QUALITY ASSURANCE PROJECT PLAN FOR THE $PM_{2.5}$ AMBIENT AIR MONITORING PROGRAM

1 NOVEMBER 1998

FOREWORD

This document has been reviewed either by the EPA Regional QA Manger or QA Officer, or both, and has been found to provide enough detail about the Commonwealth of Virginia PM2.5 monitoring program to be considered acceptable. (See approval page.)

The following elements contain a description of the Quality Assurance Program Plan (QAPP) for the environmental data operations involved in monitoring for PM2.5 as part of the ambient air monitoring program for the Commonwealth of Virginia. EPA regulation mandates the preparation of this QAPP; therefore, EPA approval must be obtained before data collection begins.

The primary purpose of the QAPP is to provide an overview of the project, to describe the need for the measurement, and to characterize the QA/QC activities to be applied. Every aspect of the project is discussed in this report. In addition, the document identifies key personnel and provides an explanation of the tasks each will perform.

This QAPP was written in accordance with EPA regulations and guidance as described in the *EPA QA/G-5, EPA Requirements for Quality Assurance Project Plans, EPA QA/G-5, Guidance for Quality Assurance Project Plans,* and EPA's Model PM2.5 QAPP. All pertinent elements of the QAPP regulations and guidance are addressed herein.

ACKNOWLEDGMENTS

This QAPP is based closely on a model QAPP produced by the combined efforts of staff members from the EPA Office of Air Quality Planning and Standards, the EPA National Exposure Research Laboratory, and the EPA Regional Offices, as well as by representatives from state and local organizations. The PM2.5 QA Work Group developed and reviewed the material found in the model QAPP. The work of these many persons is appreciated.

ACRONYMS AND ABBREVIATIONS

AIRS	Aerometric Infonnation Retrieval System
ANSI	American National Standards Institute
AP11	Air Pollution Training Institute
ASTM	American Society for Testing and Materials
AWMA	Air and Waste Management Association
CAA	Clean Air Act
CPR	Code of Federal Regulations
CMD	Contracts Management Division
CMZ	community monitoring zone
CO	Contracting Officer
COC	chain of custody
DAS	data acquisition system
DCLS	Division of Consolidated Laboratory Services
DCO	Document Control Officer
DEQ	Department of Environmental Quality
DQA	data quality assessment
DQOs	data quality objectives
EDO	environmental data operation
EMAD	Emissions, Monitoring, and Analysis Division
EPA	Environmental Protection Agency
FAR	Federal Acquisition Regulations
FEM	Federal equivalent method
FIPS	Federal Information Processing Standards

FRM	Federal reference method
GIS	geographical information systems
GLP	good laboratory practice
IMPROVE	Interagency monitoring of protected visual environments
LAN	local area network
MPA	monitoring planning area
MQOs	measurement quality objectives
MSA	metropolitan statistical area
MSR	management system review
NAAQS	National Ambient Air Quality Standards
NAMS	national air monitoring station
NIST	National Institute of Standards and Technology
OAM	Office of Air Monitoring
OAQPS	Office of Air Quality Planning and Standards
OARM	Office of Administration and Resources Management
ORD	Office of Research and Development
PC	personal computer
POC	pollutant occurrence code
PD	percent difference
PE	performance evaluation
PM2.5	particulate matter $\leq$ 2.5 microns
PTFE	polytetrafluoroethylene
Qa	sampler flow rate at ambient (actual) conditions of temperature and pressure.
QA/QC	quality assurance/quality control
QA	quality assurance
QAAR	quality assurance annual report

QAD	quality assurance division director
QAM	quality assurance manager
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
QMP	quality management plan
SIPS	State Implementation Plans
SLAMS	state and local monitoring stations
SOP	standard operating procedure
SOW	statement or scope of work
SPMS	special purpose monitoring stations
SYSOP	system operator
T_a	temperature, ambient or actual
TSA	technical system audit
TSP	total suspended particulate
VA	Virgjnia
V_a	air volume, at ambient or actual conditions
VOC	volatile organic compound
VSLA	Virginia State Library and Archives
WAM	Work Assignment Manager

2.0 TABLE OF CONTENTS

3.0 DISTRIBUTION

A hard copy of this document has been distributed to the persons whose names are listed below. The document also will be available in electronic format on diskette. Each regional office and each air satellite office will receive one copy which will be available for staff use and public inspection.

John M. Daniel, Jr.	Director of Operations	DEQ – Air
James E. Sydnor	Division Director	DEQ - Air
Wesley M. Motley	Office Director	DEQ - Air
W. Marshall Ervine	Environmental Engineer	Air Monitoring
Thomas F. Jennings	Environmental Engineer	Air Monitoring
Sidney Keith	Environmental Engineer	Air Monitoring
Carolyn Stevens	Environmental Engineer	Air Monitoring
Rudley Young	Chemist	Air Monitoring
Richard Morris	Technician	Air Monitoring
Da Xin Ren	Field Operations	Piedmont Reg. Office
Christopher Bednar	Field Operations	Piedmont Reg. Office
Brady Collins	Field Operations	Tidewater Reg. Office
Jerry Ford	Field Operations	West Cent. Reg. Off.
Edwin Shaw, Jr.	Project Officer	Va. Consolo Labs
Raymond McIntyre	Air Monitoring Supervisor	Fairfax County H. D.
Charles Dickson	Field Operations	Southwest Reg. Off.
Christi Gordon	Environmental Specialist	National Park Service
Cindy Huber	Air Network Specialist	National Forest Ser.
Craig Lowrance	**Field Operations**	**Northern Reg. Office**
Victor Guide	Project Officer	EPA Reg. Office
Theodore Erdman	Project Officer	EPA Reg. Office

4.0 PROJECT/TASK ORGANIZATION

4. 1 ROLES AND RESPONSIBILITIES

Federal, state, tribal, and local agencies all have important roles in developing and implementing satisfactory air monitoring programs. As part of the planning effort, EPA is responsible for developing National Ambient Air Quality Standards (NAAQS), that define the quality of the data necessary to make comparisons to the NAAQS, and identify a minimum set of QC samples from which to judge data quality. The state and local organizations are charged with taking this information and developing and implementing a system that will meet the data quality requirements. When the system is in place and and is producing reliable data, the EP A and the State and local organizations are responsible for assessing the quality of the data and taking corrective action when appropriate. The responsibilities of each organization follow.

4.1.1 OFFICE OF AIR QUALITY PLANNING AND STANDARDS (OAQPS)

OAQPS is the organization charged under the authority of the Clean Air Act (CAA) to protect and enhance the quality of the nation's air resources. OAQPS sets standards for pollutants considered harmful to public health or welfare and, in cooperation with EPA's Regional Offices and the States, enforces compliance with the standards through state implementation plans (SIPs) and regulations controlling emissions from stationary sources. The OAQPS evaluates the need to regulate potential air pollutants and develops national standards; works with State and local agencies to develop plans for meeting these standards; monitors national air quality trends and maintains a database of information on air pollution and controls; provides technical guidance and training on air pollution control strategies; and monitors compliance with air pollution standards.

Within the OAQPS Emissions Monitoring and Analysis Division, the Monitoring and Quality Assurance Group (MQAG) oversees the ambient air quality monitoring network. MQAG is responsible for the following:

- ensuring that the methods and procedures used in making air pollution measurements are adequate to meet the programs objectives, and that the resulting data are of satisfactory quality
- operating the national performance audit program (NPAP) and the FRM performance evaluation
- evaluating the performance, through technical systems audits and management systems reviews, of organizations making air pollution measurements of importance to the regulatory process
- implementing satisfactory quality assurance programs over EPA's ambient air quality monitoring network
- ensuring that national regional laboratories are available to support chemical speciation and QA programs
- ensuring that guidance pertaining to the quality assurance aspects of the ambient air program are written and revised as necessary
- rendering technical assistance to the EP A Regional Offices and air pollution monitoring community

4.1.2 EPA REGION III OFFICE

Regional Offices have been developed to address environmental issues related to the states within their jurisdiction and to administer and oversee regulatory and congressionally mandated programs. The major quality assurance charge of EPA's Region III Office, with regard to the Ambient Air Quality Program, is coordinating quality assurance matters at the Regional level with the state and local agencies. This is accomplished by the appointing EPA Regional Project Officers who manage the technical aspects of the program, including the following:

- reviewing QAPPs by Regional QA Officers who are delegated the authority by the Regional Administrator to review and approve QAPPs for the Agency.
- supporting the FRM Performance Evaluation Program
- evaluating quality system performance, through technical systems audits and network reviews whose frequency is addressed in the Code of Federal Regulation
- acting as a liaison by making available the technical and quality assurance information developed by EPA Headquarters and the Region to the State and local agencies, and making EPA Headquarters aware of the unmet quality assurance needs of the state and local agencies

The Virginia DEQ will direct all technical and QA questions to Region III.

4.1.3 VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

40 CFR Part 58 defines a State Agency as "the air pollution control agency primarily responsible for the development and implementation of a plan (SIP) under the Act (CAA)". Section 302 of the CAA provides a more detailed description of the air pollution control agency.

40 CFR Part 58 defines the Local Agency as "any local government agency, other than the state agency, which is charged with the responsibility for carrying out a portion of the plan (SIP)."

The major responsibility of state and local agencies is to implement a satisfactory monitoring program, which will include putting into action a meticulous quality assurance program. State and local agencies will perform quality assurance programs in all phases of the environmental data operation (EDO), including the field, their own laboratories, and in any consulting and contractor laboratories they may use to obtain data. An EDO is defined as work performed to obtain, use, or report information pertaining to environmental processes or conditions.

Figure 4.1 represents the organizational structure of the areas of the DEQ that carry out the activities of the PM2.5 ambient air quality monitoring program.

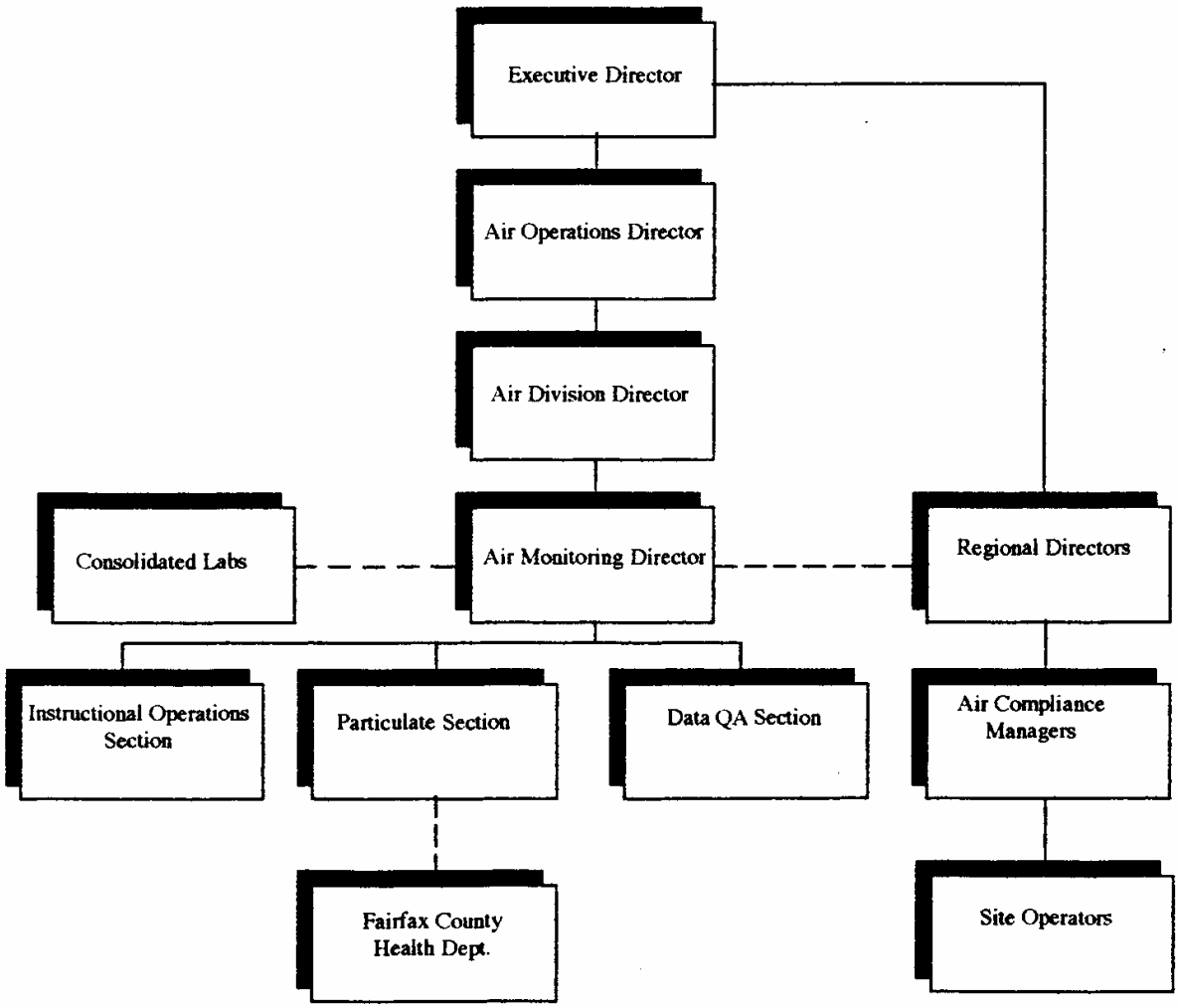


FIG. 4.1—ORGANIZATIONAL STRUCTURE OF THE $PM_{2.5}$ AMBIENT AIR MONITORING PROJECT

Key: dashed line (— —) indicates unofficial reporting structurs
solid line (———) indicates official leporting structurs

4.3.2 THE VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

The DEQ will implement the PM2.5 air monitoring program. The major responsibilities are divided between the Office of Air Monitoring and the staff from the various DEQ regional offices. The Office of Air Monitoring will perform major program tasks, including sample procurement, major sampler repair, site installations, supply, data handling, and training, as well as various quality assurance functions. Regional staff will operate the samplers and perform various field QA and maintenance functions. The Fairfax County Health Department also will operate PM2.5 samplers as part of the DEQ's air monitoring network.

The Virginia Division of Consolidated Laboratory Services (DCLS) is the contract laboratory for all analytical services and QA functions pertaining to laboratory operations. The lab is responsible for filter QA, weighing, and data calculation.

Various persons have been assigned direct responsibility and accountability for program operations and quality assurance. The following listing describes the program's organizational structure for data collection and QA/QC activities. This listing is not inclusive because the PM2.5 program is still being developed; therefore, certain personnel have not been identified, and certain duties have not been assigned. Information on additional personnel will be included in QAPP revisions.

MANAGEMENT

Name:	John M. Daniel, Jr.
Title:	Environmental Director of Operations
QA Responsibilities:	Senior Air Manager; program direction
Name:	James E. Sydnor
Title:	Environmental Quality Division Director
QA Responsibilities:	Program and QA review

OFFICE OF AIR MONITORING

Name:	Wesley M. Motley
Title:	Environmental Technical Services Administrator
QA Responsibilities:	Director, Office of Air Monitoring; program review
Name:	Thomas F. Jennings
Title:	Environmental Engineer Senior
QA Responsibilities:	Particulate Section Leader-oversight of PM-2.5 monitoring program; Laboratory liaison
Name:	Vacant
Title:	Environmental Engineer, Consultant
QA Responsibilities:	Data Quality Assessment Section Leader-directs data QA and reporting activities; PM2.5 QA manager
Name:	W. Marshall Ervine
Title:	Environmental Engineer. Consultant
QA Responsibilities:	Instrument Operations Section Leader-major equipment repair; 103 Grant manager
Name:	Rudley A. Young
Title:	Analytical Chemist
QA Responsibilities:	Sampler Installation; filter handling; maintenance; calibrations

Name: Richard S. Morris
Title: Electronic Technician
QA Responsibilities: Sampler installation; supply; maintenance; training; calibration

Name: Sidney Keith
Title: Environmental Engineer Senior
QA Responsibilities: Performance audits; data QA

Name: Carolyn Stevens
Title: Environmental Engineer Senior
QA Responsibilities: Data QA review

Name: Crystal Sorensen
Title: Statistical Analyst
QA Responsibilities: Data QA; data submittal

Name: Michael A. Bellanca
Title: Environmental Engineer Senior
QA Responsibilities: Sampler repair

Name: Marie Hayes
Title: Electronic Technician Senior
QA Responsibilities: Sampler repair

FAIRFAX COUNTY

Name: Raymond McIntyre
Title: Air Monitoring Supervisor
QA Responsibilities: Sampler Operations; field QA

REGIONAL OFFICES

Name: Crystal Bazyk
Title: Environmental Manager-Field
QA Responsibilities: Regional sampler operations oversight

Name:	Charles B. Dickson
Title:	Enforcement/Compliance Specialist Senior
QA Responsibilities:	Sampler operations, field QA
Name:	Robert W. Saunders
Title:	Environmental Manager-Field
QA Responsibilities:	Regional sampler operation oversight
Name:	Jerry R. Ford
Title:	Enforcement/Compliance Specialist Senior
QA Responsibilities:	Sampler operations; field QA
Name:	Charles L. Clouse
Title:	Environmental Manager-Field
QA Responsibilities:	Regional sampler operations oversight
Name:	Charles B. King
Title:	Environmental Manager-Field
QA Responsibilities:	Regional Sampler operations oversight
Name:	Da Xin Ren
Title:	Environmental Engineer
QA Responsibilities:	Sampler operations, field QA
Name:	Christopher Bednar
Title:	Enforcement Compliance Specialist
QA Responsibilities:	Sampler operations; field QA
Name:	Richard C. Craft
Title:	Environmental Manager-Field
QA Responsibilities:	Regional sampler operations oversight
Name:	Brady Collins
Title:	Environmental Specialist-Field
QA Responsibilities:	Sampler operations; field QA

(REGIONAL OFFICE, CONTINUED)

Name: Alice Nelson
Title: Environmental Manager-Field
QA Responsibilities: Regional sampler operations oversight

Name: Craig Lowrance
Title: Environmental Specialist Senior-Field
QA Responsibilities: Regional Sampler operations oversight

DIVISION OF CONSOLIDATED LABORATORY SERVICES

Name: Edward E. LeFebvre
Title: Assistant Director
QA Responsibilities: Analytical program direction

Name: Edwin Shaw, Jr.
Title: Group Manager, Metals and Radiochemistry
QA Responsibilities: PM-2.5 analytical program oversight

Name: Beverley Lockwood
Title: Group Manager, Laboratory Support Services
QA Responsibilities: Quality Assurance and Safety Program.

4.3.3 COMMUNICATIONS

Formal lines for communicating information about the status of the quality assurance program and its needs are essential to ensure that an effective quality assurance program is put into action within the DEQ. Accordingly, the DEQ and DCLS management routinely will be provided with assessments of the quality assurance program status, its problems, if any, and its needs.

Communication amongst the project manager, the quality assurance officer, appropriate EPA staff, and DEQ and DCLS management is a key element in developing and

implementing the DEQ's quality assurance program. The following organizational chart demonstrates the official and the unofficial lines of communication for this project.

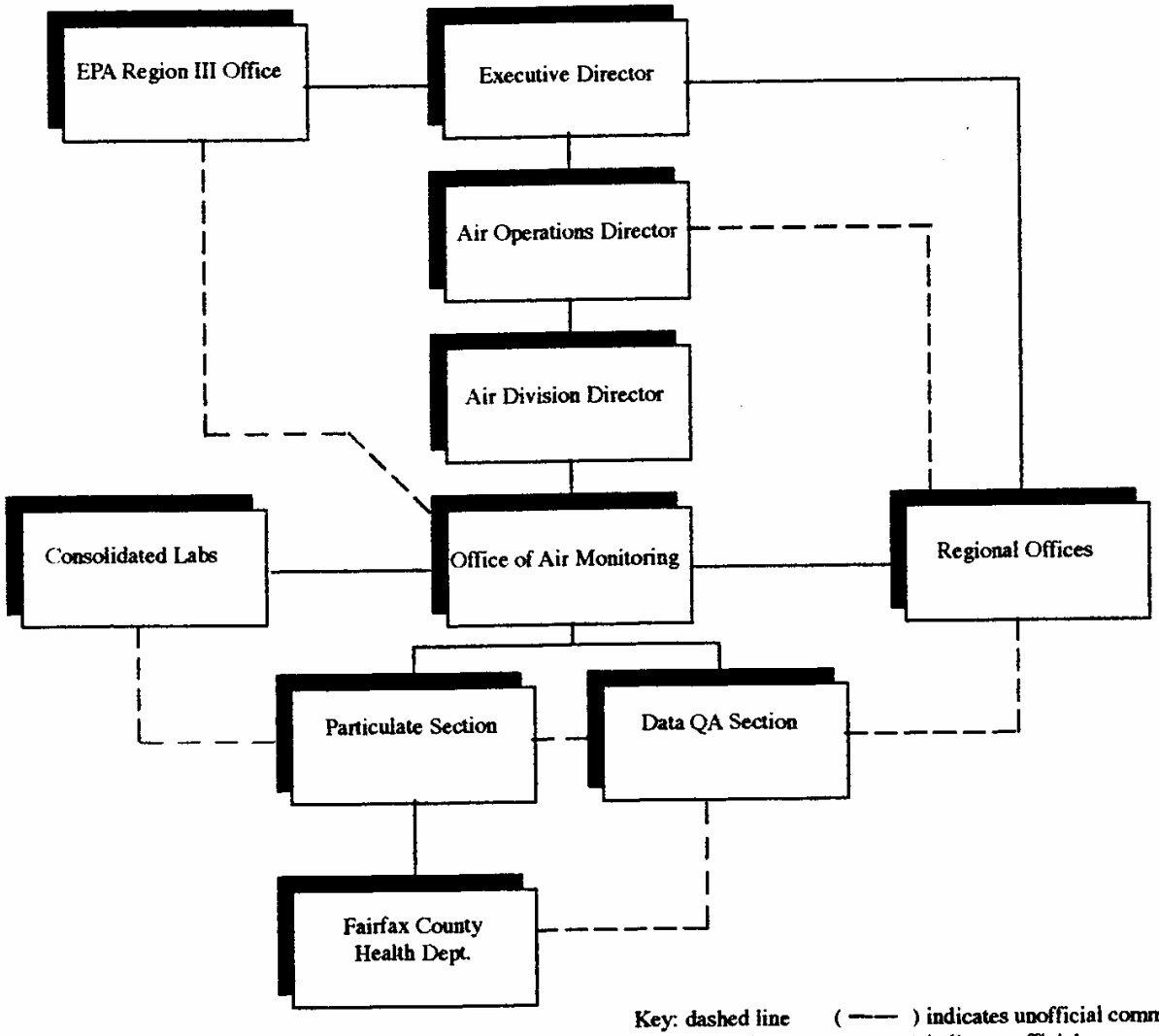


FIG. 4.2—LINES OF COMMUNICATION

5.0 PROBLEM DEFINITION/BACKGROUND

5.1 PROBLEM STATEMENT AND BACKGROUND

Between the years 1900 and 1970, the emission of six principal ambient-air pollutants increased significantly. The principal pollutants, also called *criteria pollutants,* are particulate matter (PM10, PM2.5); sulfur dioxide; carbon monoxide; nitrogen dioxide; ozone; and lead. In 1970, the Clean Air Act (CAA) was signed into law. The CAA and its amendments provide the framework on which all pertinent U.S. organizations build their air-quality-protection programs. This framework provides the policy guidelines for state and local organizations to monitor the criteria pollutants through the Air Quality Monitoring Program.

The criteria pollutant defined as "particulate matter" is used to describe a broad class of substances that exist as liquid or solid particles over a wide range of sizes. As part of the ambient air quality monitoring program, EPA through state and local agencies, will measure two particle size fractions-those less than or equal to 10 micrometers (PM10), and those less than or equal to 2.5 micrometers (PM2.5). This QAPP focuses on the QA activities associated with monitoring PM2.5.

The background and rationale for implementing the PM2.5 ambient air monitoring network can be found in the Federal Register. Some of the findings from the Federal Register are listed below.

- The characteristics, sources, and potential adverse effects on health between larger or "coarse" particles (from 2.5 to 10 micrometers in diameter) and smaller or "fine" particles (smaller than 2.5 micrometers in diameter) differ.

- Coarse particles come from sources such as wind-blown dust from the desert or from agricultural fields, and dust kicked up on unpaved roads from vehicle traffic.

- Generally, fine particles are emitted from industrial and residential combustion, and from vehicle exhaust. Fine particles also are formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and also from volatile organic compounds that are emitted from combustion activities and then become particles as a result of chemical transformations in the air.

- Coarse particles can deposit in the respiratory system and thus contribute to such detrimental effects on health as aggravation of asthma. EPA's "staff paper" concludes that fine particles, which also deposit deeply in the lungs, are more likely than are coarse particles to impair health. A number of recently published community epidemiological studies cite fine particles as being a contributing factor in increased hospital admissions, as well as in premature mortality due to respiratory disease.

- These recent community studies find that adverse public-health effects are associated with exposure to particles at levels well below the current PM standards for both short-term (e.g., less than 1 day to up to 5 days), and long-term (generally one year to several years) periods.

Consequences of exposure to coarse particles include increased hospital admissions and emergency room visits, as well as premature death, primarily among elderly persons and persons with cardiopulmonary disease. Also, when children with asthma and adults with cardiopulmonary disease and chronic obstructive pulmonary disease are exposed to these particles, they may experience increased respiratory distress, decreased lung function (particularly in children and persons with asthma); and alterations in lung tissue and structure and in respiratory tract defense mechanisms.

Air quality samples are generally collected for one or more of the following purposes:

- To judge compliance with and/or progress made towards meeting the National ambient air quality standards.
- To observe pollution trends throughout the region, including non-urban areas.
- To provide a data base for research and evaluation of effects

With the end use of the air quality samples as a prime consideration, various networks can be designed to meet one of six basic monitoring objectives listed below:

- To determine the highest concentrations to occur in the area covered by the network
- To determine representative concentrations in areas of high population density
- To determine the impact on ambient pollution levels of significant source or source categories
- To determine general background concentration levels
- To determine the extent of Regional pollutant transport among populated areas, and in support of secondary standards
- To determine the impact on health in more rural and remote areas

The monitoring network consists of four major categories of monitoring stations that measure the criteria pollutants. These stations are described as follows.

