan Nieratt**
Principal AQ Chemist
Source Test
John McLaughlin
Sr. AQ Chemist
John Brad Parrack II
AQ Chemist
Joe Vail
AQ Chemist
Alicia Diaz
Lab Technician
Compliance
Tereso Banuelos
AQ Chemist
Ningquin Ran
AQ Chemist
Paul Williamson
AQ Chemist
Daniel Iha
AQ Chemist
Brian Sinajon
AQ Chemist
Yadira DeHaro-Hammock
AQ Chemist
Uyen-Uyen Vo
AQ Chemist
Cynthia Fisette
AQ Chemist*
Evaluations
Michael Cecconi
Sr. AQ Engineer
Michael Wickson
Sr. AQ Engineer
Peter Ko
AQ Engineer II
Tom J. Lee
AQ Engineer II
Scott Wilson
AQ Engineer II
Glenn Kasai
AQ Engineer II
Pam Beres
Office Assistant
Field Testing & Method Development
Mike Garibay
Supvg AQ Engineer
Eric Padilla
Asst. AQ Engineer
u/f AQ Engineer II
Ron Lem
AQ Engineer II
Wayne Stredwick
AQ Engineer II
Jason Aspell
AQ Engineer II
Carey Willoughby
AQ Engineer II
Michelle Naples
Office Assistant
* Underfill as Asst. AQ Chemist
**Perform Quality Assurance activities
STA LS&ST Nov2012.ppt
11/7/12

APPENDIX D. AQMD DOCUMENTS

1. Procurement Policy and Procedure (revised: September 5, 2007)
2. Records Retention Policy and Procedure (revised: October 7, 2009)
3. Records Retention Schedule (revised: October, 7, 2009)
4. Guidelines for Implementing the California Public Records Act (adopted May 6, 2005)
5. Annual Air Quality Monitoring Network Plan (June 2010)
6. Public Records Request Form
7. Ambient Air Monitoring Quality Assurance Plan (1995)

APPENDIX E. STANDARD OPERATING PROCEDURES

SOP#	Topic
SOP00116	General AMS Station Operations
SOP00117	Calibrations Systems Operations
SOP00118	Data Collection Systems Operations
SOP00058	Ozone (O_3), API Teledyne
SOP00109	Ozone (O_3), Thermo
SOP00051	Carbon Monoxide (CO), Horiba 370
SOP00051A	Carbon Monoxide (CO), Horiba 360
SOP00055	Nitrogen Oxides (NO, NO_2, NO_x), API Teledyne 200E
SOP00055A	Nitrogen Oxides (NO, NO_2, NO_x), API Teledyne 200A
SOP00075	Nitrogen Oxides (NO, NO_2, NO_x), Thermo
SOP00057	Sulfur Dioxide (SO_2), Thermo
SOP00062	Continuous PM_{10}, TEOM
SOP00063	Continuous PM_{10}, BAM
SOP00072	Continuous $PM_{2.5}$, BAM
SOP00070	Meteorological Systems
SOP00083	Data Management of Continuous Instruments
SOP00112	PM_{10} Mass Analysis
SOP00081	PM_{10} FRM Sampler, SSI
SOP00113	Selection, Preparation & Extraction of Glass Fiber & Quartz Filters for Metal Analysis
SOP00061	$PM_{2.5}$ FRM Sampler, RAAS
SOP00082	TSP Sampler
SOP00112	PM_{10} Mass Analysis
SOP00104	$PM_{2.5}$ Gravimetric Laboratory (Mass Room) Operations
SOP00005	Metals Analysis by ICP-MS
SOP00121	Data Processing and Validation
SOP0100	Standard Operating Procedure for SOP Process
SOP00135	Standard Operating Procedure for Field Station Criteria Pollutant Ambient Air Instrument Performance Evaluation
SOP00124	Data QC using Data Management System (DMS)
SOP00160	Standard Operating Procedures for Performance Audit of Met One SASS Sampler

SOP#	Topic
SOP00161	Standard Operating Procedures for Performance Audits of High-Volume Total Suspended Particulates (TSP) and PM10 Samplers
SOP00162	Standard Operating Procedures for Performance Audits of the Andersen Model RAAS2.5-300 PM2.5 Sampler and Rupprecht & Patashnick Partisol-FRM Model 2000 PM2.5 Sampler
QA0001	Operational Assistance Guide for Corrective Action Request Process
QA0002	Operational Assistance Guide for Quality Assurance Alert Process
QA0003	Operational Assistance Guide for OAG Formatting

APPENDIX F

Criteria Pollutant Data Quality Indicators

F-1 Precision

Precision is generally defined as a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions expressed generally in terms of the standard deviation. Precision checks are performed by challenging an analyzer with a known concentration of gas from an on-site gas dilution calibrator or transfer standard or by challenging other equipment with a standard or reference material. The percent difference between the analyzer or other equipment and the input concentration is then calculated as:

$$\text{Percent Difference} = \frac{\text{Analyze Response} - \text{Input Concentration}}{\text{Input Concentration}} \times 100$$

Equation 1

For the purposes of this QAPP and the measurement of sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), and CO, the analyzer or other equipment must respond within the specifications listed in Tables 2.3 and 2.15. The AQMD performs analytic instrument precision checks daily for continuous methods and per batch for discrete sample analyses.

These precision percent differences for the performance evaluations, calculated using equation 1 of this appendix can be compared to the probability intervals for the respective site or at the primary quality assurance organization level. Ninety-five percent of the individual percent differences (all audit concentration levels) for the performance evaluations should be captured within the probability intervals for the primary quality assurance organization.

F-2 Precision Estimates

F-2.1 In addition to precision as a percent difference between an analyzer's response and a known standard value a precision estimate is determined. The precision estimate is defined as one-point quality control (QC) checks for SO_2, NO_2, O_3, and CO where the precision estimator is the coefficient of variation upper bound and is calculated according to equation 2:

Equation 2

$$CV = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^2 - \left(\sum_{i=1}^{n} d_i\right)^2}{n(n-1)}} \cdot \sqrt{\frac{n-1}{X^2_{0.1,n-1}}}$$

where, $X^2_{0.1,n-1}$ is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom.

F-2.2 Precision estimates from collocated samplers for SO_2, NO_2, O_3, and CO are estimated via duplicate measurements from collocated samplers of the same type at

quarterly, annually, and 3-year intervals. For each collocated data pair, the relative percent difference is determined according to equation 10:

Equation 10

$$d_i = \frac{X_i - Y_i}{(X_i + Y_i)/2} \cdot 100$$

where, X_i is the concentration from the primary sampler and Y_i is the concentration value from the audit sampler. The coefficient of variation upper bound is calculated using the equation 11:

Equation 11

$$CV = \sqrt{\frac{n \cdot \sum_{i=1}^{n} d_i^2 - \left(\sum_{i=1}^{n} d_i\right)^2}{2n(n-1)}} \cdot \sqrt{\frac{n-1}{X^2_{0.1,n-1}}}$$

where, n is the number of valid data pairs being aggregated, and $X^2_{0.1,\,n-1}$ is the 10th percentile of a chi-squared distribution with n-1 degrees of freedom. The factor of 2 in the denominator adjusts for the fact that each d_i is calculated from two values with error.

F-2.3 Precision estimates from collocated samplers for $PM_{2.5}$ and $PM_{10-2.5}$ are estimated as per section F-2.1.

F-3 Bias

Bias is a systematic error occurring in a measurement that is inherent in the method itself or caused by some artifact in the system, such as a temperature effect. Typically, this result is determined during an audit where a reference gas or standard is analyzed using an instrument calibrated as per normal procedure. The result obtained is compared to the accepted value for analyte in the reference gas or parameter in the standard.

$$B = \frac{I - D}{D} * 100\%$$

Where:

B = % bias
I = analyzer response when the gas or standard is introduced
D = accepted value for the analyte or parameter

Acceptable bias for each criteria pollutant instrument or analyzer is specific to the particular field or lab instrument under consideration. Performance evaluations indicate the level of bias in the system and are conducted annually at a minimum to each collection and analytical system.