The **SLAMS** consist of a network of ~3,500 monitoring stations whose size and distribution is largely determined by the needs of state and local air pollution control agencies to meet their respective State implementation plan (SIP) requirements.

The **NAMS** (~1,080 stations) are a subset of the SLAMS network, with emphasis being given to urban and multi-source areas. In effect, they are key sites under SLAMS, with emphasis on areas of maximum concentrations and high population density .

The **PAMS** network is required to measure ozone precursors in each ozone non-attainment area that is designated "serious," "severe," or "extreme." The required networks will have from two to five sites, depending on the population of the area. There is a phase-in period of one site per year, starting in 1994. The ultimate PAMS network could exceed 90 sites at the end of the 5-year phase-in period.

Special Purpose Monitoring Stations provide for special studies needed by the state and local agencies to support their State implementation plans (SIPs) and other air program activities. The SPMS are not permanently established and, thus, can be adjusted easily to accommodate changing needs and priorities. The SPMS are used to supplement the fixed monitoring network as circumstances require and resources permit. If the data from SPMS are used for SIP purposes, they must meet all QA and methodology requirements for SLAMS monitoring.

This QAPP focuses only on the QA activities of the SLAMS and NAMS network, and the objectives of this network, which include any sampler used for comparison to the NAAQS.

Throughout this document, the term "decision maker" will be used. Decision makers are the ultimate users of ambient air data and therefore may be responsible for such activities as setting and making comparisons to the NAAQS, and evaluating trends. Because there is more than one objective for this data, and more than one decision maker, the quality of the data will be based on the highest-priority objective-the to determine violations of the NAAQS. This QAPP will describe how the Virginia DEQ PM2.5 Ambient Air Quality Monitoring Program proposes to control and evaluate data quality to meet the NAAQS data quality objectives.

6.0 Project/Task Description

6.1 Description of Work To Be Performed

In general, the measurement goal of the PM2.5 ambient air monitoring program is to estimate the concentration of particulate less than or equal to 2.5 micrometers that have been collected on a polytetrafluoroethylene (PTFE) filter. For the SLAMS/NAMS network, the primary goal is to compare the PM2.5 concentrations to the annual and 24-hour NAAQS. The national primary and secondary ambient air quality standards for PM2.5 are 15.0 ug/m^3 annual arithmetic mean concentration and 65 ug/m^3 24-hour average concentration measured in ambient air. A description of the NAAQS and its calculation can be found in the 40 CFR Part 50, Appendix N.

6.2 Field Activities

The performance requirements of the air samplers has been specified by EPA and can be found in 40 CFR Part 50, Appendix L. These design and performance specifications include filter design, composition, and performance characteristics; and sampler performance criteria including sample flow rate, flow rate tolerances, leakage tolerances, and designated temperature and barometric pressure measurements. The design and performance specifications must be met before a specific sampler can receive official EPA designation as a FRM or FEM type sampler. Virginia will acquire and use only EPA approved samplers; therefore Virginia assumes that these sampling instruments are adequate for the sampling of PM2.5.

6.2.1 Field Measurements

Virginia intends to use sequential samplers for PM2.5 measurement. These samplers are

microprocessor controlled, and the microprocessor is capable of monitoring several parameters that can be critical to the collection of valid samples. Table 6-1 presents the measurements which are made by the air sampler and stored in the instrument for downloading by field operators.

Table 6-1 Field Measurements

Information to be Provided	**Units**
Flow rate, 30-second maximum interval	L/min
Flow rate, average for sample period	L/min
Flow rate, CV, for sample period	%
Flow rate, S-min average out of spec.	
Sample volume, total	M^3
Temperature, ambient, 30-second interval	^oC
Temperature, ambient, min, max, average	^oC
Temperature, filter, 30-second interval	^oC
Temperature, filter, differential, out of spec	
Temperature, filter, max differential from ambient	^oC, date and time
Barometric pressure, ambient, 30-second interval	mm/Hg
Barometric pressure, ambient, min, max, average	mm/Hg
Date and time	Yr/mo/day/hr/min
Sample start/stop time	Yr/mo/day/hr/min
Sample period start time	Yr/mo/day/hr/min
Elapsed sample time	Hr/min
Elapsed sample time out of spec.	
Power interruptions	Hr/min
User entered info - site, sampler ID	

In addition to these measurement, additional field measurements will be conducted, and a description can be found in *Guidance Document* 2.12.

6.3 Laboratory Activities

Laboratory activities for the *PM2.5* program include preparing the filters for the field operator, which includes three general phases:

Presampling Weighing

- Receiving filters from EPA
- Checking filter integrity
- Conditioning filters
- Weighing filters
- Storing prior to field use
- Packaging filters for field use
- Associated *QA/QC* activities
- Maintaining microbalance at specified conditions
- Equipment maintenance and calibrations

Shipping and Receiving

- Receiving filters from the field and log in
- Storing filters
- Associated QA/QC activities

Postsampling Weighing

- Checking filter integrity
- Stabilizing and weighing filters
- Review of data downloads from field data loggers
- Data transfer to Air Monitoring Office for transfer to AIRS
- Preparing filters for storing/archiving
- Associated QA/QC activities

Table 6-2 provides performance specifications for the laboratory environment and equipment.

Table 6-2 Laboratory Performance Specifications

Equipment	Acceptance Criteria
Microbalance	Resolution of 1 ug, repeatability of 1 ug
Microbalance environment	Climate-controlled. RH 30-40% +/- 5% for 24 hours. Mean temperature 20-23 ℃., +/- 2 ℃. for 24 hours.
Mass reference standards	Standards bracket weight of filter, individual standards tolerance less than 25 ug.

6.3.1 Laboratory Measurements

Table 6-3 provides a listing of parameters that will be required to be recorded for pre and postsampling weighing laboratory activities.

Table 6-3 Laboratory Measurements

Filter Conditioning

- Start date
- Start time
- Filter number
- Relative humidity
- Temperature
- End date
- End time

Presampling Filter Weighing

- Date
- Filter lot number
- Balance number
- Analyst
- QA officer
- Relative humidity
- Temperature
- Filter number
- QC sampler number
- Presampling mass
- Transport container ID
- Sampler ID
- Free form notes

Postsampling Filter Weighing

- Date
- Balance Number
- Analyst
- QA officer
- Relative humidity
- Temperature
- Filter number
- QC sample number
- Postsampling mass
- Net mass
- Weighing flag
- Free form notes

6.4 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. Table 6-4 provides information on the type of assessment and its frequency.

Table 6-4 Assessment Schedule

Assessment Tvpe	Assessment Agency	Frequency
Technical Systems Audit	EPA Regional Office	1 every 3 years
	DEQ - Air Monitoring Office	1 every 3 years
Network Review	EPA Regional Office	Every year
	DEQ Air Monitoring Office and Regional Offices	App D 1/year App E 1/year
FRM Performance Evaluation sites/year/4timesperyear	EPA	25% of
Data Quality Assessment	DEQ Air Monitoring Office	Every year

6.5 Schedule of Activities

Table 6-5 contains a listing of the critical activities required to plan, implement, and assess the PM2.5 program.

Table 6-5 Schedule of Critical PM2.5 Activities

Activitv	Date Due	Comments
Network development	January 15, 1998	Preliminary site listing and samplers required
Sampler order	March 1998	Samplers ordered from National Contract
Laboratory design	May 1998	Determination of laboratory requirements
Personnel requirements	July 1, 1998	Assessment of needs
Network design completion	July 1,1998	Final
Sampler arrival starts	July 1998	FRMs
Sampler testing and installation	July - December 1998	
QAPP development	October - November 1998	
Field orientation	September - October 1998	Sampler operations training
Laboratory procurement	November 1998	Environmental control equipment
QAPP submittal	November 1998	
QAPP approval	December 1998	EPA approval of QAPP
1st year sampler installation	December 31, 1998	21 sites
Routine sampling	January 1,1999	Network operational

6.6 Project Records

The DEQ has a records retention schedule that is in conformance with the records retention regulations for the Commonwealth of Virginia and administered by the Virginia State Library and Archives. Additional information on the records retention program is provided in Section 9.

7.0 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

7.1 DATA QUALITY OBJECTIYES (DQOs)

Derived from the DQO Process, DQOs are qualitative and quantitative statements that clarify the monitoring objectives, define the appropriate type of data; and specify the tolerable levels of decision errors for the monitoring program.[1] By applying the DQO Process to the development of a quality system for PM2.5, the EPA, as well as states and localities, guard against committing resources to data collection efforts that do not support a defensible decision. During the months from April to July of 1997 the DQO Process was implemented for the PM2.5. The DQOs were based on the data requirements of the decision maker(s). Regarding the quality of the PM2.5 measurement system, the objective is to control precision and bias in order to reduce

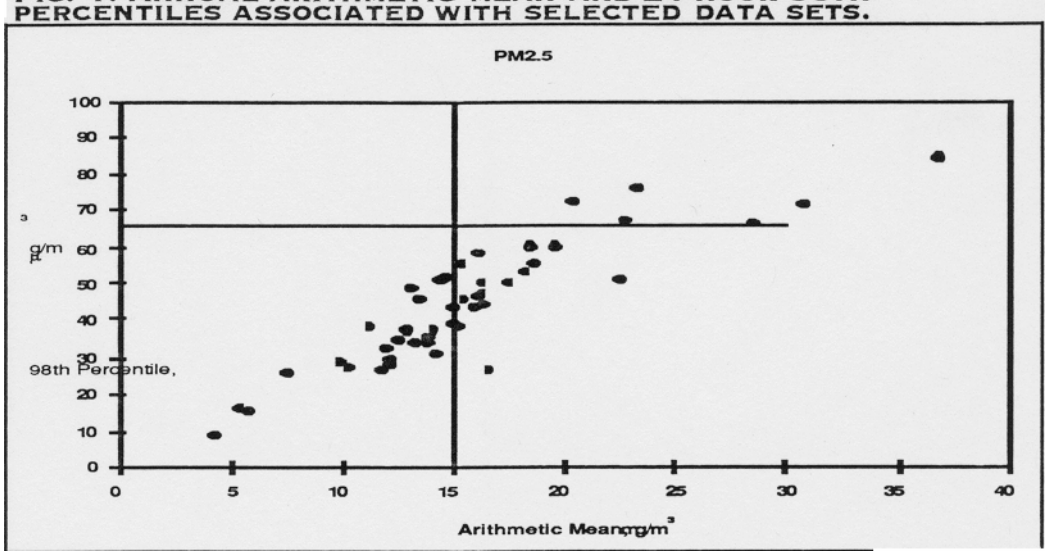
the probability of decision errors. Assumptions necessary for the development of the DQO included:

1. *The DQO is based on the annual arithmetic mean NAAQS*.
The PM2.5 standards are a 15 ug/m^3 annual average and a 65 ug/m^3 24-hour average. The annual standard is met when the three-year average of annual arithmetic means is less than or equal to 15 ug/m^3. Due to rounding, the 3-year average does not meet the NAAQS if it equals or exceeds 15.05 prior to rounding. The 24-hour average standard is met when the 3-year average 98th percentile of daily PM2.5 concentrations is less than or equal to 65 ug/m^3.

AIRS PM2.5 data were reviewed for two purposes: (a) to determine the relative "importance" of the two standards; and (b) to suggest "reasonable" hypothetical cases for which decision makers would wish to declare attainment and nonattainment with high probability. Twenty-four locations were found to have at least one year of PM2.5 data in AIRS. Figure 7.1 displays the annual averages and 98th percentiles that are

associated with lognormal distributions for the 47 data sets. Figure 7.1 does not display estimates derived according to the standard, as the data sets covered one rather than three years, but it does indicate the relative importance of the two standards. Points to the right of the vertical line may be viewed as exceeding the annual average standard. Points above the horizontal line may be viewed as exceeding the 24-hour average standard. All of those points are also to the right of the vertical line, indicating that the annual standard is the "controlling" standard for these locations. For this reason, the DQOs discussed in the remainder of this document focus on attainment with the annual average standard.

FIG. 1. ANNUAL ARITHMETIC MEAN AND 24-HOUR 98TH PERCENTILES ASSOCIATED WITH SELECTED DATA SETS.



2. *Normal distribution for measurement error.*

Error in environmental measurements is often assumed to be normal or lognormal. Figures 7.2 and 7.3 illustrate what happens to the normal and lognormal distribution functions for the same median concentration at two values for measurement error (CV's of 10 and 50%). In the case of PM2.5, the measurement error is expected to be in the range of 5 to 10 % of the mean, as shown in Figure 7.2, where normal or lognormal errors produce close-to-identical results. Therefore, due to these comparable results and the simplicity in modeling, the normal distribution of error was selected.

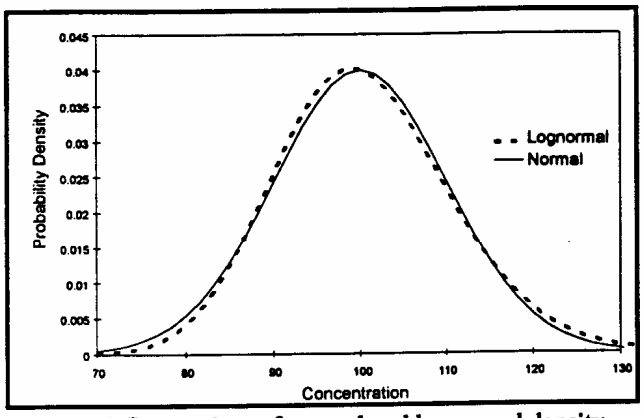


Figure 7.2 Comparison of normal and lognormal density functions at low measurement error (10% CV)

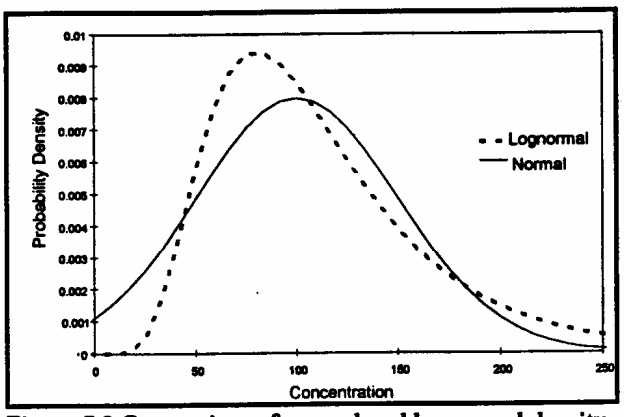


Figure 7.3 Comparison of normal and lognormal density functions at higher measurement errors (50% CV)

3. *Decision errors can occur when the estimated* 3 *-year average differs from the actual, or true, three-year average.*

Errors in the estimate are caused by population uncertainty (sampling less frequently than every day) and measurement uncertainty (bias and imprecision). The false

positive decision error occurs whenever the estimated three-year average exceeds the standard and the actual three-year average is less than the standard. The false negative decision error occurs whenever the estimated three-year average is less than the standard and the actual three-year average is greater than the standard.

4. *The limits on precision and bias are based on the smallest number of sample values in a three-year period.*

Because the requirements allow one-in-six-day sampling and a 75% data completeness requisite, the minimum number of values in a three-year period is 137. It can be demonstrated that obtaining more data, either through more frequent sampling or the use of spatial averaging, will lower the risk of attainment/non-attainment decision errors at the same precision and bias acceptance levels.

5. *The decision error limits were set at* 5%.

For the two cases that follow, the decision-maker will make the correct decision 95% of the time if precision and bias are maintained at the acceptable levels. For cases that are less challenging, such as annual average values that are farther from the standard, the decision-maker will make the correct decision more often. This limit is based on the minimum number of samples from assumption 4 above (137) and the present uncertainty in the measurement technology. However, if precision and bias prove to be lower than the DQO, the decision-maker can expect to make the correct decision more than 95% of the time.

6. *Measurement imprecision was established at 10% coefficient o/variation (CV).*
By reviewing available AIRS data and other PM2.5 comparison studies, it was determined that it is reasonable to allow measurement imprecision at 10% CV. While measurement imprecision has relatively little impact on the ability to avoid false positive and false negative decision errors, it is an important factor in estimating bias. CV's greater than 10% make it difficult to detect and correct bias problems. Two sine functions were developed (case 1 and 2) to represent distributions at which decision-makers began to be concerned about decision errors. Table 7-1 is a summary of the case 1 and 2 distributions.

TABLE 7-1. SUMMARY OF CASE 1 AND 2 PARAMETERS

	Model Equation	Mean	Correct Decision	Incorrect Decision	Tolerable Error Rate
Case 1	$C_D=12.75+8.90\ \sin(2\pi D/365)+\delta_D$	12.75	Attainment	F(+) = nonattainment	5%
Case 2	$C_D=18.4+12.85\ \sin(2\pi D/365)+\delta_D$	18.4	Nonattainment	F(-) = attainment	5%

***Case* 1:** With this model (case 1), the three-year average is 12.75 ug/m3. The correct decision is "attainment." A false positive error is made when the estimated average exceeds the standard. The probability of the false positive error for sampling every sixth day depends on the measurement system bias and precision, as shown in Table 7-2. As stated in assumption 6 above, the data in Table 7-2 show that precision alone has little impact on decision error, but is an important factor for bias, which is an important factor in decision error.

Because the decision error probability limits were set at 5% (assumption 5), acceptable precision (CV) and bias are combinations yielding decision errors around 5%.

TABLE 7.2. MEASUREMENT SYSTEM DECISION

Precision Probability		Decision Error Probability
CV%	Bias	False Positive (%)
0	+5	0.18
0	+10	4.4
0	+15	26.8 (not acceptable)
80	0	1.3
100	0	3.0
10	+10	4.7
15	+10	5.1

***Case 2*:** With this model (case 2), the three-year average is 18.4 ug/m^3. The correct decision is "nonattainment." A false negative error is made when the estimated average is less than the standard. The probability of the false negative error for sampling every sixth day depends on the measurement system bias and precision, as shown in the Table 7-3. Similar to case 1, combinations of precision and bias that yield decision error probabilities around 5% are considered acceptable.

After reviewing cases 1 and 2, based upon the acceptable decision error of 5%, the DQO for acceptable precision (10% CV) and bias ($\pm$ 10%) were identified. These precision and bias values will be used as a goal from which to evaluate and control measurement uncertainty.

TABLE 7.3. MEASUREMENT SYSTEM DECISION

PRECISION		DECISION ERROR PROBABILITY
CV%	Bias (%)	False Negative(%)
0	-5	<0.1
0	-10	1.6
0	-15	18.9 (not acceptable)
80	0	1.2
100	0	2.8
10	-10	1.8
15	-10	2.1

7.2 MEASUREMENT QUALITY OB.JECTIVES (MQOs)

After a DQO is established, the quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. Measurement quality objectives are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. MQOs can be defined in terms of the following data quality indicators:

Precision-a measure of mutual agreement among individual measurements of the

same property usually under prescribed similar conditions. This is the random component of error. Precision is estimated by various statistical techniques using some derivation of the standard deviation.

Bias-the systematic or persistent distortion of a measurement process which causes error in one direction. Bias will be determined by estimating the positive and negative deviation from the true value as a percentage of the true value.

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

Detectability- The determination of the low-range critical value of a characteristic that a method-specific procedure can reliably discern.

Completeness-a measure of the amount of valid data obtained from a measurement system compared with the amount expected to be obtained under correct, nonnal conditions. Data completeness requirements are included in the reference methods (40 CFR Pt. 50).

Comparability-a measure of confidence with which one data set can be compared with another.

Accuracy has been a term frequently used to represent closeness to "truth" and includes a combination of precision and bias-error components. This term has been used throughout the CPR and in some of the sections of this document. If possible, the DEQ will distinguish measurement uncertainties into precision and bias components.

For each of these attributes, acceptance criteria can be developed for various phases of the EDO. Various parts of 40 CFR have identified acceptance criteria for some of these attributes as well as *Guidance Document* 2.12[2]. In theory, if these MQOs are met, measurement uncertainty should be controlled to the levels required by the DQO. Table 7-4 lists the MQOs for PM2.5 program. More detailed descriptions of these MQO's and how they will be used to control and assess measurement uncertainty will be described in other elements, as well as SOPs (Appendix E) of this QAPP.

TABLE 7.4. MEASUREMENT : QUALITY OBJECTIVES—PARAMETERS

REQUIREMENT	FREQUENCY	ACCEPTANCE CRITERIA	40 CFR REFERENCE	QA GUIDANCE DOCUMENT 2.12 REFERENCE
Calibration/Verification				
Flow Rate (FR) Calibration	If multi-point failure	±2% of transfer standard	Part 50, App.L, Sec 9.2	Sec 6.3 and 6.6
FR multi-point verification	1/yr	±2% of transfer standard	Part 50, App.L, Sec 9.2.5	Sec 8.3
One point FR verification	1/4 weeks	±4% of transfer standard		Sec 8.3
External Leak Check	every 5 sampling events	80 mL/min	Part 50, App.L, Sec 7.4	Sec. 8.3
Internal Leak Check	every 5 sampling events	80 mL/min	"	Sec. 8.3
Temperature Calibration	If multi-point failure	±2% of standard	Part 50, App.L, Sec 9.3	Sec. 6.4
Temp multi-point verification	on installation, then 1/yr	±2%C of standard	Part 50, App.L, Sec 9.3	Sec. 6.4 and 8.2
One- point temp Verification	1/4 weeks	±4%C of standard	"	Sec. 6.4 and 8.2
Pressure Calibration	on installation, then 1/yr 1/4	Å10 mm Hg	"	Sec. 6.5
Pressure Verification	weeks	Å10 mm Hg	"	Sec. 8.2
Clock/timer Verification	1/4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	not described
Accuracy				
FRM performance evaluation	25% of sites 4/yr	±10%	Part 58, App A, Sec 3.5	Sec 10.3
Flow Rate Audit	1/2wk (automated) 4/yr (manual)	±4% of audit standard	"	Sec. 10.2
External Leak Check	4/yr	< 80 mL/min	not described	"
Internal Leak Check	4/yr	< 80 mL/min	not described	"
Temperature Audit	4/yr	±2%C	not described	"
Pressure Audit	4/yr	Å10 mm Hg	not described	"
Balance Audit	1/yr	Manufacturers specs	not described	"
Precision				
Collocated samples	every 6 days for 25% of sites	CV ≤ 10%	Part 58, App.A, Sec 3.5 and 5.5	Sec. 10.3
Single analyzer	1/3 mo.	CV ≤ 10%	not described	not described
Single Analyzer	1/yr	CV ≤ 10%	not described	not described
Reporting Org.	1/3 mo.	CV ≤ 10%	not described	not described
Calibration μ Check Standards				
Flow Rate Transfer Std.	1/yr	±2% of NIST-traceable Std.	Part 50, App.L Sec 9.1 and 9.2	Sec. 6.3
Field Thermometer	1/yr	±0.1° C resolution	not described	Sec 4.2 and 8.3
		±0.5° C accuracy	not described	"
Field Barometer	1/yr	±1 mm Hg resolution	not described	"
		±5 mm Hg accuracy	not described	"
Working Mass Stds.	3-6 mo.	0.025 mg	not described	Sec 4.3 and 7.3
Primary Mass Stds.	1/yr	0.025 mg	not described	"

TABLE 7.4. MEASUREMENT : QUALITY OBJECTIVES—PARAMETERS

REQUIREMENT	FREQUENCY	ACCEPTANCE CRITERIA	40 CFR REFERENCE	QA GUIDANCE DOCUMENT 2.12 REFERENCE
Filter Holding Times				
Pre-sampling	all filters	< 30 days before sampling	Part 50, App.L Sec 8.3	Sec. 7.8
Post-sampling weighing	"	< 10 days at 25° C < 30 days at 4°C	" "	Sec. 7.10
Reporting Units	All data	$\mu g/m^3$	Part 50.3	Sec. 11.1
Detection Limit				
Lower DL	All data	$2 \mu g/m^3$	Part 50, App.L Sec 3.1	
Upper Conc. Limit	All data	$200 \mu g/m^3$	Part 50, App.L Sec 3.2	
Data Completeness	quarterly	75%	Part 50, App. N, Sec. 2.1	
Filter				
Visual defect check	All Filters	See reference	Part 50, App.L Sec 6.0	Sec 7.5
Filter Conditioning Environment				
Equilibration	All filters	24 hours minimum	Part 50, App.L Sec 8.2	Sec. 7.6
Temp. Range	"	20-23°C	"	"
Temp. Control	"	± 2° C over 24 hr	"	"
Humidity Range	"	30% - 40% RH	"	"
Humidity Control	"	± 5% RH over 24 hr.	"	"
Lot Blanks	3 filters per lot	less than 15 µg		Sec. 7.6
Lab QC Checks				
Field Filter Blank	see 2.12 reference	±30 µg change between weighings	Part 50, App.L Sec 8.2	Sec. 7.7
Lab Filter Blank	3 per weighing session	±15 µg change between weighings	"	"
Balance Check	beginning, every 10th samples, end	≤3 µg		Sec. 7.9
Duplicate Filter Weighing	1 per sample batch	±15 µg change between weighings		Sec 7.7

REFERENCES

1. *EPA Guidance for Quality Assurance Project Plans.* EPA QA/G-5, EPA/600/R-98/018, February 1998

2. *U.S. EPA Quality Assurance Guidance Document* 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods. April, 1998.

8.0 TRAINING REQUIREMENTS/CERTIFICATION

8.1 TRAINING

Personnel assigned to the PM2.5 ambient air monitoring activities will meet all requirements for their positions, including education, special training, years of relevant work experience, level of responsibility, and personal attributes. Records documenting each employee's qualifications and training are maintained in personnel files, and will be accessible for review during audit activities, to the extent allowable under Virginia law and under the regulations of the Virginia Department of Personnel and Training.

The education and the training of each employee is a critical quality-control component of any monitoring program. To that end, senior staff have undergone special supervisory training on such topics as elements of performance evaluation. In addition, experienced air monitoring staff members train junior staff members on the job.

8.1.1 AMBIENT-AIR-MONITORING TRAINING

Pertinent training will be available to employees supporting the ambient air quality monitoring program, commensurate with their duties. Such training may consist of classroom lectures, workshops, teleconferences, and on-the-job training.

Over the years, a number of courses have been developed for personnel involved with ambient air monitoring and quality assurance aspects. Formal QA/QC training is offered through the following organizations:

- Air Pollution Training Institute (APTI) http://www.epa.gov/oar/oaq.apti.html
- Air & Waste Management Association (A WMA) http://awma.org/epr.htm
- American Society for Quality Control (ASQC) http://www.asqc.org/products/educat.html
- EPA Institute
- EPA Quality Assurance Division (QAD) http://es.inel.gov/ncerqa/qa/
- EPA Regional Offices

In Table 8-1 is shown a sequence of core ambient air monitoring and QA courses for ambient air monitoring staff, and QA managers. The suggested course sequences are based upon the assumption that a staff member will have little or no experience in QA/QC or air monitoring. A persons already knowledgeable about the subject matter should choose the course that is germane to his or her experience level and professional focus.

Courses not included in the core sequence may be selected according to available resources, and in keeping with individual responsibilities and preferences.

TABLE 8-1. CORE AMBIENT-AIR MONITORING TRAINING COURSES

Sequence	Course Title (SI = Self Instructional)	Department #	Source
1	Air Pollution Control Orientation Course (Revised), SI:422	422	APTI
2	Principles and Practices of Air Pollution Control, 452	452	APTI
3	Orientation to Quality Assurance Management	QA1	QAD
4	Introduction to Ambient Air Monitoring (Under Revision), SI:434	434	APTI
5	General Quality Assurance Considerations for Ambient Air Monitoring (Under Revision), SI:471	471	APTI
6	Quality Assurance for Air Pollution Measurement Systems (Under Revision), 470	470	APTI
7	Data Quality Objectives Workshop	QA2	QAD
8	Quality Assurance Project Plan	QA3	QAD
9	Atmospheric Sampling (Under Revision), 435	435	APTI
10	Analytical Methods for Air Quality Standards, 464	464	APTI
11	Chain-of-Custody Procedures for Samples and Data, SI:443	443	APTI
	Data Quality Assessment	QA4	QAD
-	Management Systems Review	QA5	QAD
	Beginning Environmental Statistical Techniques (Revised), SI:473A	473	APTI
-	Introduction to Environmental Statistics, SI:473B	473B	APTI
-	Quality Audits for Improved Performance	QA6	AWMA
-	Statistics for Effective Decision Making	STAT1	ASQC
-	AIRS Training	AIRS1	OAQPS
-	FRM Performance evaluation Training (field/lab)	QA7	OAQPS
-	$PM_{2.5}$ Monitoring Operations (Video)	PM1	OAQPS
-	$PM_{2.5}$ Monitoring QA/AC (video)	-	OAQPS

8.2 CERTIFICATION

For the PM2.5 program, the DEQ human resouces office, in conjunction with the air- monitoring office, will issue certifications to employees upon their successful completion of each training activity. Certification will be based upon the qualitative and the quantitative assessment of each person's adherence to the SOPs.

9.0 DOCUMENTATION AND RECORDS

A number of documents and records must be retained for the Ambient Air Monitoring Program. From a records-management perspective a document is a volume that contains information that describes, defines, specifies, reports, certifies, or provides data or results pertaining to environmental programs.

The DEQ maintains a records management program in compliance with the Virginia Public Records Act, Section 42.1-76, et. Seq. of the *Code of Virginia,* "Appendix A." This records management program is a cooperative effort between the Virginia State Library Archives and Records Division, and state and local agencies of the Commonwealth of Virginia.

The following information describes the DEQ's document and records management procedures for PM2.5 Program. In EPA's QAPP regulation and guidance, EPA uses the term reporting package. Although this is not a term currently used by the DEQ, it will be defined as follows: all the information required to support the concentration data reported to EPA, which includes all data required to be collected, as well as data deemed important by the DEQ under its policies and its records management procedures. Table 9-1 contains a listing of the these documents and records as they apply to the PM2.5 Program.

9.1 INFORMATION INCLUDED IN THE REPORTING PACKAGE

9.1.1 ROUTINE DATA ACTIVITIES

The DEQ has a structured records management retrieval system that allows for the efficient archive and retrieval of records. The PM2.5 information will be included in this system. Table 9.1 includes a listing of the documents and records that will be filed according to the records retention and disposal schedule allowed by the Virginia State Library and DEQ filing practices.

FIG.9-1 PM2.5 REPORTING PACKAGE

INFORMATION

Commonwealth of Virginia

Virginia State Library and Archives

Archives and Records Division

(804) 786-5634

RECORDS RETENTION AND DISPOSITION SCHEDULE

SPECIFIC SCHEDULE NO. 422-019

AGENCY: Department of Air Pollution Control

DIVISION: Monitoring

SUBUNIT:

==========

This schedule is continuing authority under the provisions of the Virginia Public Records Act, §§42.1-76 et. seq. Code of Virginia, for the retention and disposition of the e records as stated. This schedule supersedes previously approved applicable schedules. Request approval on Form RM-3. Certificate of Records Disposal, for the destruction of record series noted in this schedule. Any records created prior to the Constitution of 1902 must first be offered to VSL&A before applying these disposition instructions.

EFFECTIVE SCHEDULE DATE:

RECORD SERIES NUMBER AND TITLE

DATA SECTION

1. Air quality data handling system il master file
2. Annual report- Virginia ambient air monitoring data
3. Downtime, analyses for criteria pollutants
4. Environmental systems corporation specifications for monthly polled data values
5. Exceeding of air quality standards

INSTRUMENT SECTION

6. Quality Assurance-Instrument Long Books
7. Quality Assurance-Calibration Sheets
8. Quality assurance-drift control charts
9. Quality assurance-operator daily check sheets
10. Quality assurance-prevention maintenance
11. Quality assurance-primary standard certification
12. Quality assurance-station log books
13. Annual monitoring network review
14. Data assessment reporting forms for precision and accuracy
15. Exposed filer weights
16. Filter weights-quality control
17. Sampler calibrations
18. Sampler preventive maintenance schedule
19. Material Safety data sheets
20 Monitoring st e information
21. National performance audit program performance audit program records
22. Orifice-type flow-rate standard calibrations
23. Quality assurance checks
24. Quality assurance manual

9.1.2 ANNUAL SUMMARY REPORTS SUBMITTED TO EPA

As indicated in 40 CFR Part 58, the DEQ shall submit to the EPA Administrator, through the Region III Office, an annual summary report of all the ambient air quality monitoring data from all monitoring stations designated as SLAMS. The report will be submitted by July 1 of each year for the data collected from January 1 to December 31 of the previous year. The report will contain the following information:

PM-Fine (PM.2.5)

Site and Monitoring Information

- City name (when applicable),
- county name and street address of site location.
- AIRS-AQS site code.
- AIRS-AQS monitoring method code.

Summary Data

- Annual arithmetic mean (ug/m^3) as specified in 40 CFR part 50, Appendix N (Annual arithmetic mean NAAQS is 15 ug/m^3)

- All daily PM-fine values above the level of the 24-hour PM-fine NAAQS (65 ug/*m^3)* and the dates of occurrence.
- Sampling schedule used as once every 6 days, every day, etc.
- Number of 24-hour average concentration in the ranges listed in Table 9-2:

TABLE 9-2 PM2.5 SUMMARY REPORT RANGES

RANGE	NUMBER OF VALUES
0 to 15 (ug/m^3)	
16 to 30	
31 to 50	
51 to 70	
71 to 90	
91 to *110*	
greater than 110	

John McDaniel, Jr., as the senior air pollution control official for the DEQ will certify that the annual summary is accurate to the best of his knowledge. This certification will be based on the various assessments and reports performed by the organization.

9.2 DATA REPORTING PACKAGE FORMAT AND DOCUMENTATION CONTROL

Table 9-1 represents the documents and records that, at a minimum, must be filed into the reporting package. The details of these various documents and records will be discussed in the appropriate sections of this document.

All raw data required for the calculation of a PM2.5 concentration, the submission to the AIRS database, and the QA/QC data, are collected electronically or on data forms that are included in the field and analytical methods sections. All hard-copy information will be filled out in indelible ink. Corrections will be made by inserting one line through the incorrect entry, and placing the correct entry alongside the incorrect entry, provided this can be done legibly, or, if not, by providing the information on a new line. The staff member making the correction will write the initial letters of his or her name next to the correction.

9.2.1 NOTEBOOKS

The DEQ will issue notebooks to each field and laboratory technician. These notebooks will be uniquely numbered and associated with the individual staff member and the PM2.5 program. Although data-entry forms are associated with all routine environmental data operations, the notebooks can be used to record additional information about these operations.

Field notebooks-Notebooks will be issued for each sampling site. These will be three-ring binders that will contain the appropriate data forms for routine operations as well as inspection and maintenance forms and SOPs.

Lab Notebooks-Laboratory staff will use notebooks in accordance with DCLS internal procedures. These notebooks will be uniquely numbered and associated with the PM2.5 program. Notebook will be available for general comments/notes; others will

be associated with, the temperature and humidity recording instruments, calibration equipment/standards, the analytical balances, and other equipment used in this program.

Sample shipping/ receipt-The DCLS shipping and receiving section will maintain notebooks in accordance with DCLS internal sample chain-of -custody procedures

9.2.2 ELECTRONIC DATA COLLECTION

We anticipated that certain instruments will provide an automated means for collecting information that otherwise would be recorded on data-entry forms. Information on these systems is detailed elsewhere in this document. To reduce the potential for data- entry errors, when appropriate automated systems will be used that will record the same information that is found on data-entry forms. In order to provide a backup, a hard copy of automated data-collection information will be stored for the appropriate time frame in project files.

9.3 DATA REPORTING PACKAGE ARCHIVING AND RETRIEVAL

In general all the information listed in Table 9-1 will be retained for five years frQm the date the grantee submits the final expenditure report, unless otherwise noted in the funding agreement. However, if any litigation, claim, negotiation, audit, or other action involving the records has been started before the expiration of the five-year period, the records will be retained the action is complete, all issues which arise from it are resolved, or until the end of the regular five-year period, whichever is later. The Department will extend this regulation in order to store records for five full years past the year of collection.

10.0 SAMPLING DESIGN

The purpose of this section is to describe all of the relevant components of the SLAMS gravimetric mass *PM2.5* monitoring network to be operated by the Commonwealth of Virginia, including the network design for evaluation of the quality of the data. This entails describing the key parameters to be estimated, the rationale for the locations of the PM2.5 monitors and the QA samplers, the frequency of sampling at the primary and QA samplers, the types of samplers used at each site, and the location and frequency of the FRM performance evaluations. The network design components comply with the regulations contained in 40 CFR Part 58, Section 58.13, Appendix A, and Appendix D, and further described in detail in *Guidance for Network Design and Optimum Site Exposure for PM2.5 and PM10.*

10.1 Scheduled Project Activities, Including Management Activities

Virginia is required to establish 28 monitoring sites, all of which must be operational by January 1, 2000. A total of 21 of these sites must be operational by January 1, 1999. Primary samplers will be installed at existing air quality monitoring sites first, followed by new sites to be established. The heavily populated MSAs of Tidewater, Northern Virginia, and Richmond will be given primary consideration for initial site installations. All QA samplers will be installed in compliance with the requirements contained in 40 CFR Part 58, Appendix A. Table 10-1 represents the activities associated with the ordering and deployment of the primary and QA PM2.5 samplers.

Table 10-1. Schedule ofPM2.5 Sampling-Related Activities

Activity	Due Date	Comments
Order samplers: 23 sequentials	March 2, 1998	Ordered from National contract.
Verify IMPROVE site operations	May 1998	2 sites – NFS & NPS
Receive samplers	July 1, 1998	
Install 19 samplers (primary & QA)	Oct – Dec 1998	Contingent upon time receipt of samplers under contract
Order sequential sampler	November 1998	State procurement
Begin sampling at 19 sites	January 1, 1999	
Begin sampling at remaining sites	January 1, 2000	
Report data to AIRS	Ongoing – within 90 days after end of quarter	40 CFR Part 58, Section 35 (c)
FRM Performance Audits	Ongoing	EPA responsibility
Report QA data to AIRS	Ongoing – 90 days	40 CFR Part 58, Section (c)
Review AIRS QA reports	Ongoing	Sampler bias and precision failure determination
Primary network review	Annually	Site evaluations
Evaluate location of collocated samplers	Annually	Collocate at sites nearest NAAQS

10.2 Rationale for the Design

10.2.1 Primary Samplers

The primary purpose of the gravimetric mass PM2.5 ambient air monitoring program operated by Virginia is to measure compliance with the national standards for particulate less than or equal to 2.5 micrometers. These standards are detailed in 40 CFR Part 50, are based on twenty-four hour average PM2.5 concentrations, and are summarized as:

1. The three-year average of the annual 98th percentiles of PM2.5 concentrations at any population-oriented monitoring site is not to exceed 65 ug/m^3.
2. The three-year average of the annual mean of PM2.5 concentrations is not to exceed 15 ug/m^3. The average may be based on a single community-oriented monitoring site or may be based on the spatial average of community-oriented monitoring sites in a community monitoring zone (CMZ).

The key characteristics being measured are annual 98th percentiles and annual means of

twenty-four average PM2.5 concentrations.

To determine whether these characteristics are quantified with sufficient confidence, Virginia must address sampler type, sampling frequency, and sampler siting. The DEQ will use FRM samplers to evaluate compliance with the PM2.5 NAAQS. By complying with the sampling frequency requirements of 40 CPR Part 58 Section 58.13 and published EPA guidance, the DEQ assumes that the sampling frequency is sufficient to attain the desired confidence in the annual 98th percentile and annual mean of PM2.5 concentrations in the vicinity of each monitor. The DEQ will select all sampling sites in accordance with the siting regulations contained in 40 CFR Part 58, Appendix D. Sampler

type, frequency of sampling, and siting are further described elsewhere in this document.

10.2.2 QA Samplers

The purpose of collocated samplers and the FRM performance evaluation is to estimate the recision and bias of the various PM2.5 samplers. The DQOs as described in an earlier section state that, for three year period, the concentrations measured by a sampler must be within +/- 10% of the true concentration as measured by a FRM sampler and that the coefficient of variation of the relative differences must be less than 10%. These levels of bias and precision need to be accomplished so that decisions can be made about attainment/nonattainment of the PM2.5 NAAQS with sufficient confidence. To estimate the level of bias and precision being achieved in the field, some of the sites will operate collocated samplers and some of the sites will be audited using FRM samplers. If a sampler is operating within the required bias and precision levels, then the decision maker can proceed knowing that the decisions will be supported by unambiguous data. If, however, a sampler exceeds either the bias limits or the precision limits or both, then the decision maker cannot use the data to make decisions at the desired level of confidence, and corrective action must be implemented to ensure that future data collected by the sampler does meet the bias and precision limits.

To determine whether these characteristics are measured with sufficient confidence, the

DEQ must address sampler type, sampling frequency, and sampler siting for the QA

network. As with the primary PM2.5 network, by using FRM/FEM samplers, maintaining

the sampling frequency specified

in 40 CFR Part 58 Appendix A and additional EP A guidance, and collocating the number of samplers as specified in 40 CPR Part 58 Appendix A, the DEQ assumes its QA network will measure bias and precision with sufficient confidence.

10.3 Design Assumptions

The sampling design is based on the assumption that the following rules and guidance provided in CFRs and *Guidance for Network Design and Optimum Site Exposure for PM 2.5 and PM 10* will result in data that can be used to measure compliance with the national standards. The only issue at Virginia's discretion is the sampler siting, and to a degree, sampling frequency.

10.4 Procedure for Locating and Selecting Environmental Samples

10.4.1 Primary Samplers

The design of the SLAMS PM2.5 network must achieve one of the six basic monitoring objectives, as described in 40 CFR Part 58, Appendix D. These are:

1. To determine the highest concentration expected to occur in the area covered by the network
2. To determine representative concentrations in areas of high population density.
3. To determine the impact on ambient pollution levels of significant sources.
4. To determine general background concentration levels.
5. To determine the extent of regional pollutant transport.
6. In support of secondary standards to determine welfare-related impacts.

The procedure for siting the PM2.5 samplers to achieve the six basic objectives is based on judgmental sampling, as is the case for most ambient air monitoring networks. Judgmental sampling uses data

from existing monitoring networks, knowledge of source emissions and population distribution, and inference from analyses of meteorology to select optimal sampler locations.

The number of SLAMS sites where gravimetric mass PM2.5 monitoring will occur and their location was determined based upon the information contained in 40 CFR Part 58 Appendix D and in *Guidance for Network Design and Optimum Site Exposure for PM* 2.5 *and PM 10.* Specifically, the following were used to define the Monitoring Planning Areas (MPAs) and to site monitors.

10.4.2 Primary Samplers - Defining MPAs

The Commonwealth of Virginia contains 8 Metropolitan Statistical Areas (MSAs) or Primary Metropolitan Statistical Areas (PMSAs). Approximately 76% of Virginia's population resides within these MSAs (1990 census). Therefore, to the extent possible, the existing boundaries of the MSAs were used to identify the boundaries of the populated areas. Also considered in the determination of MPAs were terrain features, existing air quality monitoring sites, and existing planning areas.

Since Virginia has very little PM-2.5 data with which to make sound judgements on MPAs, existing MSA boundaries were used, removing only those localities that have low populations and no significant sources. For the Northern Virginia portion of the Washington, D.C. PMSA, the existing

ozone nonattainment planning area was designated as the MPA.

When a data base for PM-2.5 has been obtained, Virginia intends to review and refine MPA boundaries as part of the annual review process. In addition, should any monitoring site show nonattainment with the NAAQS, Virginia will take appropriate actions to define the actual nonattainment area and will not necessarily use any designated MPA as the nonattainment area.

MPA	**Cities/Counties**	**Population**
Northern Virginia portion of Washington, D.C.-Md-Va	Alexandria	111,183
	Arlington	170,926
	Fairfax City	19,622
	Fairfax County	818,584
	Falls Church	9,578
	Loudoun County	86,129
	Manassas	27,957
	Manassas Park	6,734
	Prince William County	215,686
	Stafford County	61,236
	Total =	1,527,635
Norfolk-Va. Beach-Newport News	Chesapeake	151,976
	Hampton	133,793
	James City County	34,859
	Newport News	170,045
	Norfolk	261,229
	Poquoson	11,005
	Portsmouth	103,907
	Suffolk	52,141
	Virginia Beach	393,069
	York County	42,422
	Total=	1,354,446

Richmond-Petersburg	Charles City County	6,282
	Chesterfield County	209,274
	Colonial Heights	16,064
	Dinwiddie County	20,960
	Hanover County	63,306
	Henrico County	217,881
	Hopewell	23,101
	Petersburg	38,386
	Prince George County	27,394
	Richmond City	203,056
	Total = 825,704	
Bristol Va. Portion of Johnston City-Kingsport-Bristol	Bristol	18,426
	Scott County	23,204
	Washington County	45,887
	Total = 87,517	
Roanoke	Botetourt County	24,992
	Roanoke City	96,397
	Roanoke County	79,332
	Salem	23,756
	Total = 224,477	
Lynchburg	Amherst County	28,578
	Bedford City	6,073
	Bedford County	45,656
	Campbell County	47,572
	Lynchburg City	66,049
	Total = 193,928	

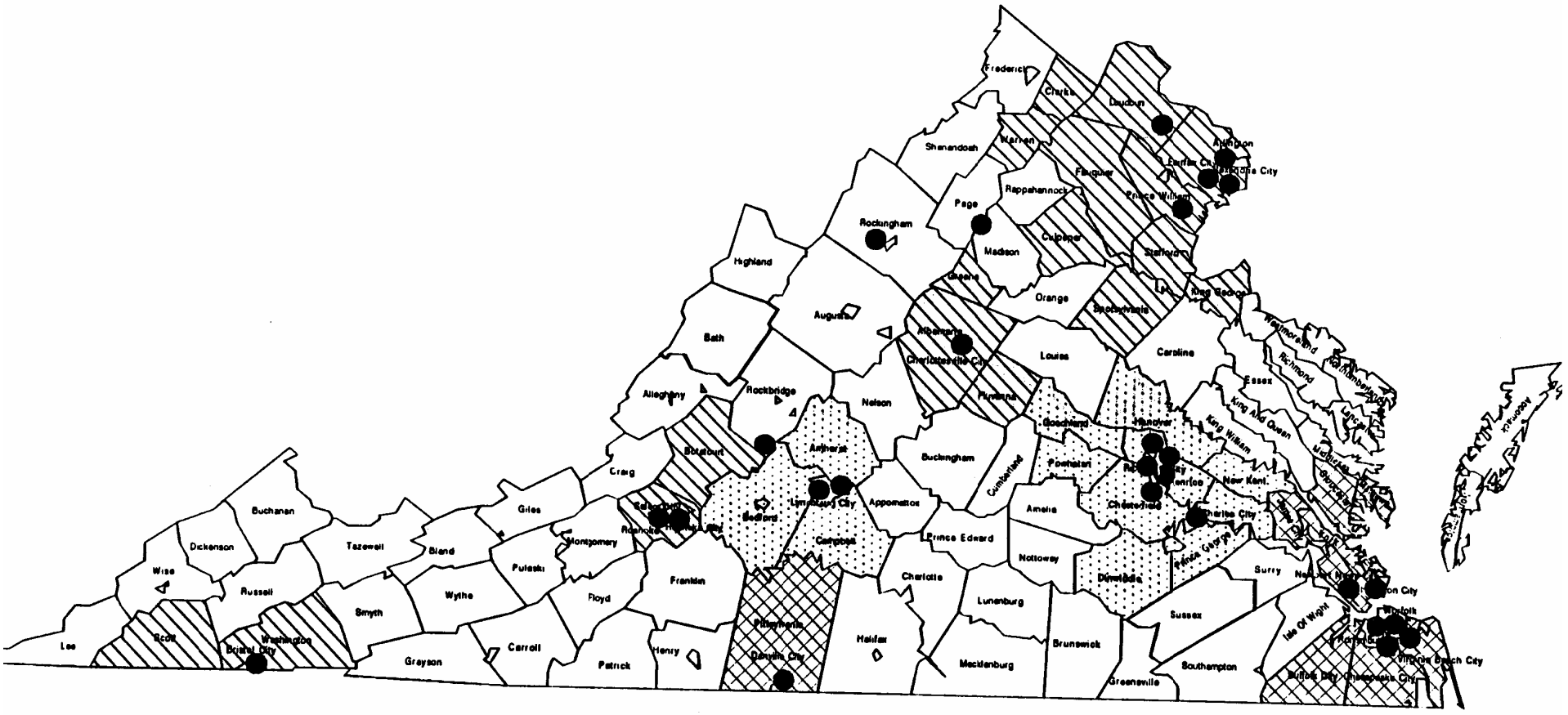
MPA	Cities/Counties	Population
Charlottesville	Albemarle County	68,040
	Charlottesville	40,3741
		Total = 108,381
Danville	Danville	53,056
	Pittsylvania County	55,655
		Total = 108,711

10.4.3 Primary Samplers - Defining CMZs

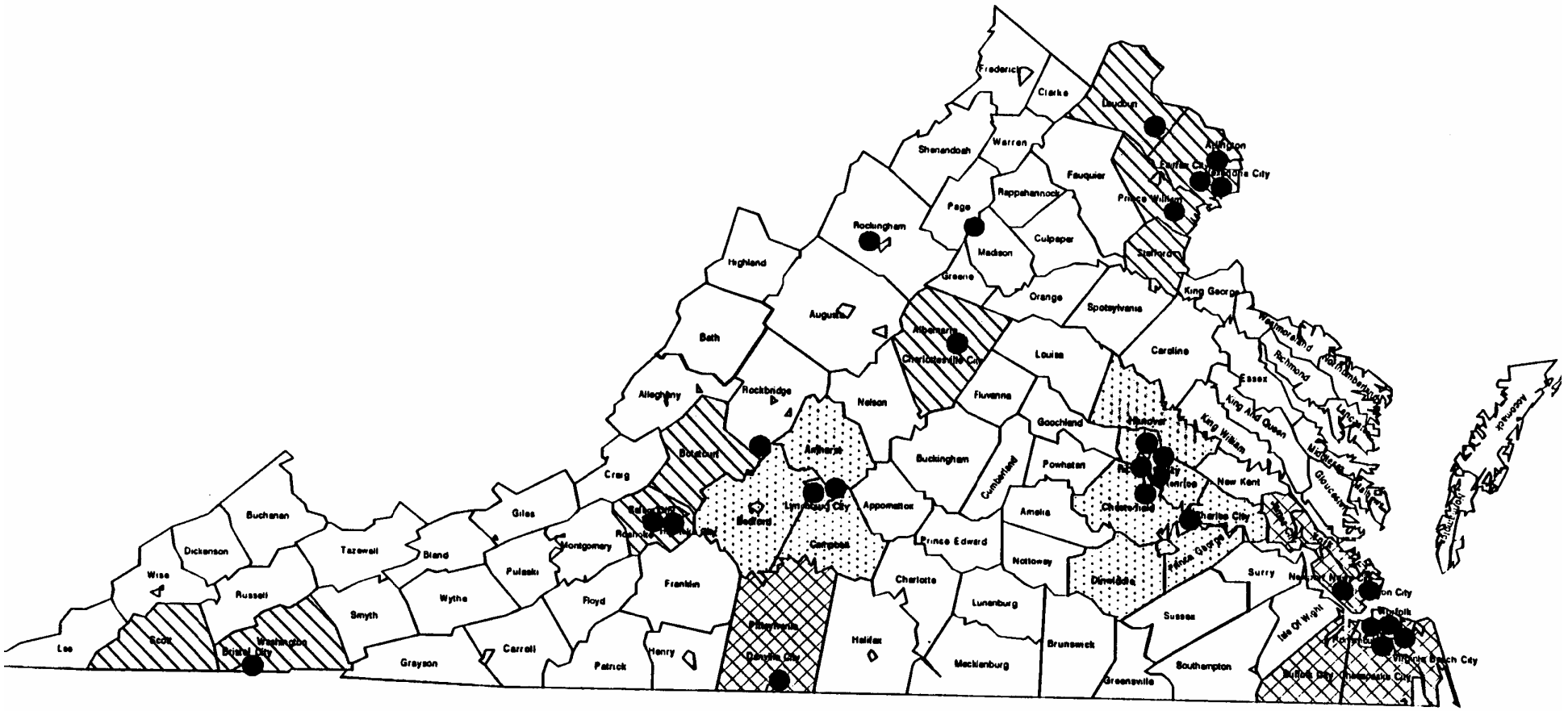
Specific CMZ definitions are needed only when spatial averaging is to be used, according to the *Guidance for Network Design and Optimum Site Exposure for PM 2.5 and PM 10.* Community Monitoring Zones are intended for use in making comparisons to the annual PM2.5 NAAQS. These sites must have spatial homogeneity with respect to emissions, population, meteorological patterns, and *PM2.5* concentrations. Use of CMZs is optional.