F-4 Bias Estimate

In addition, for the criteria pollutants Pb, $PM_{10-2.5}$, SO_2, NO_2, O_3, and CO a bias estimate is calculated using one-point QC checks. The bias estimator is an upper bound on the mean absolute value of the percent differences as described in equation 3:

Equation 3

$$|AB| = AB + t_{0.95,n-1} \cdot \frac{AS}{\sqrt{n}}$$

where, *n* is the number of single point checks being aggregated; $t_{0.95,n-1}$ is the 95th quantile of a t-distribution with n-1 degrees of freedom; the quantity *AB* is the mean of the absolute values of the d_i's and is calculated using equation 4:

Equation 4

$$AB = \frac{1}{n} \cdot \sum_{i=1}^{n} |d_i|$$

and the quantity *AS* is the standard deviation of the absolute value of the d_i's and is calculated according to equation 5:

Equation 5

$$AS = \sqrt{\frac{n \cdot \sum_{i=1}^{n} |d_i|^2 - \left(\sum_{i=1}^{n} |d_i|\right)^2}{n(n-1)}}$$

F-4.1. The $PM_{2.5}$ bias estimate is calculated using paired routine and PEP monitor data. Calculate the percent difference, d_i, using equation 1, where "Analyze Response" is the measured concentration from the monitor and "Input Concentration" is the concentration from the PEP monitor. Estimates of bias are presented for various levels of aggregation, sometimes aggregating over time, sometimes aggregating over samplers, and sometimes aggregating over both time and samplers. These various levels of aggregation are achieved using the same basic statistic.

This statistic averages for individual biases determined according to equation 1 compared to the desired level of aggregation is determined using equation 12:

Equation 12

$$D = \frac{1}{n_j} \cdot \sum_{i=1}^{n_j} d_i$$

where, n_j is the number of pairs and d_1, d_2, * * *, d_{nj} are the biases for each of the pairs to be averaged.

F-4.2. Flow rate measurement bias estimates using one-point flow rate verifications are determined based upon the calculate percent difference in volume using equation 1 where "Analyze Response" is the value indicated by the sampler's volume measurement and "Input Concentration" is the actual volume indicated by the auditing flow meter. The absolute volume bias upper bound is then calculated using equation 3, where *n* is the number of flow rate audits being aggregated; $t_{0.95,n-1}$ is the 95th quantile of a t-distribution with n-1 degrees of freedom, the quantity *AB* is the mean of the absolute values of the d_i's and is calculated using equation 4 of this appendix , and the quantity *AS* in equation 3 of this appendix is the standard deviation of the absolute values if the d_i's and is calculated using equation 5.

F-5 Assigning a sign (positive/negative) to a bias estimate.

Since the bias statistic as calculated in equation 3 uses absolute values, it does not have a tendency (negative or positive bias) associated with it. A sign will be designated by rank ordering the percent differences of the QC check samples from a given site for a particular assessment interval. To perform this assessment, the 25th and 75th percentiles of the percent differences for each monitoring site are calculated. The absolute bias upper bound is flagged as positive if both percentiles are positive and negative if both percentiles are negative. The absolute bias upper bound is not be flagged when the 25th and 75th percentiles are of different signs.

F-6 Validation of Bias Using the one-point QC Checks.

Annual performance evaluations for SO_2, NO_2, O_3, and CO are used to verify the results obtained from one-point QC checks and to validate those results across a range of concentrations. To quantify this annually at the monitoring site level and at the 3-year primary quality assurance organization level, probability limits are calculated from the one-point QC checks according to equations 6 and 7:

Equation 6

$$\text{Upper Probability Limit} = m + 1.96 \cdot S$$

Equation 7

$$\text{Lower Probability Limit} = m - 1.96 \cdot S$$

where, *m* is the mean (equation 8):

Equation 8

$$m = \frac{1}{k} \cdot \sum_{i=1}^{k} d_i$$

where, *k* is the total number of one point QC checks for the interval being evaluated and *S* is the standard deviation of the percent differences (equation 9) as follows:

Equation 9

$$S = \sqrt{\frac{k \cdot \sum_{i=1}^{k} d_i^2 - \left(\sum_{i=1}^{k} d_i\right)^2}{k(k-1)}}$$

F-7 Confidence Intervals.