Virginia intends to use spatial averaging within MPAs once an adequate PM2.5 data base has been obtained. These data will allow for the evaluation of specific monitoring sites during the annual review process.

COMMONWEALTH OF VIRGINIA
Metropolitan Statistical Areas



COMMONWEALTH OF VIRGINIA
Monitoring Planning Areas



10.4.4 Primary Samplers - Siting Monitors

The procedure for siting the PM2.s samplers is based on judgmental sampling. Virginia has been required to establish 22 PM2.5 monitoring sites, 2 of which will be existing IMPROVE sites operated by the National Forest Service and the National Park Service. A listing of sampling locations by MSA is provided in this chapter.

10.4.5 Primary Samplers - Review of MPA and CMZ Definitions

The number of MPAs and the MPA boundaries will be regularly reviewed as part of the network review. These MPAs may be revised as new census data become available or in the event that MSA definitions change.

The need for CMZ definitions will also be reviewed as part of the network review. The review will be based on actual data collected and a review of emission sources within a MPA. According to 40 CFR Part 58, Appendix D, Section 2.8.1.6, annual air quality averages may be averaged for comparison with the annual *PM2.5* NAAQS provided:

1. The average concentrations at individual sites do not exceed the spatial average by more than 20 percent.
2. The monitoring sites exhibit similar day to day variability
3. All sites in the CMZ are affected by the same major emission sources of PM2.5.

To address these three issues, Virginia will use the following procedure should it be decided to use the CMZ option. This procedure is based on the information in *Guidance for Network Design and*

Optimum Site Exposure for PM 2.5 *and PM 10.*

1. Determine if the average concentration at selected sites within a MPA are within 20 percent of the spatial average. The calculations for achieving this are provided in 40 CFR Part 50 Appendix N.

2. Determine if the monitoring sites exhibit similar day to day variability.

3. Review the location of existing and new emission sources.

4. Review any data from speciation monitors or air quality models. If the emission profiles look similar near each of the monitors, then it can be concluded that the sites are impacted by the same major sources of emissions.

The information from these steps will be used to determine how homogenous the air is and what the appropriate CMZ boundaries are. Preliminary assessments will be made on an annual basis, but three years of PM2.5 air quality data are required before a final evaluation can be made.

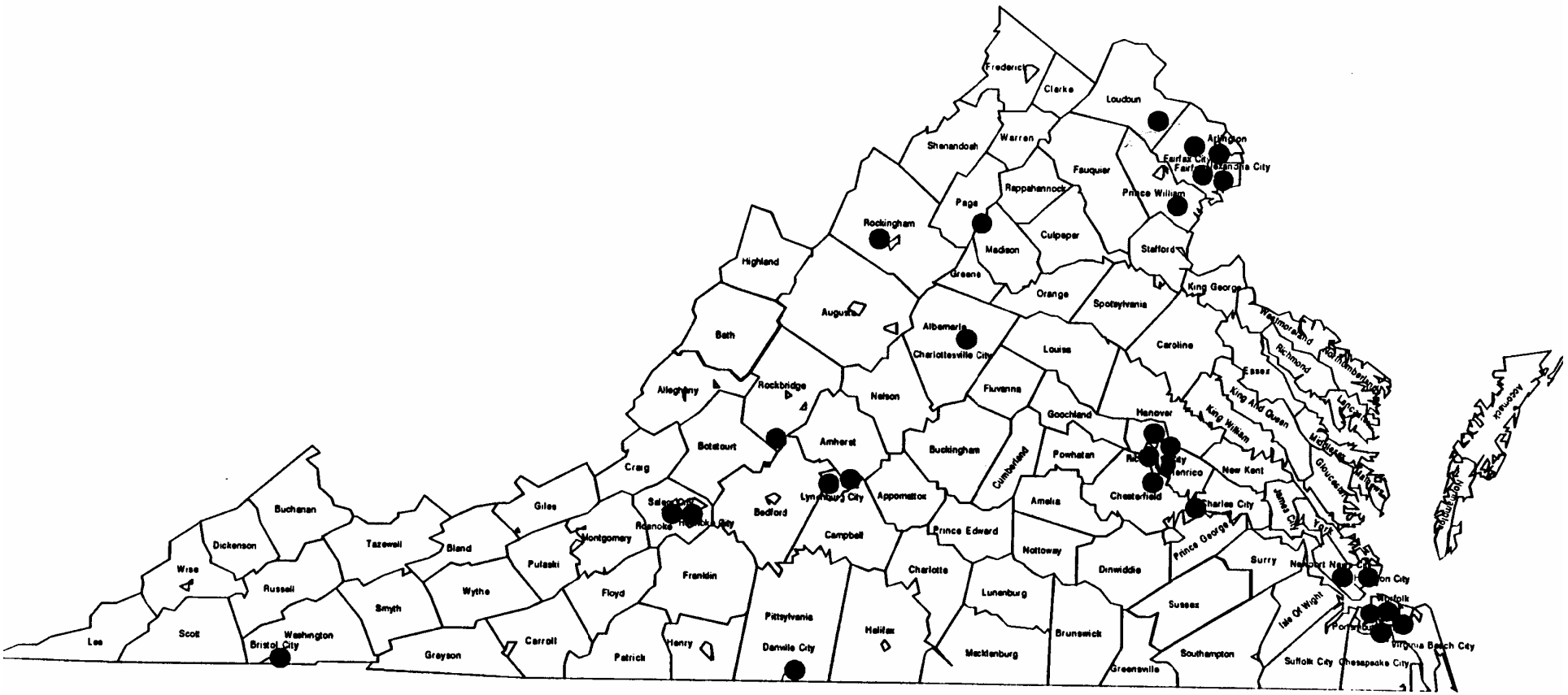
10.4.6 Primary Samplers - Sample Frequency

According to 40 CFR Part 58, Section 58.13, Appendix D, and EPA guidance, the required sampling frequency for the samplers operated by Virginia is every day or every three days. Future sampling schedules will depend on observed pollutant levels and additional EPA guidance.

10.4.7 Primary Samplers - Types of Samplers

Virginia will operate only sequential samplers manufactured by Rupprecht & Patashnick Co., Inc., Partisol-Plus model 2025. This sampler is a FRM.

COMMONWEALTH OF VIRGINIA
PM 2.5 Sampler Network



COMMONWEALTH OF VIRGINIA
PM2.5 AIR QUALITY MONITORING NETWORK

MPA	AIRS I.D	LOCATION	SITE TYPE	SAMPLING METHOD	OPERATING SCHEDULE	SITE CLASSIFICATION	MONITORING OBJECTIVE	SCALE OF REPRESENTATIVENESS	COLLOCATED
Northern Virginia	51-013-0020	Arlington Co. – Aurora Hills	SLAMS	Sequential FRM	1/3	CORE	Population	Neighborhood	X
	51-059-0030	Fairfax Co. – Lee Park	SLAMS	Sequential FRM	1/1	CORE	Population	Neighborhood	
	51-059-5001	Fairfax Co. – Lewinsville	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
	51-059-1004	Fairfax Co. – Seven Corners	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
	51-107-1005	Loudoun Co. – Broad Run H.S.	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
	51-153-0010	Prince William Co. – Northern Regional Office	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
Tidewater	51-550-0012	Chesapeake – Oscar Smith Stadium	SLAMS	Sequential FRM	1/1	CORE	Population	Neighborhood	
	51-650-0004	Hampton – VA School	SLAMS	Sequential FRM	1/3	CORE	Population	Neighborhood	
	TBA	Newport News – Pump Station #103	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
	51-710-0024	Norfolk – NOAA Facility	SLAMS	Sequential FRM	1/3	CORE	Population	Neighborhood	X
	51-710-0024	Norfolk – NOAA Facility	SPM	Continuous	Continuous	Other	Population	Neighborhood	
	TBA	VA Beach – Tidewater Regional Office	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
Richmond	51-041-0003	Chesterfield Co. – Bensley Armory	SPM	Sequential FRM	1/3	Hot Spot	Population	Neighborhood	
	51-087-0014	Henrico Co. – Math & Science Center	SLAMS	Sequential FRM	1/3	CORE	Population	Neighborhood	

COMMONWEALTH OF VIRGINIA
PM2.5 AIR QUALITY MONITORING NETWORK

MPA	AIRS I.D	LOCATION	SITE TYPE	SAMPLING METHOD	OPERATING SCHEDULE	SITE CLASSIFICATION	MONITORING OBJECTIVE	SCALE OF REPRESENTATIVENESS	COLLOCATED
	TBA	Henrico Co. – Piedmont Regional Office	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
	51–760–0020	Richmond – Air Monitoring Office	SLAMS	Sequential FRM	1/1	CORE	Population	Neighborhood	X
	51–760–0024	Richmond – Science Museum	SPM	Continuous	Continuous	Other	Population	Neighborhood	
	51–036–0002	Charles City Co. – Off Rt. #608	SPM	Sequential FRM	1/3	Hot Spot	Population	Neighborhood	
Roanoke	TBA	Roanoke – Raleigh Court Library	SLAMS	Sequential FRM	1/3	CORE	Population	Neighborhood	
	TBA	Salem – Market Street Fire Station	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
Lynchburg	TBA	Amherst Co. – Training School	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
	TBA	Lynchburg – Community College	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
Charlottesville	TBA	Charlottesville – VA Division of Forestry	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
Danville	TBA	Danville – Community College	SPM	Sequential FRM	1/3	CORE	Population	Neighborhood	
Bristol	TBA	Bristol – VA Intermont College	SPM	Sequential FRM	1/3	Hot Spot	Population	Neighborhood	
——	51–113–0003	Madison Co. – Shenandoah National Park Big Meadows	SPM	IMPROVE	1/3	Background/ Transport	Background	Regional	
——	51–163–0002	Rockbridge Co. – James River Face Wilderness	SPM	Sequential FRM	1/3	Background/ Transport	Visibility	Regional	
——	TBA	Rockingham Co. – WHSV–TV	SPM	Sequential FRM	1/3	Background/ Transport	Transport	Regional	

TBA – To Be Assigned

10.4.8 Primary Sampling - Other PM2.5 Monitoring

For the purposes of this QAPP, special purpose monitoring will be accomplished with sequential FRM samplers. These samplers will be operated in accordance all applicable SLAMS requirements and EPA guidance.

10.4.9 QA Samplers

In accordance with the *PM2.5* network design, Virginia will install and operate 20 sites using sequential samplers, with the remaining 2 sites operational as part of the IMPROVE network. Virginia initially will operate 3 sites designated for collocation.

Based upon the data collected by the PM10 network, it is assumed that these sites were most likely to meet the requirements for designation as collocated sites. However, as data from the *PM2.5* monitoring network become available, the data will be reviewed on an annual basis to determine if a different site is more appropriate for collocation. The three collocated samplers will be operated on a one-in-three day sampling schedule. One of the primary samplers operates on an everyday schedule, and the other two primary samplers operate on a one-in-three day schedule.

A complementary method for estimating bias and precision is the FRM Performance Evaluation. The EPA regional office will be responsible for conducting this program. The DEQ will coordinate with the EPA regional office to provide access to the sites and offer other needed support performance evaluation data will be reviewed by the DEQ.

10.5.1 Primary Samplers

The critical information collected at the primary samplers is that specified in Table 6-2 and will be provided to AIRS. All necessary site information will also be submitted. Data will be used for comparison to the NAAQS.

10.5.2 QA Samplers

The critical information collected at collocated samplers is the same as for primary samplers. Data from collocated samplers will used for estimation of bias and precision.

10.6 Validation of Non-Standard Measurements

Since Virginia is operating only FRMs in accordance with *Guidance Document* 2.12, there will not be any nonstandard measurements from either the primary or QA samplers. Also, since the DEQ will be sending its filters to a certified laboratory for weighing, there will not be any nonstandard measurements from the analysis of the filters.

11.0 SAMPLING METHODS REQUIREMENTS

11.1 Purpose/Background

This method provides for measurement of the mass concentration of fine particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers in ambient air over a 24- hour period for purposes of determining whether the primary and secondary NAAQS for particulate matter specified in 40 CFR Part 50.6 are met. The measurement process is considered to be non-destructive, and the PM2.s sample obtained can be subjected to subsequent physical or chemical analyses.

11.2 Sample Collection and Preparation

FRM samplers will be used as the monitor for collection of PM2.5 samples for comparison to the NAAQS. The Virginia network will utilize only one kind of FRM sampler. The Rupprecht & Patashnick PM2.5 Sampler Model 2025A is a sequential sampler that will be used for every day, every third day, and collocated sampling. Each sampler will be installed according to the procedures, guidance, and requirements set forth in 40 CFR Parts 50, 53, and 58; Section 2.12 of the QA Handbook; as well as in keeping with the sampler manufacturer's operations manual; with Virginia's PM2.5 field SOPs, and with this QAPP.

11.2.1 Sample Set-up

Sample set-up of the FRM sampler in the Virginia network takes place any day after the previous

sample has been recovered. For multiple day samplers, two sample days may be set-up when one-in three day sampling is required. It is important to recognize that the only holding time that affects sample set-up is the 30 day window from the time a filter is preweighed to the time it is installed in the sampler. At collocated sites, the second sampler will be set up to run on a sample frequency of 1 in 3 days; however, sample set-up will take place on the same day as the primary sampler. Detailed sample set-up procedures are available from the Virginia *PM2.5* sampling methods standard operating procedures.

11.2.2 Sample Recovery

Sample recovery of any individual filter from the FRM samplers in the Virginia network must occur within 177 hours of the end of the sampling period for that filter. The next sample also will be set up at this time. For 1-in-3 day sampling on multiple-day samplers, this normally will be on the day after the second sample is taken. The next sample set up for the two samples would take place on this day. At collocated sites, the sample from the second monitor will be recovered on the same day as the primary sampler. Sample recovery procedures are detailed in the Virginia *PM2.5* sampling methods standard operating procedures. Table 11-1 contains an example of sample set-up, sample run, and sample recovery dates based upon sample frequency requirements of 1-in-3 day sampling.

TABLE 11-1 SAMPLE SET-UP, RUN AND RECOVERY DATES

SAMPLE FREQUENCY	SAMPLER TYPE	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 in 3 Week 1	Multiple Day	Sample Day 1			Sample Day 2	Recovery & Set-up		Sample Day 3
1 in 3 Week 2	Multiple Day			Sample Day 4	Recovery & Set-up		Sample Day 5	
1 in 3 Week 3	Multiple Day		Sample Day 6	Recovery & Set-up		Sample Day 7		
1 in 3 Week 4	Multiple Day	Sample Day 8	Recovery & Set-up		Sample Day 9	Recovery & Set-up		Sample Day 10
1 in 3 Week 5	Multiple Day			Sample Day 11	Recovery & Set-up		Sample Day 12	
1 in 3 Week 6	Multiple Day		Sample Day 13	Recovery & Set-up		Sample Day 14		
1 in 3 Week 1	Single Day	Sample Day 1	Recovery & Set-up		Sample Day 2	Recovery & Set-up		Sample Day 3
1 in 3 Week 2	Single Day		Recovery & Set-up	Sample Day 4	Recovery & Set-up		Sample Day 5	Recovery & Set-up
1 in 3 Week 3	Single Day		Sample Day 6	Recovery & Set-up		Sample Day 7	Recovery & Set-up	

11.3 Support Facilities for Sampling Methods

The Virginia DEQ Regional Offices and the Office of Air Monitoring will be the supporting facilities for the *PM2.5* monitoring program. In each of these offices, there will be a designated area for WINS cleaning, sample preparation, and PM2.5 sampling supply storage. The Office of Air monitoring will procure and distribute these supplies. Table 11.2 is a listing of some of the basic supplies that will be maintained at the support facility.

TABLE 11-2 SUPPLIES AT SUPORT FACILITIES

Item	Minimum Quantity	Notes
Barometer	1	In range expected for area, and NIST traceable
Fuses	2	Of the type specified in the sampler manual
Temperature /humidity standard	1	In the range expected for this area and NIST traceable
Flow rate standard	1	Calibrated from at least 15.0 LPM to 18.4 LPM and NIST Traceable
Sampler Operations Manual	1 per model	
$PM_{2.5}$ Sampling SOP	1	
Flow rate verification filter	2	
Non-Permeable Membrane	2	Contained in sampling cassette
Filter Cassettes	2	For use with flow rate check filter or non-permeable membrane
Impactor Oil	1 Bottle	
Cleaning Wipes	1 Box	Dust resistant
Rain collector	1	
Tweezers	2	One for teflon filters, one for quartz filter
Methanol	1 bottle	In labeled squeeze bottle
Cotton swabs	1 package	
Pressurized air spray cans	1	For cleaning cassettes and WINS
Anti-static mat	1	Cassette preparation
Small refrigerator	1	Filter storage

Because there are other items that the field operator may need during a site visit that are not expected to be at each site, the operator is expected to bring these items. Table 11-3 details those items each operator is expected to bring.

TABLE 11-3 SITE DEPENDENT EQUIPMENT AND CONSUMABLES

ITEM	MINIMUM QUANTITY	NOTES
Min/Max thermometer	1	Sample QA
Lap Top Computer or palmtop	1	Set-up to receive data from monitor.
Floppy Disks	1 box	3.5", with labels
WINS Impactor Assembly	1	
FRM Filter Cassettes	1 for each sampler, plus field blanks	Loaded with pre-weighed filter
Transport Container	2	1 for pre-weighed, 1 for sampled filter.
Ice substitute	1	
Storage cooler	1	Filter transport QC

11.4 Sampling/Measurement System Corrective Action

Should problems occur in the PM2.5 air quality monitoring network, corrective measures will be taken to ensure that the data quality objectives are attained. Table 11-4 contains a description of a number of potential problems, and the actions required to correct each, in keeping with the maintenance of a well-run monitoring network.

TABLE 11-4 FIELD CORRECTIVE ACTION

ITEM	PROBLEM	ACTION	NOTIFICATION
Filter Inspection (Pre-sample)	Pinhole(s) or torn	1.) If additional filters have been brought, use one of them. Void filter with pinhole or tear.	1.) Document on field data sheet.
		2.) Use new field blank filter as sample filter.	2.) Document on field data sheet.
		3.) Obtain a new filter from Regional office or lab.	3.) Notify Field Manager
Filter Inspection (Post-sample)	Torn or otherwise suspect particulate by-passing 46.2 mm filter.	1.) Inspect area downstream of where filter rests in sampler and determine if particulate has been by-passing filter.	1.) Document on field data sheet.
		2.) Inspect in-line filter before sample pump and determine if excessive loading has occurred. Replace as necessary.	2.) Document in log book.
WINS Impactor	Heavily loaded with course particulate. Will be obvious due to a "cone" shape on the impactor well.	Clean downtube and WINS impactor. Load new impactor oil in WINS impactor well	Document in log book
Sample Flow Rate Verification	Out of Specification (±4% of transfer standard)	1.) Completely remove flow rate device, re-connect and re-perform flow rate check.	1.) Document on data sheet.
		2.) Perform leak test.	2.) Document on data sheet.
		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 zero bias or slope.	3.) Document on data sheet. Notify Field Manager
		4.) Re-calibrate flow rate	4.) Document on data sheet. Notify Field Manager.

TABLE 11-4 FIELD CORRECTIVE ACTION

ITEM	PROBLEM	ACTION	NOTIFICATION
LeakTest	Leak outside acceptable tolerance (80 mL/min)	1.) Completely remove flow rate device, re-connect and re-perform leak test.	1.) Document in log book.
		2.) Inspect all seals and O-rings, replace as necessary and re-perform leak test.	2.) Document in log book, notify Field Manager, and flag data since last successful leak test.
		3.) Check sampler with different leak test device.	3.) Document in log book and notify Field Manager.
Sample Flow Rate	Consistently low flows documented during sample run	1.) Check programming of sampler flowrate.	1.) Document in log book.
		2.) Check flow with a flow rate verification filter and determine if actual flow is low.	2.) Document in log book.
		3.) Inspect in-line filter downstream of 46.2 mm filter location, replace as necessary.	3.) Document in log book.
Ambient Temperature Verification, and Filter Temperature Verification.	Out of Specification (+4%C of standard)	1.) Make certain thermocouples are immersed in same liquid at same point without touching sides or bottom of container.	1.) Document on data sheet.
		2.) Use ice bath or warm water bath to check a different temperature. If acceptable, re-perform ambient temperature verification.	2.) Document on data sheet.
		3.) Connect new thermocouple.	3.) Document on data sheet. Notify Field Manager.
		4.) Check ambient temperature with another NIST traceable thermometer.	4.) Document on data sheet. Notify Field Manager

TABLE 11-4 FIELD CORRECTIVE ACTION

ITEM	PROBLEM	ACTION	NOTIFICATION
Ambient Pressure Verification	Out of Specification (±10 mm Hg)	1.) Make certain pressure sensors are each exposed to the ambient air and are not in direct sunlight.	1.) Document on data sheet.
		2.) Call local Airport or other source of ambient pressure data and compare that pressure to pressure data from monitors sensor. Pressure correction may be required	2.) Document on data sheet.
		3.) Connect new pressure sensor	3.) Document on data sheet. Notify Field Manager
Elapsed Sample Time	Out of Specification (1 min/mo)	Check Programming, Verify Power Outages	Notify Field Manager
Elapsed Sample Time	Sample did not run	1.) Check Programming	1.) Document on data sheet. Notify Field Manager
		2.) Try programming sample run to start while operator is at site. Use a flow verification filter.	2.) Document in log book. Notify Field Manager.
Power	Power Interruptions	Check Line Voltage	Notify Field Manager
Power	LCD panel on, but sample not working.	Check circuit breaker, some samplers have battery back-up for data but will no work without AC power.	Document in log book
Data Downloading	Data will not transfer to laptop computer	Document key information on sample data sheet. Make certain problem is resolved before data is written over in sampler microprocessor.	Notify Field Manager.

11.5 Sampling Equipment, Preservation, and Holding Time Requirements

In this section, details are provided on the following: the requirements for preventing sample contamination; the volume of air to be sampled; how to protect the sample from contamination; temperature preservation requirements; and the permissible holding times to ensure against degradation of sample integrity.

11.5.1 Sample Contamination Prevention

The PM2.5 network has rigid requirements for preventing sample contamination. Filter cassettes are to be stored in filter cassette storage containers provided by the sampler manufacturer during transport to and from the filter preparation area. Once samples have been weighed, they are to be stored individually in petri dishes, with the particulate side up.

11.5.2 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50. This sample flow rate is 16.67L/min. The total sample of air collected will be 24 cubic meters, based upon a 24 hour sample. Samples are expected to be collected over 24 hours; however, in some cases a shorter sample period may be necessary, not to be less than 23 hours. Because capture of the fine particulate is predicated upon a design flow rate of 16.67 L/min, deviations of greater than 10% from the design flow rate will enable a shut-off mechanism for the sampler. If a sample period is less than 23 hours or greater than 25 hours, the sample will be flagged and the QA Officer notified.

11.5.3 Temperature Preservation Requirements

The temperature requirements for the PM25 network are explicitly detailed in 40 CFR Part 50, Appendix L. During transport from the weigh room to the sample location, there are no specific requirements for temperature control. The filter temperature requirements are provided in Table 11- 5

TABLE 11-5 FILTER TEMPERATURE REQUIREMENTS

ITEM	TEMPERATURE REQUIREMENT	REFERENCE
Filter temperature control during sampling and until recovery.	No more than 5°C above ambient temperature.	40 CFR Part 50, Appendix L, Section 7.4.10
Filter temperature control from time of recovery to start of conditioning.	Protected from exposure to temperatures over 25°C.	40 CFR Part 50, Appendix L, Section 10.13
Post sample transport so that final weight may be determined up to 30 days after end of sample period.	4° C or less	40 CFR Part 50, Appendix L, Section 8.3.6

11.5.4 Permissible Holding Times

The permissible holding times for PM2.5 samples are detailed in both 40 CFR Part 50, Appendix 1, and Section 2.12 of the EPA QA Handbook. These holding times are provided in Table 11-6.

TABLE 11-6 HOLDING TIMES

ITEM	HOLDING TIME	FROM:	TO:	REFERENCE
Pre-weighed Filter	≤30 days	Date of Pre-weigh	Date of Sample	40 CFR Part 50, Appendix L, Section 8.3.5
Recovery of Filter	≤96 hours	Completion of sample period	Time of sample recovery	40 CFR Part 50, Appendix L, Section 10.10
Transport of Filter	<24 Hours (ideally)	Time of recovery	Time placed in conditioning room	40 CFR Part 50, Appendix L, Section 10.13
Post Sample Filter stored at <4° C.	≤30 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Section 8.3.6
Post Sample Filter continuously stored at <25° C.	≤10 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Section 8.3.6

References

U.S. EP A (1997a) National Ambient *Air* Quality Standards for Particulate Matter - Final Rule. 40 CFRPart 50. *Federal Register,* 62(138):38651-38760, July 18,1997.

U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Surveillance for Particulate Matter - Final Rule. 40 CFR Parts 53 and 58. *Federal Register,* 62(138):38763-38854, July 18, 1997.

U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring *PM2.s* in Ambient Air Using Designated Reference or Class I Equivalent Methods. March 1998.

R & P Company, Inc. *PM2.5 Monitor Model2025A Operating Manual #42-004773.* June 1998

12.0 SAMPLE CUSTODY

Preservation of the integrity of the PM2.5 filters in the pre-sampling, sampling, and post-sampling stages is a critical component of the PM2.5 air monitoring project. All filter handling operations will be conducted by trained personnel, and a written record of filter history will be maintained for each sample.

12.1 Presampling Custody

The DEQ Office of Air Monitoring will receive the PM2.5 Teflon filters from the EPA contract supplier in staggered shipments. The contact for filter receipt is Thomas Jennings, DEQ Office of Air Quality Monitoring. Filters then will be hand-delivered to the Virginia Division of Consolidated Laboratory Services for storage, conditioning, inspection, and weighing prior to sampling. The laboratory will provide a signed receipt to acknowledge receipt of the filters.

At the laboratory, the PM2.5 filters will be conditioned and weighed in accordance with procedures as described in EPA Guidance Document 2.12. The tared filters will be placed in individual tight seal petri dishes supplied by the OAM. A tracking number will be affixed to the petri dish. (A bar code may be utilized.) Tared filters will then be shipped to the DEQ Regional Offices via contract courier. A regional contact will be established for each office, and this individual will sign for the filters. The filters will be logged in and placed in the designated clean holding area. Just prior to

sampling, the filter will be removed from the petri dish and placed in the filter holder cassette. The sampler operator will log the filter number, cassette number, monitoring site number, set-up date, and the sample date. The filter/cassette will then be transported to the sampling site in a protected container. At the monitoring site, the operator will log the filter number into the sampler microprocessor via keyboard entry.

12.2 Post-sampling Custody

After completion of sampling, the operator will electronically download the operational data for each sample period. The filter/cassette will be removed and placed in a protective container. The container will be placed in a cooler containing cold packs and transported to the operator's office. The cooler will contain a minimum/maximum temperature recording thermometer. Once at the office, the filter will be removed from the cassette and placed back into its labeled petri dish. The filter will then be placed in a refrigerator while awaiting shipment to the laboratory. The maximum temperature in the cooler interior during transport will be recorded on the accompanying sample information sheet.

The sampler operational data that was downloaded will be transferred to the Office of Air Quality Monitoring via e-mail attachment.

12.3 Shipping Information

Filter samples, accompanied by all of the operational and QA information for each sample, will be sent to the Division of Consolidated Laboratory Services (DCLS) for analysis. The shipment will be via a contract courier service. Each container will be sealed, and the courier will sign for each package. The courier will deliver the containers to the DCLS in Richmond.

12.4 Filter Receipt

The filters will be received by the lab's Sample Receiving Section. The filters will then be processed in accordance with the DCLS internal sample custody procedures.

The Office of Air Quality Monitoring will ensure the following:

- samples are collected, transferred, stored, and analyzed by authorized personnel;
- sample integrity is maintained during all phases of handling and analysis;
- an accurate record of filter handling and transfer is maintained from the time of initial receipt until archiving.

13.0 ANALYTICAL METHODS REQUIREMENTS

13.1 PURPOSE/BACKGROUND

The Division of Consolidated Laboratory Services will provide the analytical services for the DEQ by utilizing EPA's approved method as described in 40 CPR, Part 40, Appendix L. This method provides for gravimetric analyses of filters used in the Virginia PM2.5 network. The net weight gain of a sample is calculated by subtracting the initial weight from the final weight. Once calculated, the net weight gain can be used with the total flow that passed through a filter to calculate the PM2.5 concentration. The filters will be archived for one year after fmal gravimetric analyses are completed.

13.2 PREPARATION OF SAMPLES

When the EPA-supplied 46.2 mm Teflon filters are delivered for use in the Virginia network, their receipt will be documented. Each case of filters then will be labeled with the date of receipt. The filters will be stored without delay in the conditioning/weighing room/laboratory. The filters will be opened one at a time, and each case will be used completely before another case is opened. All filters in a given lot will be used before a case containing another lot is opened. When more than one case is available to open, the "First In-First Out" rule will apply-that is, the first case of filters received will the first case to be used.

Filters will be taken out of the case when there is enough room for more samples in the pre-sampling weighing section of the filter-conditioning storage compartment. Filters will be inspected visually according to the FRM criteria to determine compliance. Filters then will be stored in the filter-conditioning compartment, where they will be conditioned for a minimum of 24 hours. Because dust could settle on the topsides of the filters- they will not be left out for excessive times.

13.3 ANALYSIS METHOD

13.3.1 ANALYTICAL EQUIPMENT AND METHOD

The DCLS intends to acquire an automated weighing system for use in the PM2.5 monitoring program. This system will meet the requirements for readability (1 μg) and repeatability (1 μg). The weighing system will be calibrated and maintained under a service agreement. SOPs for this system are now under development, and upon completion they will be included as part of this QAPP.

13.3.2 CONDITIONING AND WEIGHING ROOM

The primary support facility for the PM2.5 network is the fIlter-conditioning and weighing room/laboratory. The weighing room/laboratory will used for both pre-sampling and post-sampling weighing of each PM2.5 filter sample. Specific requirements for environmental control of the conditioning/weighing room laboratory are detailed in 40 CFR Part 50 Appendix L.

The DCLS is moving ahead to procure the necessary equipment and seIVices to install a weigh room that is environmentally controlled. At a minimum, the room temperature will be controlled from 20°to 23°C. Humidity will be contro lled at from 30 to 40% relative humidity. The temperature and the relative humidity will be measured and recorded continuously during filter equilibration. The balance will be situated to minimize vibration, and it will be protected from or located out of the path of any sources of drafts. To allow their weights to stabilize, filters will be conditioned for at least 24 hours before both the pre- and the post-sampling weighings.

13.4 INTERNAL QC AND CORRECTIVE ACTION FOR MEASUREMENT SYSTEM

The DCLS will maintain QC information files that will include microbalance calibration and maintenance information, routine internal QC checks of mass reference standards, laboratory and field filter blanks, and external QA audits.

The analyst will follow procedures as described in EPA guidance document 2.12 and 40 CFR, Part 50, Appendix L. These procedures will include instructions for zeroing and calibrating the microbalance, weighing filters and field blanks, and performing

additional QA reweighings. Limits will be established for differences in blank measurements, in working standards, and in reweighings. Protocols for managers to monitor the quality of the data collected will be instituted, as will protocols for taking corrective actions.

Corrective actions measures in the PM2.5 FRM system will be taken to ensure the collection of good data. Tables 13-1 (organized by laboratory support equipment); and 13-2 (organized by laboratory support activity) list possible problems and the corrective actions needed to support a well-run PM2.5 network. Should any of the listed problems occur, filter weighing will be delayed until the pertinent corrective actions are implemented satisfactorily.

TABLE 13-1—POTENTIAL PROBLEMS/CORRECTIVE ACTION FOR LABORATORY SUPPORT EQUIPMENT

SYSTEM	ITEM	PROBLEM	ACTION	NOTIFICATION
Weigh Room	Humidity	Out of Specification	Check HVAC system	Lab Group Manager
Weigh Room	Temperature	Out of Specification	Check HVAC system	Lab Group Manager
Balance	Internal Calibration	Unstable	Re-do and check working standards	Lab Group Manager
Balance	zero	Unstable	Redo and check for drafts, sealed draft guard	Lab Group Manager
Balance	Working Standards	Out of Specification	Check balance with Primary standards	Lab Group Manager
Balance	Filter Weighing	Unstable	Check Lab Blank Filters	Document in Log Book

TABLE 13-2—FILTER PREPARATION AND ANALYSIS CHECKS

ACTIVITY	METHOD & FREQUENCY	REQUIREMENTS	ACTION IF UNMET
Microbalance use	—	Resolution of 1 μg, repeatability of 1 μg	Obtain proper microbalance
Control of balance. environment	—	Climate-controlled, draft-free room or chamber or equivalent	Modify the environment
Use of mass reference standards	Working standards checked every 3 to 6 months against laboratory primary standards	Standards bracket weight of filter, individual standard's tolerance less than 25 μg, handle with smooth, nonmetallic forceps	Obtain proper standards or forceps
Filter handling	Observe handling procedure	Use powder-free gloves and smooth forceps. Replace ^{210}Po antistatic strips every 6 months	Discard mishandled filter or old antistatic strip
Filter integrity check	Visually inspect each filter	No pinholes, separation, chaff, loose material, discoloration, or filter nonuniformity	Discard defective filter
Filter identification	Write filter number on filter handling container, sampler number on protective container, and both numbers on laboratory data form in permanent ink	Make sure the numbers are written legibly	Replace label or correct form
Pre-sampling filter equilibration	Determine the correct equilibration conditions and period (at least 24 hours) for each new lot of filters. Observe and record the equilibration chamber relative humidity and temperature; enter to lab data form.	Check for stability of laboratory blank filter weights. Weight changes must be <15 μg before and after equilibration. Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 percent over 24 hours. Mean temperature will be held between 20 and 23 %C, with a variability of not more than ±2° C over 24 hours.	Revise equilibration conditions and period. Repeat equilibration
Initial filter weighing	Observe all weighing procedures. Perform all QC checks	Neutralize electrostatic charge on filters. Wait long enough so that the balance indicates a stable reading (oscillates no more than ±2, drifts no more than 3μg, in 5-10 sec).	Repeat weighing

ACTIVITY	METHOD & FREQUENCY	REQUIREMENTS	ACTION IF UNMET
Internal QC	After approximately every tenth filter, re-zero the microbalance and reweigh the two working standards. Weigh three laboratory filter blanks. Reweigh one duplicate filter with each sample batch (duplicate weighing).	The working standard measurements must agree to within 3 µg of the certified values.The blank and duplicate measurements must agree to within 15 µg	Flag values for validation activities.
Post-sampling inspection, documentation, and verification	Examine the filter and field data sheet for correct and complete entries. If sample was shipped in a cooled container, verify that low temperature was maintained.	No damage to filter. Field data sheet complete. Sampler worked OK.	Notify Lab Group Manager. Discard filter. Void sample.
Post-sampling filter equilibration	Equilibrate filters for at least 24 hours. Observe and record the equilibration chamber relative humidity and temperature; enter to lab data sheet. Must be within ± 5% RH of pre-sampling weighing conditions.	Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 % over 24 hours. Mean temperature will be held between 20 and 23°C, with a variability of not more than ±2 °C over 24 hours.	Repeat equilibration
Post-sampling filter weighing	Observe all weighing procedures. Perform all QC checks.	Neutralize electrostatic charge on filters. Wait 30 to 60 seconds after balance indicates a stable reading before recording data.	Repeat weighing

13.5 FILTER SAMPLE CONTAMINATION PREVENTION, AND HOLDING TIME REQUIREMENTS

This section details the requirements for preventing and protecting the filter sample from being either contaminated or degraded; for determining the volume of air to be sampled; and for establishing the temperature preservation requirements, as well as the permissible holding time.

13.5.1 SAMPLE CONTAMINATION PREVENTION

The analytical support component of the PM2.5 network has rigid requirements for preventing sample contamination. Filters will be equilibrated, conditioned, and stored in the same room where they are weighed. Staff will wear powder-free gloves while handling filters; and will contact the filters with only smooth (nonserrated) forceps. After pre-sampling, the filter will be weighed, and then placed in a protective petri dish. The petri dish will be labeled with a unique identifying number in a sequence that includes each filter originating from the DCLS weigh room laboratory.

13.5.2 SAMPLE VOLUME

The volume of air to be sampled is specified in 40 CFR, Part 50. Sample flow rate of air will be 16.67 L/min. Total sample of air collected will be 24 cubic meters based upon a 24-hour sample.

13.5.3 TEMPERATURE PRESERVATION REQUIREMENTS

The temperature requirements of the PM2.5 network are explicitly detailed in 40 CFR, Part 50. In the weigh room laboratory, the filters must be conditioned for a minimum of 24 hours prior to pre-weighing; although, a longer period of conditioning may be required. The weigh room laboratory temperature must be maintained between 20 and 23°C, with no more than a +/- 2℃ change over the 24-hour time span prior to the weighing of the filters. During transport from the weigh room to the sample location, there are no specific requirements for temperature control; however, the filters will be located in their protective container and thus excessive heat will be avoided. Temperature requirements for the sampling and post sampling periods are detailed in 40 CFR. Part 50. Appendix L Section 7.4.10. These requirements specify that the

temperature of the filter cassette during sampler operation and in the period from the end of sampling to the time of sample recovery will not exceed that of the ambient temperature by more than 5°C for more than 30 minutes.

The specifics of temperature preservation requirements are clearly detailed in 40 CFR Part 50, Appendix L[1]. These requirements pertain to both the sample media and the sample. In addition, during the sample collection there are requirements for temperature control. The temperature requirements are noted in Table 13-3.

TABLE 13-3 TEMPERATURE REQUIREMENTS

ITEM	TEMPERATURE REQUIREMENT	REFERENCE
Weigh Room	20 - 23°C	40 CFR Part 50, Appendix L, Section 8.3.1
Pre-weighed Filter	+/- 2° C for 24 hours prior to weighing	40 CFR Part 50, Appendix L, Section 8.3.2
Filter Temperature Control during sampling and until recovery	No more than 5°C above ambient temperature.	40 CFR Part 50, Appendix L, Section 7.4.10
Post Sample Transport so that final weight may be determined up to 30 days after end of sample period	4°C or less	40 CFR Part 50, Appendix L, Section 8.3.6

13.5.4 PERMISSIBLE HOLDING TIMES

The permissible holding times for the PM2.5 sample are clearly detailed in both 40 CFR Part 50[1] and Section 2.12 of the U.S. EPA QA Handbook.

REFERENCES

The following documents were utilized in the development of this section:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter- Final Rule. 40 CFR Part 50. *Federal Register,* **62**(138):38651-38760. July 18,1997.

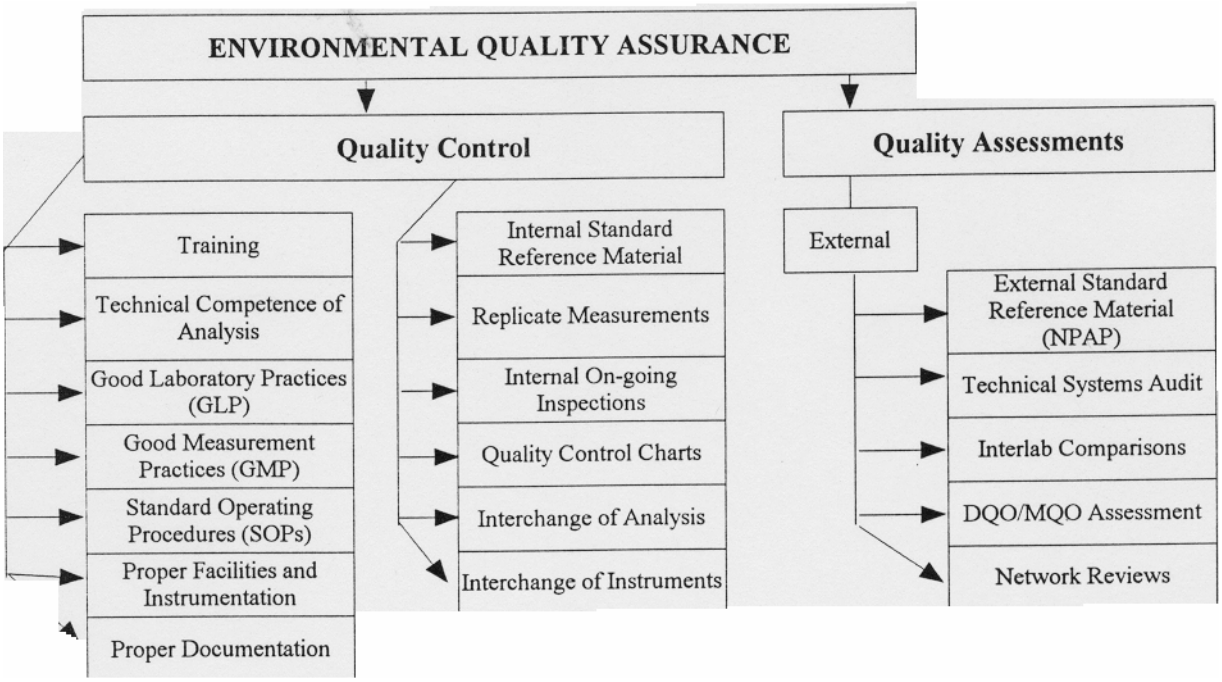
2. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods. March, 1998.

14.0 QUALITY CONTROL REQUIREMENTS

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is to control the measurement process through broad quality assurance activities, such as establishing policies and procedures, developing data quality objectives, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is to control the measurement process through the implementation of specific quality control procedures, such as audits, calibrations, checks, replicates, and routine self-assessments. In general, the greater the control of a given monitoring system, the better will be the resulting quality of the monitoring data.

Quality Control (QC) is 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 data user. In the ambient air quality monitoring network, QC activities ensure that measurement uncertainty is maintained within acceptance criteria for attaining the data quality objectives (DQOs). Figure 14.1 shows QC activities that help to evaluate and control data quality for the PM2.5 program. Many of the activities in this figure are implemented by the VA DEQ and are discussed in this QAPP.

Figure 14.1 Quality Control and Quality Assessment Activities



14.1 QC Procedures

Day-to-day quality control is implemented through the use of various check samples or instruments that are used for comparison. The measurement quality objectives table (Table 7-4) in Section 7 contains a complete listing of these QC samples as well as other requirements for the PM2.5 Program. The procedures for implementing the QC samples are included in the field and analytical methods section (Sections 11 and 13 respectively). Various types of QC samples have been inserted at phases of the data operation to assess and control measurement uncertainties. Tables 14-1 and 14-2

summarize all the field and laboratory QC samples. The following information provides additional descriptions of these QC activities, how they will be used in the evaluation process, and what corrective actions will be taken when they do not meet acceptance criteria.

Table 14-1 Field QC Checks

Requirement	Frequency	Acceptance Criteria	CFR Reference	2.12 Reference	Information Provided
Calibration standards					
Flow rate transfer std.	yearly	± 2% of NIST-traceable std.	Part 50 App. L, sec. 9.1, 9.2	Sec. 6.3	Certification of traceability
Field thermometer	yearly	± 0.1 C resolution	not described	Sec. 4.2 and 8.3	Certification of traceability
		± 0.5 C accuracy	"	"	
Field barometer	yearly	± 1 mm Hg resolution	not described	"	Certification of traceability
		± 5 mm Hg accuracy	"	"	
Calibration, verification					
Flow rate (FR) calibration	If multi-point failure	± 2% of transfer standard	Part 50 App L, sec. 9.2	Sec. 6.3 and 6.6	Calibration drift and memory effects
FR multi-point verification	yearly	± 2% of transfer standard	Part 50 App L, sec. 9.2.5	Sec. 8.3	Calibration drift and memory effects
One point FR verification	monthly	± 4% of transfer standard		Sec. 8.3	Calibration drift and memory effects
External leak check	every 5 sampling events	80 mL/min	Part 50 App L sec. 7.4	Sec. 8.3	Sampler function
Internal leak check	every 5 sampling events	80 mL/min		Sec. 8.3	Sampler function
Temperature calibration	If multi-point failure	± 2% of standard	Part 50 App L, sec. 9.3	Sec. 6.4	Calibration drift and memory effects
Temp multi-point verification	On installation, then yearly	± 2 C of standard	Part 50 App.L, Sec 9.3	Sec. 6.4 and 8.2	Calibration drift and memory effects
One- point temp verification	monthly	± 4 C of standard		Sec. 6.4 and 8.2	Calibration drift and memory effects
Pressure calibration	On installation, then yearly	± 10 mm Hg		Sec. 6.5	Calibration drift and memory effects
Pressure verification	monthly	± 10 mm Hg		Sec. 8.2	Calibration drift and memory effects
Clock/timer verification	monthly	1 minute per month	Part 50 App L, sec. 7.4	not described	Verification of proper function
Blanks					
Field Blanks	See 2.12 reference	± 30 ug	Part 50 App L, sec. 8.2	Sec. 7.10	Measurement system contamination
Precision checks					
Collocated samples	every 6 days	CV < or = 10%	Part 58 App A, sec. 3.5, 5.5	Sec. 10.3	Measurement system precision
Accuracy					
Flow rate audit	every 3 mos. (manual)	± 4% of transfer standard	Part 58 App A, sec. 3.5.1	Sec. 8.1	Instrument bias, accuracy
External leak check	4 per year	< 80 mL/min	not described	"	Sampler function
Internal leak check	4 per year	< 80 mL/min	not described	"	Sampler function
Temperature check	4 per year	± 2 C	not described	"	Calibration drift and memory effects
Pressure check	4 per year (?)	± 10 mm Hg			Calibration drift and memory effects
Audits (external assessments)					
FRM performance evaluation	25 % of sites 4 per year	± 10 %	Part 58 App A, sec. 3.5.3	Sec. 10.3	Measurement system bias
Flow rate audit	yearly	± 4% of audit standard	not described	Sec 10.2	External verification bias/accuracy
External leak check	yearly	< 80 mL/min	not described		Sampler function
internal leak check	yearly	< 80 mL/min	not described		Sampler function
Temperature audit	yearly	± 2 C	not described		Calibration drift and memory effects
Pressure audit	yearly	± 10 mm Hg	not described		Calibration drift and memory effects

Table 14-2 Laboratory QC

Requirement	Frequency	Acceptance Criteria	QA Guidance Doc 2.12 Reference	Information Provided
Blanks				
Lot Blanks	3 per lot	± 15 ug difference	2.12 sec. 7	Filter stabilization/ equilibrium
Lab Blanks	3 per batch	± 15 ug difference	Part 50, App. L sec. 8.2 2.12 sec. 7.10	Laboratory contamination
Calibration, verification				
Balance calibration	yearly	Manufacturer's specs	2.12 sec. 7.2	Verification of equipment operation
Lab temp. calibration	every 3 mos.	± 2 C	QAPP sec 13/16	Verification of equipment operation
Lab humidity calibration	every 3 mos.	± 2%	QAPP sec 13/16	Verification of equipment operation
Accuracy				
Balance audit	yearly	± 15 ug for unexposed filters	2.12 sec. 10.2	Laboratory technician operation
Balance Check	beginning, every 10 samples, end	= or < 3 ug	2.12 sec. 7.8	Balance accuracy/stability
Calibration standards				
Working mass stds.	25 % of sites 4 per year	25 ug	2.12 sec. 4.3 and 7.3	Standards verification
Primary mass stds.	yearly	25 ug	"	Primary standards verification
Precision				
Duplicate filter weighings	1 weighing per session	± 15 ug difference	2.12 tab. 7-1 QAPP sec 13/16	Weighing repeatability/filter stability

14.1.1 Calibrations

Calibration is the comparison of a measurement standard or instrument with another standard or instrument to report or eliminate by adjustment any variation (deviation) in the accuracy of the item being compared [1]. The purpose of calibration is to minimize bias.

For PM2.5, calibration activities follow a two step process:

Certifying the calibration standard and/or transfer standard against an authoritative standard, Comparing the calibration standard and or transfer standard against the routine sampling/analytical instruments.

Calibration requirements for the critical field and laboratory equipment are found in Tables 14-1 and 14-2 respectively; the details of the calibration methods are included in the calibration section (Section 16) and in the field and laboratory methods sections (11 and 13 respectively).

14.1.2 Blanks

Blank samples are used to determine contamination arising from principally three sources: the environment from which the sample was prepared, collected, or analyzed, the apparatus used, and the operator or analyst performing the data operation. Three types of blanks will be implemented in the PM2.5 program and are defined below:

- Lot blanks,
- Field blanks, and
- Laboratory blanks.

The VA DEQ personnel will randomly select three lot blanks from each shipment of 46.2 mm filters sent by the EPA. The blanks will be subjected to the conditioning and pre-sampling weighing

procedures; they will be measured every 24 hours for a minimum of one week to determine time required for the filters to maintain a stable weight reading.

Field blanks provide an estimate of total measurement system contamination. By comparing information from the laboratory blanks and the field blanks, one can assess contamination from field activities. Lab blanks provide an estimate of contamination occurring at the weighing facility.

14.1.2.1 Blank Evaluation:

The VA DEQ will include three field and three lab blanks in each weighing session batch. A batch is defined in section 14.2. The following statistics will be generated for data evaluation purposes:

- Difference for a single check (d),
- **Percent difference for a single check (d_i)**
- Mean difference for a batch (d_z).

The difference, *d,* for each check is calculated using Equation 1, where *X* represents the concentration produced from the original weight and *Y* represents the concentration reported for the duplicate weight,

$$d = |Y - X| \qquad \text{Equation 1}$$

The percentage difference d_i for each check is calculated using Equation 2, where X_i represents the original weight and Y_i represents the concentration reported for the duplicate weight.

$$d_i = \frac{(Y_i - X_i)}{(Y_i + X_i)/2} \times 100\% \qquad \text{Equation 2}$$

The mean difference d_z, for both field and lab blanks within a weighing session batch, is calculated using Equation 3 where d_1 through d_n represent individual differences (calculated from equation 1) and *n* represents the number of blanks in the batch.

$$d_z = \frac{(d_1 + d_2 + d_3 + \ldots + d_n)}{n} \qquad \text{Equation 3}$$

14.1.2.2 Corrective action following blank evaluation:

The acceptance criteria for field blanks is 30 *u*g difference; for lot and lab blanks it is 15 *u*g difference and is determined by Equation 1. The mean difference based upon the number of blanks in each batch will be used for comparison against the acceptance criteria. If the mean difference of either the field or laboratory blanks is greater than 15 *ug,* all the samples in the weighing session will be re-weighed. The laboratory balance will first be checked for proper operation. If the blank means of either the field or lab blanks are still out of the acceptance criteria, all samples within the weighing session will be flagged, and efforts will be made to determine the source of contamination. In theory, field blanks should contain more contamination than lab blanks. Therefore, if the field blanks are outside of the criteria while the lab blanks are acceptable, weighing can continue on the next batch of samples while field contamination sources are investigated. If the mean difference of the laboratory blanks is greater than 20 *ug,* and two or more of the blanks were greater than 15 u*g,* the laboratory weighing will stop until the issue is satisfactorily resolved. The laboratory technician will alert the

laboratory group manager to the problem. The problem and solution will be reported and filed under response and corrective action reports.

Lab and field blanks will be control charted (see Section 14.3). The percent difference calculation (equation 2) is used for control charting purposes and can be used to determine equilibrium status.

14.1.3 Precision Checks

Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. In order to meet the data quality objectives for precision, the VA DEQ must ensure that the entire measurement process is within statistical control. Two types of precision measurements will be made in the PM2.5 program.

- Collocated monitoring
- Filter duplicates.