Confidence intervals are constructed for average bias estimates determined according to equation 12 using equations 13 and 14:

Equation 13

$$\text{Upper 90\% Confidence Interval} = D + t_{0.95,df} \cdot \frac{s}{\sqrt{n_j}}$$

Equation 14

$$\text{Lower 90\% Confidence Interval} = D - t_{0.95,df} \cdot \frac{s}{\sqrt{n_j}}$$

Where, $t_{0.95,df}$ is the 95th quantile of a t-distribution with degrees of freedom df = $n_j - 1$ and *s* is an estimate of the variability of the average bias calculated using equation 15:

Equation 15

$$s = \sqrt{\frac{\sum_{i=1}^{n_j} (d_i - D)^2}{n_j - 1}}$$

F-7 Flow Rate Audits

Flow rate audits are used to assess the results obtained from the one-point flow rate verifications and to provide an estimate of flow rate acceptability. For each flow rate audit, calculate the percent difference in volume using equation 1 where "Analyze Response" is the value indicated by the sampler's volume measurement and "Input Concentration" is the actual volume indicated by the auditing flow meter. To quantify this annually and at the 3-year primary quality assurance organization level, probability limits are calculated from the percent differences using equations 6 and 7 of where *m* is the mean described in equation 8 and *k* is the total number of one-point flow rate verifications for the year and *S* is the standard deviation of the percent differences as described in equation 9.

F-8 Completeness

Completeness, as defined for AQMD under this program, is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected for scheduled sampling. The minimum valid data recovery objective for the Criteria Pollutant Monitoring Program is greater than or equal to 75%. Typical good performance for is 90%. The calculation of percent valid is based on the number of valid measurements as compared to the number of possible measurements.

$$C = \frac{P - V}{P} * 100\%$$

Where:

C = % completeness
V = valid measurements
P = scheduled samples

F-9 Representativeness

Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Historical data and modeling studies are used to establish the representativeness of monitoring for criteria pollutants based upon an expectation that measurements will be similar throughout a geographical area. These sites do not necessarily indicate the highest concentrations in the area for a particular pollutant. To achieve the criteria pollutant data representativeness data quality objective, siting assessments are conducted periodically. The first representativeness assessment was performed in 1980 when AQMD along with CARB, conducted an extensive review of the air monitoring sites in the SCAB. NAMS or SLAMS designations, monitoring objectives, and spatial scales of representativeness were assigned to the criteria pollutants monitored by site. EPA Region 9 and CARB staff continue to periodically evaluate all sites with respect to compliance with applicable siting criteria, representativeness of collected data, and related requirements in the five year network assessment. In addition, AQMD conducts an annual evaluation including the continued representativeness of data collected using its air monitoring network, and submits a report on this evaluation to the U.S. EPA.

F-10 Comparability

Comparability is a measure of the confidence with which one data set or method can be compared to another. Siting, equipment specifications, and adopted monitoring protocols, and validation and reporting procedures are consistent at criteria pollutant monitoring sites throughout the network and follow U.S. EPA siting guidelines. As needed, revision of the AQMD Annual Air Quality Monitoring Network Plan or other documents is performed to evaluate appropriateness of station siting with regard to monitoring needs and data comparability. Also, annual review of documentation and training confirms practices are being followed and incorporates updates. Ensuring comparability also requires that data be reported in standard units. Data are reviewed by the data validation staff supervisors before uploading to AQS, and then reviewed by the QA Branch before being certified

Appendix G: Training Form

South Coast Air Quality Management District
Monitoring and Analysis Division
Training_Sheet_Template_1.2.doc

Version 1.2
June 2010

NAME OF TRAINEE: _____

POSITION TITLE: _____

CLASS/TRAINING TITLE: _____

SOP TITLE OR #: _____ **VERSION:** _____

DATE(S) OF INSTRUCTION: _____

PERSON/ORGANIZATION CONDUCTING INSTRUCTION:

_____

SHORT DESCRIPTION OF TRAINING/SKILLS ACQUIRED:

_____

_____

_____

_____

_____

TRAINEE SIGNATURE _____ **DATE** _____

INSTRUCTOR SIGNATURE _____ **DATE** _____

QA MANAGER SIGNATURE _____ **DATE** _____

COMMENTS:

_____

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