14.1.3.1 Collocated Monitoring:

Collocated monitoring will be implemented to evaluate total measurement precision, as referenced in *CFR.* Every method designation will

- have 25% of the monitors collocated (values of 0.5 and greater round up),
- have 50% of the collocated monitors FRM monitors and 50% the same method designation; if an odd number of collocated monitors is required, bias will be in favor of the FRM.

Every designated monitor in the VA DEQ PM 2.5 network will be an FRM Rupprecht & Patashnick model 2025 Sequential Sampler. The VA DEQ will collocate at least 25% of its PM2.5 network with

the same FRM R&P Model 2025 Sequential Samplers.

14.1.3.1.1 Evaluation of Collocated Data:

Collocated measurement pairs are selected for use in the precision calculations only when both measurements are above 6 $g/m^{3.}$ All collocated data will be reported to AIRS.

The algorithms listed below will be used to evaluate collocated data. They are describe in detail in *40 CFR Part 58 Appendix A:*

- Percent difference for a single check *(d_i)*,
- Coefficient of variation (CV) for a single check *(CV_i),*
- Precision of a single sampler, quarterly and annual basis ($CV_{j,q}$),

The 90 percent upper and lower confidence limits for the single sampler's CV.

14.1.3.1.2 Corrective action, single monitor:

The precision data quality objective of a 10% coefficient of variation (CV) is based upon the evaluation of three years of collocated precision data. The goal is to ensure that precision is maintained at this level. Precision estimates for a single pair of collocated instruments, or even for a quarter, may be greater than 10% while the three year average is less than or equal to 10%. Therefore, single collocated pairs with values > 10% will be flagged and reweighed. If the value remains between 10-20% the field technician will be alerted to the problem. If the CV is greater than 20% for both the initial and reweigh, all the primary sampler data from the last precision check will be flagged, and corrective action will be initiated. Paired CV s and percent differences will be control charted to determine trends (section 14.2). The laboratory technician will alert the laboratory group

manager to the problem. The problem and solution will be reported and filed under response and corrective action reports.

14.1.3.1.3 Corrective action, quarter:

Normally, corrective action will be initiated and imprecisions will be rectified before a quarter's worth of data fail to meet 10% CV. Where a quarter's CV is greater than 20%, the routine data for that monitor for that quarter will be flagged. The OAM, the Lab, and the regional air monitoring managers will work together to identify the problem and find a solution. The EPA Region III office will be informed of the issue and may be asked to help find a common solution. The problem and solution will be reported and filed under response and corrective action reports.

14.1.3.2 Duplicate Laboratory Measurements:

During laboratory pre- and post-sample weighing sessions, a routine filter from the sampling batch will be selected for a second weighing. Equations 1 and 2 will be generated for this sample. The difference between the weights of the two filters must be less than 15 ug. If this criteria is not it met, the pair of values will be flagged. A difference might result from transcription errors, microbalance malfunction, or routine samples not yet reaching equilibrium. Other QC checks, namely balance standards and lab blanks, will minimize microbalance malfunction. If the duplicate does not meet the criteria, another routine sample will be selected and reweighed as a second duplicate check. If this second check fails the acceptance criteria, and the possibility of balance malfunction and transcription errors have been eliminated, then all samples in the batch will be equilibriated for another 24 hours and

reweighed. Corrective actions will continue until duplicate weights for the batch meet acceptance criteria.

14.1.4 Accuracy or Bias Checks:

Accuracy is defined as the level of agreement between an observed value and an accepted reference value and includes a combination of random error (precision) and systematic error (bias). Accuracy checks implemented in the PM2.5 program include:

- Collocated monitors,
- Flow rate audits,
- Balance checks,
- FRM performance evaluations.

14.1.4.1 Collocated Monitors:

Although the collocated monitors are primarily used for evaluating and controlling precision, they can be used to determine accuracy or bias. By calculating percent difference, one can track trends or bias between two instruments without knowing which is producing the true value. Using the FRM performance evaluation information, discussed below, in conjunction with collocation data should help improve the quality of data.

14.1.4.1.1 Corrective action for collocated monitors:

The percent difference of the paired values will be control charted to determine trends. If it appears that there is a statistically significant bias between the pairs (> 10% at the 90% confidence level), corrective action will be initiated. The process will include eliminating uncertainties at filter handling,

transport, and laboratory stages, to verify that bias is with the instrument. Corrective actions at the instrument will include multi-point temperature, pressure, and flow rate checks, and complete maintenance activities. Additional corrective action might include a request for vendor servicing or a request for EPA Region Ill to implement an FRM performance evaluation.

14.1.4.2 Flow Rate Audits:

Since the VA DEQ will be implementing manual rather than continuous sampling devices, we will perform a flow rate audit every quarter. Details of the audit are included in Section 11. The audit is made by measuring the analyzer's normal operating flow rate using a certified flow rate transfer standard. The flow rate standard used to audit the analyzer will be separate from the one used for calibration. Both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. The audit (actual) flow rate and the corresponding sampler (indicated) flow rate will be reported. The procedures listed below are used to calculate measurement uncertainty. They are described in detail in *40 CFR Part* 58, *Appendix A:*

- Accuracy of a single sampler: single check (quarterly) basis *(d* i),
- Bias of a single sampler - annual basis *(d* j).
- Bias for each EP A federal reference and equivalent method designation employed by the VA DEQ - quarterly basis *(d* $_{k, q}$).

14.1.4.2.1 Corrective action following flow rate audits:

The single sampler accuracy requirement is $\pm$ 4%. If the audit finds a violation of the acceptance

criteria, the sampler will be checked for internal and external leaks; if temperature and pressure are within acceptable ranges, the audit will be run a second time. If the audit is still unacceptable, a multi-point calibration is required. Routine data, back to an acceptable audit, will be flagged and reviewed to determine validity. The flow rate calibration verification checks that will be implemented every 5 sampling events would indicate a drift towards unacceptable accuracy. If a review of the flow rate calibration verification check data does not show a problem, one or both of the flow rate standards might need to be recertified.

14.1.4.3 Balance Checks:

Balance checks compare the working standards (100 and 200 mg) with the balance to ensure that the balance is within acceptance criteria throughout the pre- and post-sampling weighing sessions. The Lab will use ASTM class 1 weights for its primary and secondary (working) standards. Both working standards will be measured at the beginning and end of the sample batch, and one will be selected for a measure after every 10 filters. Balance check samples will be control charted (see Table 14-5). The statistic *d* v (difference for a single check) will be used to evaluate balance checks.

14.1.4.3.1 Corrective action following balance checks:

The difference between the reported weight and the certified weight must be $\leq$ 3 ug. This is the first check before pre- or post-sampling weighings; if the acceptance criteria is not met, corrective action will be initiated. Corrective action may be as simple as allowing the balance to perform internal calibrations or to sufficiently warm up, which may require checking the balance weights more than

once. If the acceptance criteria still is not met, the laboratory technician will be required to verify the working standards to the primary standards. Finally, if it is established that the balance does not meet acceptance criteria for both the working and the primary standards, and if other troubleshooting techniques are inconclusive, the balance company service technician will be called to perform corrective action.

If the balance check fails acceptance criteria during a run, the 10 filters weighed prior to the failure will be rerun. If the balance check continues to fail, troubleshooting will be initiated. The values for the 10 samples weighed prior to the failure will be recorded and flagged, but will remain with the unweighed samples in the batch and be reweighed once the balance meets the acceptance criteria. The data acquisition system will flag any balance check outside the acceptance criteria.

14.1.4.4 FRM Performance Evaluation:

The Federal Reference Method (FRM) Performance Evaluation is a quality assurance activity which will be used to evaluate measurement system bias of the PM 2.5 monitoring network. The regulations pertaining to this performance evaluation are found in 40 CFR Part 58, App. A, section 3.5.3 [2]. The strategy is to collocate a portable FRM PM 2.5 air sampling instrument with an established routine monitoring site, operate both monitors in exactly the same manner, and then compare the results from this instrument with those from the routine sampler at the site. The EPA will implement this program and will inform the VA DEQ when an evaluation will be conducted. The evaluation will be conducted on a regularly scheduled sampling day, and the filters from the evaluation instrument will

be sent to a national laboratory in for measurement. The EPA personnel will compare the data using the AIRS data base. The performance evaluation estimates of the uncertainty of the measurement system rather than the instrument; biases may be attributed to sample handling, transportation, or laboratory activities, as well as to the instrument. The statistics used in the assessment are described in *40 CFR Part* 58 [2].

14.1.4.4.1 Corrective action following FRM evaluation:

The EPA will inform the VA DEQ of the evaluation results within 10 days of sampling. The bias acceptance criteria for the data comparison is ± 10%. If it appears that there is a bias, corrective action will be initiated. The process will include an attempt to determine at what data collection phase(s) the measurement errors are occurring. This may require that the Region Ill office conduct additional FRM performance evaluations to troubleshoot the process.

14.2 Sample Batching - QC Sample Distribution:

To ensure that the Lab can review all types of QC samples within a weighing session, the Lab may use the concept of sample batches. An example of a batch of samples would consist of all routine and QC samples collected in a two week sample period and the samples indicated in Table 14-3.

Table 14-3 Sample Batch Example

Sample	Number
5 sites 1/3 day sampling	20
Collocated monitors (2)	4
Duplicate filter weighings	1
lab blanks	3
field blanks	3
Balance checks	7
Total	**38**

Sample Distribution:

QC samples need to be dispersed in the batch to provide data quality information throughout the batch weighing session. Table 14-4 represents an example of a sample batch arrangement the laboratory may use during post-sampling weighing activities.

Table 14-4 Batch Sample Distribution:

1) Balance check 1	9) Site 3 wk 1 sample 1	17) Collocated sample site 5 wk 1	25) Lab blank	33) Balance check
2) Balance check 2	10) Site 3 wk 1 sample 2	18) Site 1 wk 2 sample 1	26) Field blank	34) Lab dupl site 1 wk 1 sample 1
3) Lab blank	11) Site 4 wk 1 sample 1	19) Site 1 wk 2 sample 2	27) Site 4 wk 2 sample 1	35) Lab blank
4) Field blank	12) Site 4 wk 1 sample 2	20) Site2 wk 2 sample 1	28) Site 4 wk 2 sample 2	36) Field blank
5) Site 1 wk 1 sample 1	13) Balance check	21) Site2 wk 2 sample 2	29) Site 5 wk 2 sample 1	37) Balance check 1
6) Site 1 wk 1 sample 2	14) Site 5 wk 1 sample 1	22) Site 3 wk 2 sample 1	30) Site 5 wk 2 sample 2	38) Balance check 2
7) Site 2 wk 1 sample 1	15) Site 5 wk 1 sample 2	23) Site 3 wk 2 sample 2	31) Collocated sample site 1 wk 2	
8) Site 2 wk 1 sample 2	16) Collocated sample site A1 wk 1	24) Balance check	32) Collocated sample site 5 wk 2	

14.3 Control Charts:

The Lab will use control charts, which provide a graphical means of determining whether various phases of the measurement process are in statistical control. The Lab will use property charts, which graph single measurements of a standard or a mean of several measurements. The Lab will also develop precision charts, which use the standard deviation of the measurement process. Table 14-5 indicates which QC samples will be control charted. The control charts will be used as an alert system to evaluate trends in precision and bias. They will be discussed in the *Annual QA Report* (Section 21).

Table 14-5 Control Charts:

QC Check	Plotting technique
Lot blanks	Mean value of 3 blanks for each measurement
Flow rate calibration verification check	Single values plotted
Lab/Field Blanks	Mean value of each batch
Flow rate audit	Single values plotted
Balance check	Mean value of each batch
Collocated monitoring pairs	Percent difference each pair charted by site Coefficient of variation each pair Coefficient of variation all sites per quarter
Duplicate filter weighings	Percent difference each pair

References

1. Taylor, J.K. 1987 Quality Assurance of Chemical Measurements. Lewis Publishers, Chelsea, Michigan. 328pp.

2. U.S. EPA (1997b) Revised Requirements for Designation of Reference and Equivalent Methods for PM2.5 and Ambient Air Quality Surveillance for Particulate Matter-Final Rule. 40 CFR Parts 53 and 58. *Federal Register,* **62**(138):38763-38854. July 18, 1997.

15.0 INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

15.1 PURPOSE/BACKGROUND

This element is centered on the procedures used to confirm that the instruments and equipment used in the Virginia DEQ PM2.5 ambient air quality monitoring network are maintained in sound operating condition, and are capable of producing consistently reliable data.

15.2 TESTING

The PM2.5 samplers used in the Virginia DEQ PM2.5 ambient air quality monitoring network will be certified by EP A as designated federal reference methods (FRM). The EPA tests such equipment by means of the procedures described in 40 CFR Part 50. Accordingly, the samplers can be assumed to be of a quality adequate for the data- collection operation. Before installing the samplers at the field locations, the Virginia DEQ will assemble and subject them to a series of tests at the Office of Air Monitoring. The tests will include external and internal leak checks; and temperature, pressure, and flow-rate multi-point verification checks. If any of these checks deviates from the specified standard (see Table 14-1), the OAM will ask the vendor to correct the deficiency. After installing the samplers at the sites, the field operators again will run the same series of tests. If the sampling instrument meets all acceptance criteria, it will be assumed to be operating properly. Complete records of the initial and all subsequent tests will be kept .

15.3 INSPECTION

Inspections will be divided into two sections: one pertaining to weigh room laboratory issues and one associated with field activities.

5.3.1INSPECTION IN WEIGH ROOM LABORATORY

Table 15-1 contains a listing of the weigh room items that must be inspected, as well as details about the optimal frequency for the inspections, the specified follow-up, and the documentation required.

TABLE 15-1. INSPECTIONS IN THE WEIGH ROOM LABORATORY

ITEM	INSPECTION FREQUENCY	INSPECTION PARAMETER	ACTION IF ITEM FAILS INSPECTION	DOCUMENTATION REQUIREMENT
Weigh room Temperature	Daily	20 - 23°C	1.) Check HVAC System	1.) Document in weigh room log book
			2.) Call service provider that holds maintenance agreement	2.) Notify Group Manager
Weigh Room Humidity	Daily	30 - 40 %RH	1.) Check HVAC System	1.) Document in weigh room log book
			2.) Call service provider that holds maintenance agreement	2.) Notify Group Manager
Dust in Weigh Room	Monthly	Use glove and visually inspect	Clean Weigh Room	Document in Weigh Room Log Book

15.3.2 INSPECTION OF FIELD ITEMS

There are several items to inspect in the field both before and after a PM2.5 sample has been taken. Table 15-2 contains a listing of each inspection, with details on the frequency, the inspection parameter, the action to be taken, and the documentation required.

TABLE 15-2. INSPECTION OF FIELD ITEMS

ITEM	INSPECTION FREQUENCY	INSPECTION PARAMETER	ACTION IF ITEM FAILS INSPECTION	DOCUMENTATION REQUIREMENT
Sample downtube	After 3 samples	Visible particulate	Clean with a clean dry cloth	Document in log book
WINS Impactor well	After 3 samples	"Cone" shape of particulate on impactor well	Replace with clean impactor well	Document in log book
Rain collector	Every site visit	>1/3 full	Empty	Document in log book
O-rings	After 3 samples	Any damage	Replace	Document in logbook
Filter Cassettes	After each sample run	Visible particulate	Check downtube and WINS impactor	Document in log book
Cassette Seals	Each sample	Clean and smooth	Clean with a clean dry cloth, or replace as needed	Document when replaced
In-line filter	Every 6 months	Loaded particulate	Replace	Document in log book
Battery	Every 6 months	Decrease in voltage	Replace	Document in log book

15.4 MAINTENANCE

The items that need maintenance in the PM2.5 network fall into two categories: those associated with the weigh room and those associated with data collection in the field.

15.4.1 WEIGH ROOM MAINTENANCE ITEMS

The DCLS will handle all preventive maintenance activities in compliance with EPA Guidance Document 2.12 and internal DCLS standard operating procedures. The laboratory heating, ventilating, and air-conditioning systems will be checked and serviced to assure that the laboratory environment remains consistently within EPA specifications. The DCLS also uses contractor expertise for primary calibrations and maintenance for all balances operating within the laboratory. The microbalance used in the PM2.5 filter weighing program will be maintained to meet all EPA microbalance operational requirements.

TABLE 15-3. PREVENTIVE MAINTENANCE IN WEIGH ROOM LABORATORIES

ITEM	MAINTENANCE FREQUENCY	RESPONSIBLE PARTY
Multi-point Micro-balance maintenance calibration	6 Months Yearly	DCLS contractor
Polonium strip replacement	6 Months	DCLS
Comparison of NIST Standards to laboratory working and primary standards	6 Months	DCLS contractor
Cleaning weigh room	Monthly	Balance Analyst
HEPA filter replacement	Monthly	Balance Analyst
Sticky floor mat (just outside weigh room)	6 Months	Balance Analyst
HVAC system preventive maintenance	Yearly	DCLS
Computer Back-up	Weekly	Balance Analyst
Computer Virus Check	Weekly	Balance Analyst
Computer system preventive maintenance (clean out old files, compress hard drive, inspect)	Yearly	DCLS

15.4.2 FIELD MAINTENANCE ITEMS

To support a successful field data collection program, it is vital to keep up a regular schedule of preventive maintenance. In Table 15-4 we list each appropriate maintenance check of the PM2.5 samplers, along with a schedule of optimal frequency.

TABLE 15-4 PREVENTIVE MAINTENANCE OF FIELD ITEM

ITEM	MAINTENANCE FREQUENCY	LOCATION MAINTENANCE PERFORMED
Clean WINS PM2.5 Impactor	After 5 samples or sooner	At Regional Office
PM 10 Inlet	Monthly	At Site or Regional Office
Filter Cassettes	Each run	At Regional Office
In-line filter	6 Months	At Site
Air Screens (under samplers rain hood)	6 Months	At Site
Clean filter holding area, internal and external	Monthly	At Site
Sample Pump Rebuild	Every 10,000 hours of operation	At OAM

REFERENCES

The following document was used to develop this element:

1. U.S. EPA (1997a) National Ambient Air Quality Standards for Particulate Matter-Final Rule. 40 CFR Part 50. Federal Register, 62(138):38651-38760. July 18,1997.

16.0 INSTRUMENT CALIBRATION

16.1 INSTRUMENTATION REQUIRING CALIBRATION

16.1.1 MASS ANALYSIS BY GRAVIMETRY-LABORATORY MICROBALANCE

Calibration of the microbalance will be an integral component of the laboratory support for the Virginia DEQ. Once a year, under a service agreement, the balance will be calibrated and the mass standard check weights recertified. The service technician will perform routine maintenance, and make any balance-response adjustments the calibration shows to be necessary. To ensure that the balance is functioning optimally, the technician will check both the in-house primary and secondary (working) standards against the manufacturer's standards. Each steps will be documented in the service technician's report, a copy of which will be provided for the laboratory manager to review. All such reports are kept on fIle.

16.1.2 FLOW RATE-LABORATORY

The OAM support will involve comparing the flow-rate transfer standard to a NIST -traceable primary flow-rate standard. Once every three years, OAM will send the primary standard to NIST for recertification.

When OAM receives any new, repaired, or replaced PM2.5 sampler, the OAM laboratory staff will perform a multipoint flow-rate calibration on the sampler to ascertain whether the initial performance is acceptable. When the sampler flow-rates are accepted, the regional operators will perform the calibration and verifications at the frequency specified in Section 14. They also will perform or arrange to have another party perform, the tests needed to recertify the organization's standards.

16.1.3 SAMPLER TEMPERATURE. PRESSURE. TIME SENSORS

The OAM will acquire the necessary equipment and consumables to arrange for the field calibration of temperature and pressure sensors.

A stationary mercury manometer at the OAM will be used as a primary standard to calibrate the barometers that go out in the field as transfer standards.

16.2 CALIBRATION METHOD THAT WILL BE USED FOR EACH INSTRUMENT

16.2.1 LABORATORY- GRAVIMETRIC (MASS) CALIBRATION

The calibration and QC (verification) checks of the microbalance will be performed following EPA Guidance Document 2.12, and DCLS SOPs currently under development for this project. For the following three reasons, the multipoint calibration for this method will be zero, 100 and 200 u*g:* (1) the required sample-collection filters weigh between 100 and 200 mg; (2) the anticipated range of sample loadings for the 24-hour sample period is rarely going to be more than a few 100 ugs; and (3) the lowest, commercially available check weights that are certified according to nationally accepted standards are in only the single milligram range. Because the critical weight is not the absolute unloaded or loaded filter weight, but the difference between the two, the lack of microgram standard check weights is not considered cause for concern about data quality, as long as proper weighing-procedure precautions are taken for controlling contamination, or other sources of mass variation in the procedure.

16.2.2 OAM (AND FIELD) FLOW CALIBRATION

The Ofice of Air Monitoring and laboratory managers will conduct spot checks of laboratory and field notebooks to ensure that the laboratory and field personnel are following the SOPs, including the *QA/QC* checks, and the acceptance criteria and check frequencies listed in Tables 6-4 and 7-4 in Sections 6 and 7.

Method summary: Perform a leak check according to the *R&P Operator's Manual,* Section 11.7. Leave the cassette and leak-check filter in place. Remove the inlet and install the Streamline Flow Transfer Standard (FTS). As outlined in the *Operator's Manual,* Section 1.8, enter the R&P Sequential Sampler. Display the screen MENU mode, and select "Calibration/Audit." Perform either a three-point or a one-point calibration. Following the calibration, restore the sampling hardware to its original state by removing the FTS, and reinstalling the inlet. If the flow rate is found to be outside the required flow range, the operator will troubleshoot the instrument to discover the cause of the error.

16.2.3 SAMPLER (AND LABORATORY-WEIGHING ROOM ENVIRONMENTAL CONROL) TEMPERATURE CALIBRATION PROCEDURE

Once a year, both the ambient and the filter temperature sensors will be calibrated. The ambient sensor is secured inside an externally mounted shield fixture. The filter sensor is located inside the monitor in the open area just below the filter cassette. Extra sensors will be purchased, calibrated at the Office of Air Monitoring, then delivered to the field. The operators will exchange the freshly calibrated sensors for the sensors in the monitors, then perform a one-point temperature check using NIST traceable ambient temperature probes. In addition to the one-point checks, the operator will perform a leak check on the system after exchanging the filter sensor. Temperature sensors removed from the monitor will be returned to the Office of Air Monitoring for calibration and use in other PM2.5 monitors.

16.2.4 SAMPLER PRESSURE CALIBRATION PROCEDURE

General: According to ASTM Standard D 3631 (ASTM 1977), a barometer can be calibrated by comparing it with a secondary standard traceable to a NIST primary standard.

Precautionary note: Protect all barometers from violent mechanical shock and from sudden changes in pressure. A barometer subjected to either of these events must be recalibrated. Maintain the vertical and horizontal temperature gradients across the instruments at less than 0.1 %C/m. Locate the instrument so as to avoid direct sunlight, drafts, and vibration.

A National Weather Service Fortin type mercury barometer is located at the Virginia DEQ Office of Air Monitoring. This barometer will be used to calibrate and verify the aneroid barometers used in the field. These aneroid barometers in turn will be used to verify the barometric sensors of the PM2.5 samplers. Further explanatory detail is given in 16.4. **Procedure for verifying relative humidity control/monitoring data for the filter conditioning/weighing room-laboratory only.** A sling psychrometer will be used by laboratorv personnel to verify the percentage of humidity generated and

controlled by the environmental control system. Detailed verification procedures will be included in the DCLS SOP, now under development.

16.3 CALIBRATION STANDARD MATERIALS AND APPARATUS

Table 16-1 is a summary of the standard materials and apparatuses used in calibrating measurement systems for parameters necessary to generate the PM2.5 data required in 40 CFR parts 50, Appendix L, and part 58.

TABLE 16-1 STANDARD MATERIAL OR APPARATUS FOR $PM_{2.5}$ CALIBRATION

PARAMETER *M-MATERIAL A=APPARATUS*	STD. MATERIAL	STD. APPARATUS	MFR. NAME	MODEL #	VARIABLE CONTROL SETTINGS
Mass M	Standard Check weight	NA	To be procurred		NA
Temperature					
M+A	Hg	Thermometer		5500	*
M+A	NA	Digital thermometer			NA
		Thermistor			*
Pressure					
M+A	Hg	Fortin	Fisher Scientific.		*
A	NA	Aneroid	Airguide		*
Flow Rate					
A	NA	Piston Meter			*
A		Bubble Meter	R&P		NA
A		Adapter			NA
Relative Humidity					*
A	NA	Sling Psychrometer			
A	NA	Digital Hygrometer			

*- See manufacturer's operating manual, instruction sheet, or both

16.4 CALIBRATION STANDARDS

Flow rate. The flow-rate standard apparatus that will be used for flow-rate calibration has its own certifon and is traceable to other standards for volume or flow rate that are themselves NIST -traceable. The manufacturer will establish and verify if necessary a

calibration relationship for the flow-rate standard that is accurate to within 2% over the expected range of ambient temperatures and pressures at which the flow-rate standard is used. The flow-rate standard will be recalibrated and recertified at least annually.

The Virginia DEQ will maintain a control chart-a running plot of the difference or percentage of difference between the flow-rate standard and the NIST -n-aceable primary flow-rate or volume standard-for all comparisons. In addition to providing excellent documentation of the certification of the standard, a control chart also will give a good indication of the stability of the standard. If the two standard-deviation control limits are close together, the chart will indicate that the standard is very stable and can be certified less frequently. The minimum recertification frequency is one year. On the other hand, if the limits are wide, the chart will indicate a less stable standard that must be recertified more often.

Temperature. The operations manuals associated with the R&P PM2.5 Sequential Samplers identify the kinds of temperature standards recommended for calibration, and provide a detailed calibration procedure for each kind that is specifically designed for the particular sampler.

The *EPA Quality Assurance Handbook,* Volume IV (EPA 1995), Section 4.3.5.1, gives information on calibration equipment and methods for assessing response characteristics of temperature sensors.

The DEQ will use an ASTM- or NIST -traceable mercury-in-glass thermometer for laboratory calibration. The temperature standard to be used for temperature calibration will have its own certification that will be traceable to a NIST primary standard. A calibration relationship to the temperature standard (an equation or a curve) will be established that is accurate to within 2% over the expected range of ambient temperatures at which the temperature standard is to be used. The temperature standard must be reverified and recertified at least annually. The actual frequency of recertification will depend on the kind of temperature standard, because some are much more stable than others. Keeping a control chart will be the best way to discern recertification requirements.

The temperature-sensor standards chosen by the OAM and the lab managers are based on standard materials contained in standardized apparatus-that is, in a strictly controlled procedure each apparatus has been compared against temperature standards the manufacturers obtained from NIST.

The Virginia DEQ standards will be two NIST -traceable glass mercury thermometers, each with its own certificate summarizing the company's NIST-traceability protocol and documenting the technician's signature, the comparison date, the identification of the NIST standard used, and the mean and the standard deviation of the comparison results.

The Virginia DEQ field-temperature standards will be thermistor probes with digital readout. Each probe comes with a certificate of NIST traceability.

Pressure. The Fortin mercury barometer works on fundamental principles of length and mass, and therefore is more accurate-but more difficult to read and correct-than other types. By comparison, the precision aneroid barometer is an evacuated capsule with a flexible bellows coupled through mechanical, electrical, or optical linkage to an indicator. The precision aneroid barometer is potentially less accurate than the Fortin type, but it can be transported with less danger of impairing the reliability of its measurements. What is more, it presents no danger from possible mercury spills. Therefore, a Fortin type of barometer will be used as a higher-quality laboratory standard for adjusting and certifying an aneroid barometer in the OAM.

16.4.1 OAM

The OAM pressure standard will be a Fisher Scientific National Weather Service type Fortin mercury barometer.

16.4.2 FIELD

The field working standard will be an Airguide Dual Scale aneroid barometer.

16.5 DOCUMENT CALIBRATION FREQUENCY

See Table 14-1 for a summary of field QC checks that includes frequency and acceptance criteria and references for calibration and verification tests of single and sequential sampler flow rates, temperature, pressure, and time. See Table 14-2 for a

similar summary of laboratory QC, including frequency of primary and working mass standards and conditioning/weighing room temperature and relative humidity.

The field sampler flow rate, temperature, and pressure-sensor verification checks include one-point checks at least monthly, and multipoint checks at least annually, as proven by tracking on control charts. (A multipoint check involves calibration without adjustment unless needed, as determined and then performed by the vendor's authorized service representative.)

All of these events, as well as sampler and calibration equipment maintenance, will be documented in field-data records and notebooks and annotated with the flags required as shown in Appendix L of 40 CFR Part 50, the manufacturer's operating instruction manual, and any others indicated. OAM and field activities associated with equipment used by the respective technical staff will be kept in record notebooks as well. The records normally will be controlled by regional PM2.5 managers, and located at field sites when in use, or at the manager's offices when being reviewed or used for validating data.

REFERENCES

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EPA. 1995. *Quality Assurance Handbook for Air Pollution Measurement Systems.* Volume IV: Meteorological Measurements. U.S. Environmental Protection Agency. Document No. EPA/600/R-94/038d. Revised March.

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17.0 INSPECTION/ACCEPTANCE FOR SUPPLIES AND CONSUMABLES

17.1 PURPOSE

In this element we establish and document our system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the PM2.5 program. Various supplies and consumables are critical to the effective operation of the Virginia DEQ PM2.5 monitoring network. By having meticulously documented inspection and acceptance criteria, consistent quality of the supplies can be assured. This section is centered on a description of the supplies and consumables, the criteria for their acceptance, and the required tracking documentation.

17.2 CRITICAL SUPPLIES AND CONSUMABLES

To run the PM2.5 monitoring network successfully, certain supplies are vital. In this section we list the necessary supplies, including items for the weigh room laboratory and the field. Table 17-1 contains a brief description of each item, the component of the network for which they are needed, and a summary of information on the vendors.

TABLE 17-1 CRITICAL SUPPLIES AND CONSUMABLES

AREA	ITEM	DESCRIPTION	VENDOR	MODEL NUMBER
Sampler	Impactor Oil	Tetramethyltetraphenyl-trisiloxane (30 ml)	Dow Corning@	704 Oil
Sampler	37 mm Glass Fiber Filter	For use in impactor well	R&P Co. Inc.	32-004294
Sampler	Rain Collector	Glass	Purchase local	—
Sampler	O-Rings	The O-rings that seal in the filter cassette when it is placed in the sampler.	R&P Co. Inc.	—
Sampler	In-line Filter	Downstream of sample collection and upstream of sample pump.	R&P Co. Inc.	32-000393

TABLE 17-1 CRITICAL SUPPLIES AND CONSUMABLES

AREA	ITEM	DESCRIPTION	VENDOR	MODEL NUMBER
Sampler	Battery	Internal Sampler Battery.	Purchase local	AA Alkaline
Sampler	Fuses	In sampler	R&P Co. Inc.	—
Sampler	Floppy Disks	3.5" Pre-formatted	Purchase local	
Filter	Filters	46.2 mm teflon	Whatman@	
Filter	Petri dish	50 mm x 9 mm Falcon	VWR Scientific	351006
Filter	Filter Cassettes (single)	As per CFR design	R&P Co. Inc.	59-004648-0001
Filter	Sequential Sampler Cassette Holder	For use with R&P 2025	R&P Co. Inc.	55-005569
Filter	Filter Handling Containers	For transport to and from the field	R&P Co. Inc.	20-004997
Weigh Room	Staticide	Anti-static solution	Cole-Parmer@	E-33672-00
Weigh Room	Static Control Strips	Polonium 500&Ci	Mettler-Toledo@	110653
Weigh Room	Air Filters	High Efficiency	Purchase Local	
Weigh Room	Powder Free Antistatic Gloves	Standard length, vinyl, powder-free	VWR Scientific@	Medium Large
All	Low-lint wipes	4.5" x 8.5" Cleaning Wipes	Kimwipes@	34155

17.3 ACCEPTANCE CRITERIA

Acceptance criteria must be consistent with the overall technical and quality standards for the project. Some of the acceptance criteria are delineated in 40 CFR Parts 50. Others, such as observation of damage due to shipping, can be performed only after the equipment has arrived on site.

In Table 17-2 we set forth the acceptance test and limits for procuring the supplies and consumables to be used in the PM2.5 DEQ network:

TABLE 17-2 ACCEPTANCE CRITERIA FOR SUPPLIES AND CONSUMABLES

EQUIPMENT	ACCEPTANCE CRITERIA	ACTION IF REQUIREMENTS NOT MET
Impactor Oil	Is the oil identified as Tetramethyltetraphenyl-trisiloxane	Return
37 mm Glass Fiber Filter	Filters of the correct size and quality	Return
Rain Collector	Not broken	Call Vendor, will likely not return
O-Rings	Of the correct size	Return
In-line Filter	Of the correct size	Return
Battery	Correct size and voltage	Return
Fuses	Correct size and specification	Return
Floppy Disks	Undamaged and pre-formatted	Return
Filters, 46.2 mm Teflon	Tested and Accepted by the U.S. EPA with documentation of acceptance in package. Should meet visual inspection and pre-weight (110-160 mg) criteria	Call David Lutz, U.S. EPA (919) 541-5476
Petri dish	Clean and appropriately sized for 46.2 mm filters	Return
Filter Cassettes (single)	Of the correct type and make	Return
Filter Cassette Holder, Protective Containers	Of the correct size so that filter cassettes will not move around that could potentially lead to dislodging particulate	Return
Sequential Sampler Cassette Holder	Of the correct type for use with the sequential sampler model	Return
Filter Handling Containers	Clean	Clean
Anti-Static Solution	Of the correct type	Return
Static Control Strips	Manufactured within past 3 months and between 400 and 500 uC_i of Polonium	Call vendor
Air Filters	Of the size and quality specified	Return
Powder Free Antistatic Gloves	Of the size and quality specified	Return
Cleaning Wipes	Of the quality specified	Return

17.4 TRACKING AND QUALITY VERIFICATION OF SUPPLIES AND CONSUMABLES

The tracking and quality-verification of supplies and consumables has two main goals: (1) for the end user to have an item of the required quality; and (2) for the purchasing department to have a faithful record of goods received so that payment or credit of invoices can be approved. In order to address these two issues, the following procedures outline the proper tracking and documentation procedures to follow:

Receiving department personnel will do the following:

1. Perform a rudimentary inspection of the packages as they are received from the supplier, noting obvious problems, such as crushed or wet cardboard box.

2. Open and inspect each package, comparing the contents against the packing slip.

3. Compare supplies and consumables with the acceptance criteria in Table 17-2.

4. Note any problem with the equipment/supplies on the packing list, and notify the appropriate supervisor to call the vendor.

5. If the equipment/supplies appear to be complete and in good condition, sign and date the packing list and give it to the purchasing coordinator so that payment can be made in a timely manner.

6. Notify appropriate personnel that equipment/supplies are available. For items such as the 46.2 mm Teflon filters, it is critical to notify the laboratory manager of the weigh room so sufficient time to stabilize of the filters can be allowed.

7. Stock equipment/supplies the designated area in the Office of Air Monitoring Warehouse area.

8. For supplies, consumables, and equipment used throughout the PM2.5 program, document when these items are changed out. Provided the information is available, include all relevant facts such as model number, lot number, and serial number.

17.0 INSPECTION/ACCEPTANCE FOR SUPPLIES AND CONSUMABLES

17.1 PURPOSE

In this element we establish and document our system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the PM2.5 program. Various supplies and consumables are critical to the effective operation of the Virginia DEQ PM2.5 monitoring network. By having meticulously documented inspection and acceptance criteria, consistent quality of the supplies can be assured. This section is centered on a description of the supplies and consumables, the criteria for their acceptance, and the required tracking documentation.

17.2 CRITICAL SUPPLIES AND CONSUMABLES

To run the PM2.5 monitoring network successfully, certain supplies are vital. In this section we list the necessary supplies, including items for the weigh room laboratory and the field. Table 17-1 contains a brief description of each item, the component of the network for which they are needed, and a summary of information on the vendors.

TABLE 17-1 CRITICAL SUPPLIES AND CONSUMABLES

AREA	ITEM	DESCRIPTION	VENDOR	MODEL NUMBER
Sampler	Impactor Oil	Tetramethyltetraphenyl-trisiloxane (30 ml)	Dow Corning@	704 Oil
Sampler	37 mm Glass Fiber Filter	For use in impactor well	R&P Co. Inc.	32-004294
Sampler	Rain Collector	Glass	Purchase local	—
Sampler	O-Rings	The O-rings that seal in the filter cassette when it is placed in the sampler.	R&P Co. Inc.	—
Sampler	In-line Filter	Downstream of sample collection and upstream of sample pump.	R&P Co. Inc.	32-000393

TABLE 17-1 CRITICAL SUPPLIES AND CONSUMABLES

AREA	ITEM	DESCRIPTION	VENDOR	MODEL NUMBER
Sampler	Battery	Internal Sampler Battery.	Purchase local	AA Alkaline
Sampler	Fuses	In sampler	R&P Co. Inc.	—
Sampler	Floppy Disks	3.5" Pre-formatted	Purchase local	
Filter	Filters	46.2 mm teflon	Whatman@	
Filter	Petri dish	50 mm x 9 mm Falcon	VWR Scientific	351006
Filter	Filter Cassettes (single)	As per CFR design	R&P Co. Inc.	59-004648-0001
Filter	Sequential Sampler Cassette Holder	For use with R&P 2025	R&P Co. Inc.	55-005569
Filter	Filter Handling Containers	For transport to and from the field	R&P Co. Inc.	20-004997
Weigh Room	Staticide	Anti-static solution	Cole-Parmer@	E-33672-00
Weigh Room	Static Control Strips	Polonium 500&Ci	Mettler-Toledo@	110653
Weigh Room	Air Filters	High Efficiency	Purchase Local	
Weigh Room	Powder Free Antistatic Gloves	Standard length, vinyl, powder-free	VWR Scientific@	Medium Large
All	Low-lint wipes	4.5" x 8.5" Cleaning Wipes	Kimwipes@	34155

17.3 ACCEPTANCE CRITERIA

Acceptance criteria must be consistent with the overall technical and quality standards for the project. Some of the acceptance criteria are delineated in 40 CFR Parts 50. Others, such as observation of damage due to shipping, can be performed only after the equipment has arrived on site.

In Table 17-2 we set forth the acceptance test and limits for procuring the supplies and consumables to be used in the PM2.5 DEQ network:

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Receiving department personnel will do the following:

9. Perform a rudimentary inspection of the packages as they are received from the supplier, noting obvious problems, such as crushed or wet cardboard box.

10. Open and inspect each package, comparing the contents against the packing slip.

11. Compare supplies and consumables with the acceptance criteria in Table 17-2.

12. Note any problem with the equipment/supplies on the packing list, and notify the appropriate supervisor to call the vendor.

13. If the equipment/supplies appear to be complete and in good condition, sign and date the packing list and give it to the purchasing coordinator so that payment can be made in a timely manner.

14. Notify appropriate personnel that equipment/supplies are available. For items such as the 46.2 mm Teflon filters, it is critical to notify the laboratory manager of the weigh room so sufficient time to stabilize of the filters can be allowed.

15. Stock equipment/supplies the designated area in the Office of Air Monitoring Warehouse area.

16. For supplies, consumables, and equipment used throughout the PM2.5 program, document when these items are changed out. Provided the information is available, include all relevant facts such as model number, lot number, and serial number.

18.0 DATA ACQUISITION REQUIREMENTS

18.1 ACQUISITION OF NON-DIRECT MEASUREMENT DATA

In this section we address data not obtained by direct measurement from the PM2.5 ambient - air-quality-monitoring program. This includes data from outside sources, and historical data related to monitoring. Such data are used by the DEQ in a variety of ways. For instance, data may be used to draw comparisons. The policies and procedures described in this section apply not only to data acquired through the DEQ monitoring program, but also to information previously acquired, and to that acquired from outside souces.

The PM2.5 ambient air quality monitoring program relies on data that are generated through field and laboratory operations; however, other significant data are obtained from sources outside the DEQ or from historical records. In this section we list these data and address quality-control issues related to the PM2.5 ambient air quality monitoring program.

18.1.1 CHEMICAL AND PHYSICAL PROPERTIES DATA

Physical and chemical properties data and conversion constants often are required in the processing of raw data into reporting units. Such information as has not already been specified in the monitoring regulations will be obtained from nationally and internationally recognized sources. Other data sources may be used with approval of the director of the Office of Air Monitoring. The following sources may be used in the PM2.5 ambient air quality monitoring program without prior approval:

- National Institute of Standards and Technology (NIST)
- ISO, IUPAC, ANSI, and other widely-recognized national and international standards organizations
- U.S. EPA

- The current edition of certain standard handbooks. Two that are relevant to the fine particulate monitoring program are CRC Press' *Handbook of Chemistry and Physics,* and *Lange's Handbook.*

18.1.2 SAMPLER OPERATION AND MANUFACTURERS' LITERATURE

Another important source of information needed for sampler operation is manufacturers' literature. Operations manuals and users' manuals frequently provide numerical information and equations pertaining to specific equipment. DEQ personnel are cautioned that such information sometimes is in error, and appropriate cross-checks will be made to verify the reasonableness and accuracy of information contained in manuals. Whenever possible, the field operators will compare physical and chemical constants in the operator's manuals to those given in the sources listed above. If discrepancies are found, we will determine the correct value by contacting the manufacturer. The field operators will correct all the operators manuals and ask the vendor to issue an errata sheet discussing the changes. The DEQ also will inform the staff of the Region ill Office of such errors, if necessary. The following kinds of errors are commonly found in such manuals:

- insufficient precision
- outdated values for physical constants
- typographical errors
- incorrectly specified units
- inconsistent values within a manual
- use of different reference conditions than those called for in EPA regulations

18.1.3 GEOGRAPHIC LOCATION

Another type of data that will commonly be used in conjunction with the PM2.5 ambient air quality monitoring program is geographic information. The DEQ will locate curent sites using global positioning systems (GPS) that meet EPA Locational Data Policy of 25-meters accuracy. USGS maps were used as the primary means for locating and siting stations in the existing network.

18.1.4 HISTORICAL MONITORING INFORMATION

The DEQ has operated a network of ambient air monitoring stations since the late 1970s. Historical monitoring data, and summary information derived from those data, may be used in conjunction with current monitoring results to calculate and report trends in pollutant concentrations. In calculating historical trends, it is important to verify that the historical data are fully comparable to current monitoring data. If different methodologies were used to gather the historical data, the biases and other inaccuracies must be described in trends reports based on that data. Direct comparisons of PM2.5 with historical TSP or PM1o data will not be reported or used to estimate trends. Trends reports comparing PM2.5 data with historical particulate data must be approved by the director of the Office of Air Monitoring prior to release.

18.1.5 EXTERNAL MONITORING DATA BASES

As a matter of policy, the Office of Air Montoring does not use without prior approval data obtained from the internet, from computer bulletin boards, or from data bases from outside organizations to create reportable data or published reports. This policy is intended to ensure the use of high quality data in DEQ publications.

Data from the EPA AIRS data base may be used in published reports with appropriate caution. Care must be taken in reviewing/using any data that contain flags or data qualifiers. If data is flagged, such data will not be used unless it is clear that the data still meets critical *QA/QC* requirements. It is impossible to assure that a data base such as AIRS is completely free from errors, including outliers and biases, so caution and skepticism is called for in comparing Virginia data from other reporting agencies as reported in AIRS. Users should review available *QA/QC* information to assure that the external data are comparable with DEQ measurements and that the original data generator had an acceptable QA program in place.

18.1.6 LEAD AND SPECIATED PARTICULATE DATA

The DEQ has been routinely monitoring airborne lead since the early 1970s. Early data is likely to be problematic because of different particle size cutpoints and because of significantly higher detection limits. Caution is needed when directly comparing these data with the PM2.5 data because of the difference in size fractions.

Existing chemical speciation data for elements other than lead have been measured at selected monitoring sites. In addition, speciation PMIO and PM 2.5 date are available for the two Improve sites in Virginia. Both of these sites operate under an approved quality-assurance plan implemented for the Improve monitoring network.

18.1.7 U.S. WEATHER SERVICE DATA

Meteorological information is gathered from the U.S. Weather Service stations throughout the Commonwealth. Parameters include temperature, relative humidity, barometric pressure, rainfall, wind speed, wind direction, cloud type/layers, percentage cloud cover, and visibility range. However, NWS data are occasionally included in summary reports.

19.0 DATA MANAGEMENT

19.1 Background and Overview

This section is devoted to a description of the data management operations applicable to PM2.5 measurements for the NAMS/SLAMS stations operated by the Virginia DEQ. The scope of these operations encompasses all aspects of data management - recording, validating, transforming, transmitting, performing reduction analyses, managing, storing, and retrieving. Contained here is an overview of the mathematical operations and analyses to be performed on raw (as-collected) PM2.5 data.

Data processing for PM2.5 data will be integrated, to the extent possible, into the existing data processing system used in Virginia's SLAMS network.

19.2 Data Recording

Functions for entering, validating, and verifying data will be integrated into the PM2.5 data system. Procedures for filling out the data sheets and subsequent data entry forms are detailed in the DCLS and OAM SOPs.

19.3 Data Validation

In order to validate the data collected, analysts will apply a protocol in which they not only verify that data processing operations have been carried out correctly, but they also monitor the quality of the field operations. A combined approach to data validation such as this will ensure that problems in either of these areas will come to light. Once problems are identified, the data can be corrected or invalidated, and corrective actions can be taken for field or laboratory operations. Numerical data stored in the PM2.5 data system are never internally overwritten by condition flags. Flags denoting error conditions or QA status are saved as separate fields in the data base, so that it is possible to recover the original data.

The following validation functions are incorporated into the PM2.5 data system to ensure the high quality of data entry and data processing operations:

- Completeness checks: Each filter must have a start time, an end time, an average flow rate, dates weighed, operator and analyst names, etc.

- Data retention: Raw data sheets are retained on file in the DAM for a minimum of five years and are readily available for audits and data verification activities. After five years, hardcopy records and computer backup media will be dispatched in accordance with the VSLA records retention program.

- Statistical data checks: Errors found during statistical screening will be traced back to original data entry files and to the raw data sheets, if necessary. These checks will be done on a monthly schedule, prior to submitting any data to AIRS.

Bias and precision are two key operational criteria for PM2.5 sampling. As defined in 40 CFR Part 58, Appendix A, bias and precision are based on differences between collocated sampler results and

FRM performance evaluations. The DEQ OAM will inspect the results of collocated sampling. These data will be evaluated as early in the process as possible, so that potential operational problems can be addressed. The goal of the DEQ is to optimize the performance of its PM2.5 monitoring equipment.

19.4 Data Transformation

In general, calculations for transforming raw data from measured units to final concentrations are straightforward, and may are carried out in the sampler data processing unit before being recorded.

The following relations in Table 19-1 pertain to PM2.5 monitoring:

Table 19-1 Raw Data Calculations

Parameter	Units	Type of Conversion	Equation
Filter Volume (V_a) *	m^3	Calculated from average Flow Rate (Q_{ave}) in L/min, and total elapsed time (t) in min. multiplied by the unit conversion (m^3/L)	$V_a = Q_{ave} \times t \times 10^3$
Mass on Filter ($M_{2.5}$)	μg	Calculated from filter post-weight (M_f) in mg and filter pre-weight (M_i) in mg, multiplied by the unit conversion (μg/mg)	$M_{2.5} = M_f - M_i \times 10^3$
$PM_{2.5}$ Concentration ($C_{PM2.5}$)	$\mu g/m^3$	Calculated from laboratory data and sampler volume	$PM_{2.5} = \frac{M_{2.5}}{V_a}$

- most FRM instruments will provide this value from the data logger.

19.5 Data Transmittal

The Virginia DEQ will report all PM2.5 ambient air quality data and information specified by the AIRS Users Guide (Volume II, Air Quality Data Coding, and Volume ill, Air Quality Data Storage), coded in the AIRS-AQS format. Such air quality data and information will be fully screened and validated,

and will be submitted directly to AIRS via electronic transmission, in the format of AIRS-AQS, and in accordance with the quarterly schedule. The specific quarterly reporting periods and due dates are show in Table 19-2

Table 19-2 Data Reporting Schedule

Reporting Period	Due Date
January 1 - March 31	June 30
April I - June 30	September 30
July I - September 30	December 31
October I - December 31	March 31

19.6 Data Reduction

Data reduction processes involve aggregating and summarizing results so that they can be understood and interpreted in different ways. The *PM2.5* monitoring regulations require certain summary data to be computed and reported for different purposes, such as station maintenance.

The audit trail is another important concept associated with data transformations and reductions. An audit trail is a data structure that provides documentation for changes made to a data set during processing.

The PM2.5 data system audit trail will be maintained in hard copy and in electronic format. Audit trail records will include the following fields:

- operator's name
- date and time of change
- reason for change
- full identifying information for the item changed
- value before and after the change

Because of storage requirements, old audit records will be moved to backup media. This information will not be moved to backup media until after the data are reported to AIRS. All backup material will be retained so that audit information can be retrieved for at least five years.

19.7 Data Analysis

The Virginia DEQ will implement the data summary and analysis requirements contained in 40 CFR Part 58, Appendix A It is anticipated that as the PM2.5 monitoring program develops, additional data analysis procedures will be developed. The following specific summary statistics will be tracked and reported for the PM2.5 network:

- Single sampler bias or accuracy (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Single sampler precision (based on collocated data)
- Network-wide bias and precision (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Data completeness

Equations used in these reports are found in 40 CFR Part 58, Appendix A.

19.8 Data Flagging - Sample Qualifiers

A sample qualifier or result qualifier consists of alphanumeric characters that act as an indicator of the fact and the reason that the data value (a) did not produce a numeric result; (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result; or (c) produced a numeric result but for administrative reasons it is not to be reported outside of the DEQ.

Some flags will be generated by the sampler itself. Qualifiers will be placed on field and laboratory sheets with additional explanations in free form notes. During the sampling validation process, the flags will be used to decide whether to validate or invalidate individual samples or batches of samples.

19.9 Data Tracking

The PM2.5 data tracking system is a combined effort by the DEQ and the DCLS. The system is currently under development, and when complete, will be included in this QAPP.

19.10 Data Storage and Retrieval

Data archival policies for the PM2.5 monitoring program are shown in Table 19-3.

Table 19-3 Data Archive Policies

Data Type	Medium	Location	Retention Time	Disposition
Weighing forms, chain of custody forms	Hardcopy	Laboratory	5 years	Discarded
Lab notebooks	Hardcopy	Laboratory	5 years	Discarded
Field notebooks	Hardcopy	OAM	5 years	Discarded
$PM_{2.5}$ data	Electronic	AIRS	Indefinite	N/A
$PM_{2.5}$ audit records	Hardcopy	OAM	5 years	Discarded
Filters	Filters	OAM	1 year	Discarded

20.0 ASSESSMENTS AND RESPONSE ACTIONS

An assessment, for this QAPP, is defined as an evaluation process used to measure the performance or effectiveness of the quality system, the establishment of the monitoring network and sites and various measurement phases of the data operation.

The results of quality assurance assessments indicate whether the control efforts are adequate or need to be improved. Documentation of all quality assurance and quality control efforts implemented during the data collection, analysis, and reporting phases is important to data users, who can then consider the impact of these control efforts on the data quality. Both qualitative and quantitative assessments of the effectiveness of these control efforts will identify those areas most likely to impact the data quality and to what extent. Periodic assessments of SLAMS data quality are required to be reported to EPA. The selection and extent of the QA and QC activities used by a monitoring agency depend on a number of local factors, such as the field and laboratory conditions, the objectives for monitoring, the level of the data quality needed, the expertise of assigned personnel, the cost of control procedures, and pollutant concentration levels.

To ensure the adequate performance of the quality system, the VA DEQ-OAM will perform the following assessments:

- Management Systems Reviews
- Network Reviews
- Technical Systems Audits
- Audits of Data Quality
- Data Quality Assessments

20.1 Assessment Activities and Project Planning

20.1.1 Management Systems Review

A management systems review (MSR) is a qualitative assessment of a data collection operation or organization to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained. Management systems reviews of the ambient air monitoring program are conducted every three years by the OAM Data Processing and Evaluation (DPE) section. The MSR will use appropriate federal regulations and the QAPP to determine the adequate operation of the air program and its related quality system. The quality assurance activities of all criteria pollutants, including PM2.5, will be part of the MSR. The DPE staff will report its findings within 30 days of completion of the MSR.
Follow-up and progress on corrective action(s) will be determined during regularly scheduled meetings.

20.1.2 Network Reviews

Conformance with requirements set forth in *40 CFR Part* 58 *Appendices D and E* is determined

through annual network reviews of the ambient air quality monitoring system. The network review determines how well an air monitoring network achieves its required objective, and how it should be modified to continue to meet its objective. The DEQ-OAM will be responsible perform a PM2.5 network review every year. When possible, the OAM will coordinate its activities with the EPA Region III office, which is also required to perform an annual network review.

The following criteria will be considered during the review:

- date of last review,
- areas where attainment/non attainment redesignations are taking place or are likely,
- results of special studies, saturation sampling, point source oriented ambient monitoring,
- proposed network modifications since the last review.

In addition, pollutant-specific priorities may be considered, e.g. newly designated nonattainment areas.

Prior to implementing the network review, the OAM will compile and evaluate data and information significant to the review. Such information might include the following

- network files, including updated site information and photographs
- AIRS reports
- air quality summaries for the past five years for the monitors in the network
- emissions trends reports for the major metropolitan area
- emission density maps for the region in which the monitor is located
- maps showing the major sources of emissions
- National Weather Service summaries for the monitoring network area

The information will be checked to make sure it is the most current. Discrepancies will be noted on the checklist and resolved during the review. Files or photographs that need to be updated will be

identified. The following categories will be emphasized during network reviews:

Number of Monitors:

For SLAMS, the number of monitors required for PM2.5 depends on the measurement objectives. This is discussed in *40 CFR Part* 58, with additional details in *Guidance for Network Design and Optimum Exposure for PM2,5 and PM10.* Section 10 of this QAPP discusses the PM 2.5 network. The following information will be used to determine the adequacy of the network:

- maps of historical monitoring data
- maps of emission densities
- dispersion modeling
- special studies and saturation sampling
- best professional judgement
- SIP requirements
- revised monitoring strategies, e.g. lead strategy, reengineering the air monitoring network

For NAMS, selection of areas to be monitored must be based on urbanized population and pollutant concentration levels. To determine whether the number of NAMS is adequate, the number operating will be compared to the number specified in *40 CFR* 58 *Appendix D.* The number of NAMS operating can be determined from the AIRS summary reports. The number of monitors required, based on concentration levels and population, can be determined from the AIRS reports and the latest official census population data.

Location of Monitors:

For SLAMS, the regulations do not specify the location of monitors; rather, location is determined by the Regional Office and State agencies on a case-by-case basis in consideration of the monitoring

objectives specified in *40 CFR Part* 58 *Appendix D.* Adequacy of the location of monitors can only be determined on the basis of stated objectives. Maps, graphical overlays, and GIS-based information will be helpful in assessing the adequacy of monitor locations. Plots of potential emissions and historical monitoring data versus monitor locations will also be used.

During the network review, the stated objective for each monitoring location or site (see section 10) will be "reconfirmed" and the spatial scale "reverified" and then compared to each location to determine whether these objectives can still be attained at the present location.

Conformance to *40 CFR Part* 58 *Appendix E,* Probe Siting Requirements:

Siting criteria applicable to SLAMS and NAMS are specified in *40 CFR* 58 *Appendix E.* The on-site visit will include physical measurements and observations to determine compliance with Appendix E requirements, such as height above ground level, distance from trees, and paved or vegetative ground cover. Since many of the Appendix E requirements will not change within one year, this check at each site will be performed every three years.

Prior to the site visit, the reviewer will review the following:

- most recent hard copy of site description, including any photographs
- data on the seasons with the greatest potential for high concentrations of specified pollutants
- predominant wind direction by season

The OAM will use a checklist similar to the one used by the EP A Regional offices during their

scheduled network reviews. This checklist, which is intended to assist the reviewers in determining conformance with Appendix E, can be found in *SLAMS/NAMS/PAMS Network Review Guidance.* The reviewer will perform the following tasks in addition to those on the checklist:

- ensure that the inlet is clean,
- check equipment for missing parts, frayed cords, and other damage,
- record findings in field notebook and checklist,
- take photographs or videotape in the eight directions,
- document site conditions, with additional photographs or videotape.

Other Discussion Topics:

In addition to the items included in the checklists, subjects for discussion as part of the network review and in determining adequacy of the monitoring program will include:

- installation of new monitors
- relocation of existing monitors.
- siting criteria problems and suggested solutions
- problems with data submittals and data completeness
- maintenance and replacement of existing monitors and related equipment
- quality assurance problems
- air quality studies and special monitoring programs
- other issues such as proposed regulations and funding

A network review report will be written within two months of the review.

20.1.3 Technical Systems Audits

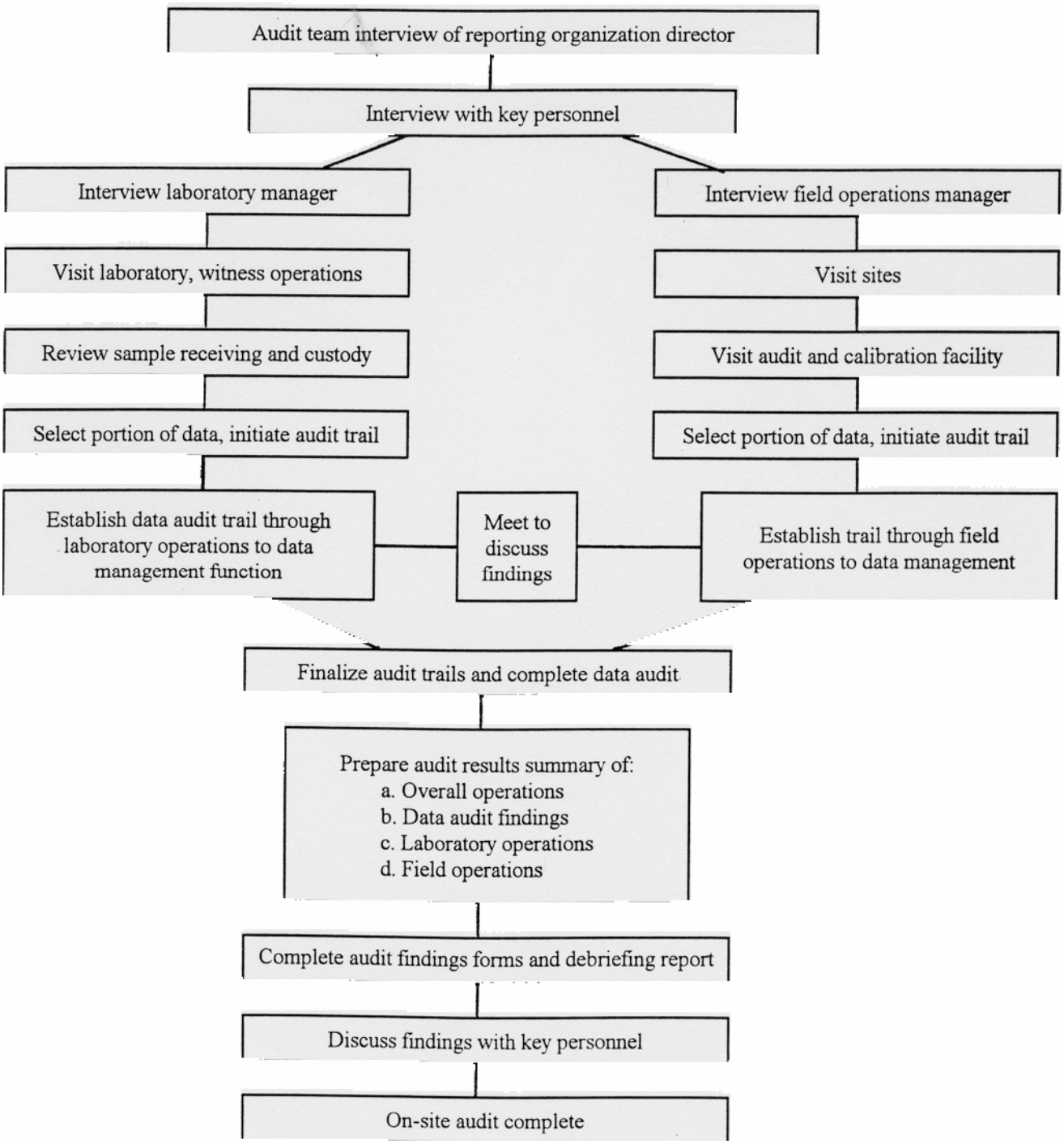
A Technical Systems Audit (TSA) is a thorough and systematic on-site qualitative audit, in which facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP. The OAM will perform a TSA of the PM2.5 network every three years and will stagger them with the required TSA conducted by the EPA Region III office. The TSA will

assess the following three areas, either separately or combined:

- Field: handling, sampling, shipping
- Laboratory: pre-sampling weighing, shipping. receiving, post-sampling weighing, archiving, and associated QA and QC
- Data management: information collection, flagging, data editing, security, upload.

Key personnel interviewed during the audit will be those responsible for planning, field operations, laboratory operations, QA and QC, data management, and reporting. To promote uniformity, the OAM will develop and use a TSA checklist. The TSA activities are outlined in Figure 20. 1

Figure 20.1 Audit Activities



The OAM audit team will prepare a brief written summary of its findings, and it will draft audit finding forms for the more serious of the problems found. The audit report will inform VA DEQ about serious problems which could compromise data quality and therefore require specific corrective actions. The report will discuss pollutant(s) impacted, estimated time period of deficiency, site(s) affected, and reason of action. The affected staff will notify the OAM within five working days after taking corrective actions.

Post-Audit Activities:

Preparation of the systems audit report is the major post-audit activity. The report will include:

- audit title and number and any other identifying information
- audit team members and audited participants
- background information about the project, purpose of the audit, dates of the audit, particular measurement phase or parameters that were audited, and a brief description of the audit process
- summary and conclusions of the audit and corrective action required
- attachments or appendices that include all audit evaluations and audit finding forms

To prepare the report, the OAM audit team will discuss observations, collected documents, and results of interviews with key personnel. Expected QA Project Plan implementation is compared with observed accomplishments and deficiencies, and the audit findings are reviewed in detail. Within thirty (30) calendar days of the completion of the audit, the systems audit report will be submitted to the appropriate managers and filed. The report will include an agreed-upon schedule for corrective action implementation.

If written comments or questions concerning the audit report are received, the OAM audit team will

review and incorporate them in a final report. The final form will be submitted within thirty (30) days of receipt of the written comments.

Follow-up and Corrective Action Requirements:

The audit team and the audited groups may work together to perform required corrective actions. Within thirty days of accepting the audit report, the audited groups will generate a response for each finding cited by the audit team.

20.1.4 Audit of Data Quality (ADQ):

An Audit of Data Quality (ADQ) reveals how the data are handled, what judgments were made, and whether uncorrected mistakes were made. ADQs can identify the means to correct systematic data reduction errors. An ADQ will be performed every year and will also be part of the TSA (every 3 years). Thus, sufficient time and effort will be devoted to this activity so that the auditor or team will have a clear understanding and complete documentation of data flow. Pertinent ADQ questions will appear on the TSA check sheets to ensure that the data collected at each stage maintains its integrity. The ADQ will serve as an effective framework for organizing the extensive amount of information gathered during the audit of laboratory, field monitoring, and support functions within the agency. The ADQ will have the same reporting and corrective action requirements as the TSA.

20.1.5 Data Quality Assessments:

A data Quality assessment (DQA) is the statistical analysis of environmental data to determine

whether the quality of data is adequate to support the decisions which are based on the data quality objectives (DQOs). Data are appropriate if the level of uncertainty in a decision based on the data is acceptable. The DQA process is described in detail in *Guidance for the Data Quality Assessment Process,* EPA QA/G-9 and is summarized below.

1. Review the data quality objectives (DQOs) and sampling design of the program. Define statistical hypothesis, tolerance limits, and confidence intervals.

2. Conduct preliminary data review; review Precision & Accuracy (P & A) and other available QA reports; calculate summary statistics, plots and graphs. Look for patterns, relationships, or anomalies.

3. Select the statistical test; select the best test for analysis based on the preliminary review, and identify underlying assumptions about the data for that test.

4. Verify test assumptions; decide whether the underlying assumptions made by the selected test hold true for the data and the consequences.

5. Perform the statistical test and document inferences. Evaluate the performance for future use.

Data quality assessment will be included in the *Annual PM2.5 Q.A. Report.*

Measurement uncertainty will be estimated for both automated and manual methods. Terms associated with measurement uncertainty are found within *40 CFR Part* 58 *Appendix A* and include:

- Precision: a measurement of mutual agreement among individual measurements of the same property usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

- Accuracy: the degree of agreement between an observed value and an accepted reference value; accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations.

- Bias: the systematic or persistent distortion of a measurement process which causes errors in one direction.

The individual results of these tests for each method or analyzer shall be reported to EPA. Estimates of the data quality will be calculated on the basis of single monitors and aggregated to all monitors.

20.2 Documentation of Assessments

Table 20-1 summarized each of the assessments discussed above.

Table 20-1 Assessment Summary

Assessment Activity	Frequency	Personnel Responsible	Report Completion
Management Systems Reviews	1 per 3 years	OAM	30 days after activity
Network Reviews App D App E	 1 per year 1 per 3 years	 OAM OAM	30 days after activity
Technical Systems Audits	1 per 3 years	OAM	30 days after activity
Audits of Data Quality	1 per year	OAM	30 days after activity
Data Quality Assessment	1 per year	OAM	120 days after end of calendar year

21.0 REPORTS TO MANAGEMENT

In this section we describe the quality-related reports and communications to management necessary to support SLAMS/NAMS PM2.5 network operations, and the associated data acquisition, validation, assessment, and reporting. Unless otherwise indicated, data pertaining to PM2.5 will be included in reports containing monitoring data for other pollutants.

Important benefits of submitting regular QA reports to management include the opportunity to alert the management to data-quality problems, to propose viable solutions to problems, and to procure necessary additional resources. Quality assessment, including the evaluation of the technical systems, the measurement of performance, and the assessment of data, will be conducted to help ensure that measurement results meet program objectives, and to ensure that necessary corrective actions are taken early, when they will be most effective. This is particularly important with respect to the new PM2.5 network, as new equipment and procedures are being implemented.

Effective communication among all personnel is an integral pan of a quality system. Regular, planned quality reporting will provide a means for tracking the following:

- adherence to scheduled delivery of data and reports,
- documentation of deviations from approved QA and test plans, and the impact of these deviations on data qualitv
- analysis of the potential uncenainties in decisions based on the data

21.1 FREQUENCY, CONTENT, AND DISTRIBUTION OF REPORTS

Required reports to management for PM2.5 monitoring and the SLAMS program in general are discussed in various sections of 40 CFR Parts 50, 53, and 58. Guidance for

management report format and content are provided in guidance developed by EPA's Quality Assurance Division (QAD) and the Office of Air Quality Planning and Standards (OAQPS). These reports are described in the following subsections.

21.1.1 ANNUAL PM2.5 QA REPORT

Periodic assessments of SLAMS data quality are required to be reported to EPA (40 CPR 58, Appendix A, Section 1.4, as revised) This document describes the quality objectives for measurement data and how these objectives are being met.

The annual PM2.5 QA report also will provide for the annual review of the SLAMS air quality surveillance system to determine whether the system is meeting the monitoring objectives defined in 40 CFR Part 58, Appendix D. Such reviews will identify needed modifications to the network, such as the termination or relocation of unnecessary stations or the establishment of new ones. The report also will include an overview of the status of the program, in addition to the following summary information required by 40 CFR 58 Appendix A.:

- flow-rate audits
- collocated federal reference method samplers
- collocated equivalent samplers of same designation
- assessment of bias using FRM audit procedure

21.1.2 NETWORK REVIEWS

The DEQ will prepare annual network reviews in accord with requirements in 40 CFR Part 58.20(d). The purpose of the annual network reviews will be to determine if the system meets the monitoring objectives defined in 40 CFR Part 58 Appendix D. The review will identify needed modifications to the network including the termination or relocation of unnecessary stations or the establishment of new stations. Information gathering for these reviews will be coordinated through the Director, Office of Air Monitoring. Supervisors and other personnel will assist as necessary to provide information and support. The DEQ Air Operations Director will assure that such changes are included in future planning. The Director, Office of Air Monitoring, also will

implement other review findings that affect data quality.

As required by 40 CFR Part 58 Appendix Z, Section 4(a), revised July 18, 1997, the DEQ will submit a list of all monitoring sites and their AIRS site identification codes to the EP A Regional Office each year. Whenever there is a change in this list of monitoring sites in a reporting organization, the DEQ, Office of Air Monitoring, will report this change to the EPA Regional Office and to AIRS- AQS.

21.1.3 QUARTERLY REPORTS

Each quarter, the DEQ Office of Air Monitoring will report to AIRS-AQS the results of all precision, bias, and accuracy tests it has carried out during the quarter. The quarterly reports will be submitted, in compliance with the data-reporting requirements specified for air quality data as set forth in 40 CFR Parts 58.26, 58.35 and 40 CFR Part 58 Appendix A, Section 4.

The data-reporting requirements of 40 CFR Part 58.35 apply to those stations designated SLAMS or NAMS. Required accuracy and precision data will be reported on the same schedule as quarterly monitoring data submittals. The required reporting periods and due dates are listed in Table 21-1.

TABLE 21-1. QUARTERLY REPORTING SCHEDULE

REPORTING PERIOD	DUE ON OR BEFORE
January 1—March 31	June 30
April 1—June 30	September 30
July 1—September 30	December 31
October 1—December 31	March 31 (following year)

In accordance with the Federal Register Notice of July 18, 1997, all QA/QC data collected will be reported and will be flagged appropriately. This data includes: "results from invalid tests, from tests carried out during a time period for which ambient data

immediately prior or subsequent to the tests were invalidated for appropriate reasons, and from tests of methods or analyzers not approved for use in SLAMS monitoring networks. . ." (40 CFR Part 58 Appendix A, Section 4, revised July 18, 1997).

Air quality data submitted for each reporting period will be edited, validated, and entered into the AIRS-AQS using the procedures described in the *AIRS Users Guide, Volume II, Air Quality Data Coding.* The DEQ Office of Air Monitoring, Data Processing and Evaluation Section will be responsible for preparing the data reports, which will be reviewed by the data QA manager before they are transmitted to EPA.

21.1.4 TECHNICAL SYSTEM AUDIT REPORTS

The DEQ will perform Technical System Audits of the monitoring system. These reports will be issued by the Office of Air Monitoring and reviewed by the Air Division Director and the Air Operations Director. These reports will be filed (see table 9-1) and made available to EP A personnel during their technical systems audits.

External systems audits are conducted at least every three years by the EP A Regional Office as required by 40 CFR Part 58, Appendix A, Section 2.5. Further instructions are available from either the EP A Regional QA Coordinator or the Systems Audit QA Coordinator, Office of Air Quality Planning and Standards, Emissions Monitoring and Analysis Division (MD-14), U.S. Environmental Protection Agency, Research Triangle Park, NC 27711.

21.1 .5 RESPONSE/CORRECTIVE ACTION REPORTS

The Response/Corrective Action Report procedure will be followed whenever a problem is found such as a safety defect, an operational problem, or a failure to comply with procedures. The Response/Corrective Action Report is one of the most important ongoing reports to management because it documents primary QA activities and provides valuable records of QA activities that can be used in preparing other summary reports.

The Response/Corrective Action Report procedure is designed as a closed-loop system. The Response/Corrective Action Report form identifies the originator who reported and

identified the problem, states the problem, and may suggest a solution. The form also indicates the name of the persons or persons who are assigned to correct the problem. The assignment of personnel to address the problem and the schedule for completion will be filled in by the appropriate supervisor. The Response/Corrective Action Report procedure closes the loop by requiring that the recipient state on the form how the problem was resolved, and to what extent the solution was effective. Supervisors and managers, as well as the originator, also will be included in the distribution.

21.1 .6 CONTROL CHARTS WITH SUMMARY

Control charts for instruments will be updated after every new calibration or standardization as defined in the relevant SOP. Field operators and analysts will review each control chart immediately after it is updated, and will take corrective actions whenever an out-of-control condition exists. Control charts will be reviewed at least quarterly by the DEQ Data Processing and Evaluations section and by the laboratory supervisor. Summary information will be included in the Annual PM2.5 QA Report to Management. Control charts also will be subject to inspection during audits. Laboratory personnel will maintain a readily accessible file of control charts for each instrument.

21.2 RESPONSIBLE ORGANIZATIONS

This section outlines the responsibilities of persons within the monitoring organization for preparing quality reports, evaluating their impact, and implementing follow-up actions. Changes made in one area or procedure may affect another part of the project. Only by defining clear-cut lines of communication and responsibility can all the affected elements of the monitoring network remain current with such changes. The documentation for all changes will be maintained and included in the reports to management. The following paragraphs describe key personnel involved with QA reporting.

Executive Director, DEQ-The ultimate responsibility for the quality of the data and the technical operation of the fine particle monitoring network rests with the Executive Director,

DEQ. The Director's responsibilities with respect to air quality reporting will be delegated through the Director of Air Operations and the Air Division

Director to the Director, Office of Air Monitoring. These responsibilities include defining and implementing the document-management and quality assurance systems for the PM2.5 monitoring network.

Director, Office of Air Monitoring-The Director, OAM will direct the operations of the air quality network. The Director will be specifically responsible for assuring the timely submittal of quarterly and annual data summary reports.

PM2.5 QA Manager – The QA Officer will be responsible for the management and administrative aspects of the PM2.5 QA program, including coordinating audits and preparing required reports. The PM2.5 QA Officer will take care of day-to-day conduct of QA activities for the ambient air monitoring program. The PM2.5 QA Officer's responsibilities for QA reports to management include the following:

- assessing data quality and performing other internal audits
- calculating and reviewing precision and bias data generated by the collocated PM2.5 monitors
- reviewing control charts and other QC materials
- monitoring Response/Corrective Action Reports
- ensuring access to data for timely reporting and interpretation
- ensuring timely delivery of all required data to the AIRS system

Particulate Section Leader-The Particulate Monitoring Group Supervisor will identify problems and issue appropriate Response/Corrective Action Reports. He is also will assign Response/Corrective Action Reports to specific personnel and assure that the work is completed and that the corrections are effective. The Particulate Monitoring Group Supervisor will assure that technicians and site operators under his or her supervision maintain their documentation files as defined in the network design. Supervisors will disseminate information appearing in audit reports and other quality-related documents to operations personnel.

Laboratory Group Manager-The Laboratory Group Manager will identify problems and issue appropriate Response/Corrective Action Reports related to laboratory activities. He or she also will review laboratory QC data, such as control charts, and assure that repairs and preventive maintenance are completed and effective. The Group Manager also is will assure that analysts under his or her supervision maintain their documentation files as defined in the relevant SOPs. The Laboratory Group Manager will provide information to assist the QA Officer in preparing QA reports and summaries.

Field and Laboratory Technicians-Individual technicians and analysts normally will not write reports to management. However, they will participate in the process by generating control charts, identifying the need for new Response/Corrective Action Reports, and maintaining other quality-related information used to prepare QA reports.

22.0 DATA REVIEW, VALIDATION AND

VERIFICATION REQUIREMENTS

In this section we will describe how the DEQ will verify and validate the data- collection operations associated with the PM2.5 ambient air monitoring network. For the purpose of this program "verification" will be defined as confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. "Validation" will be defined as confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Although there are a number of objectives for collecting ambient air monitoring data, the major objective for the DEQ PM2.5 network is to compare the data collected with the NAAQS standard.

This section is focussed upon the verification and validation activities that occur at a number of the important data collection phases. Earlier elements of this QAPP contain detailed descriptions of how the activities in each data collection phase will be set in motion to meet the data quality objectives of the program. Review and approval of this QAPP by the Department and EPA provide initial agreement that the processes described in the QAPP, if implemented, will provide data of adequate quality. In order to verify and validate the phases of the data collection operation, the DEQ will use various qualitative assessments to verify that the QAPP is being followed, and will rely on the various quality control samples, inserted at various phases of the data collection operation, to validate that the data will meet the DQOs.

22.1 SAMPLING DESIGN

Section 10 contains a description of the sampling design for the network established by the DEQ, including the number of sites required, their location, and the frequency of data collection. The objective of the sampling design it to represent the population of interest at adequate levels of spatial and temporal

resolution. Most of these requirements have been described in the Code of Federal Regulations. However, the DEQ is responsible for ensuring that the intent of the regulations are properly administered and carried out

22.1.1 SAMPLING DESIGN VERIFICATION

Verification of the sampling design will occur through three processes:

(1) Network Design Plan Confirmation-the Network Design Plan that covers the initial deployment of the network must be submitted, reviewed, and approved by EP A prior to implementation. This process verifies the initial sampling design.

(2) Internal Network Reviews-Once a year, the OAM will perform a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting the CFR siting criteria.

(3) External Network Reviews-Every three years the EP A Region III Office will conduct a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met, and whether the sites are meeting the CFR siting criteria.

22.1.2 SAMPLING DESIGN VALIDATION

The ambient air data derived from the sites will be used to validate the sampling design.

Through the initial stages of implementation, in order to validate that the monitors are properly sited, and that the sampling design will meet the objectives of the network, the DEQ may use both saturation and special-purpose monitors. The resulting information will be included in network-review documentation, and communicated to the EPA Region III Office. In addition, the processes described in Section 10 will be used to confirm the network design.

22.2.1 SAMPLE COLLECTION VERIFICATION

Sample-collection procedures are described in detail in Section 11 and are developed to ensure proper sampling and to maintain sample integrity. The following two processes will be used to verify the sampling collection activities:

(1) *Internal Technical -Systems Audits* will be required every three years as described in Section 20

(2) *External Technical-Systems Audits* will be conducted by the EPA Region III Office every three years.

Both kinds of technical-systems audits will be used to verify that the sample collection activity is being performed as described in this QAPP and the SOPs. Deviations from the sample collection activity will be noted in the audit report, and corrected using the procedures described in Section 20.

22.2.2 SAMPLE COLLECTION VALIDATION

The sample collection activity is only one phase of the measurement process. The use of QC samples that have been placed throughout the measurement process can help validate the activities occurring at each phase. The review of such QC data as the collocated sampling data, the field blanks, the FRM performance evaluation, and the sampling equipment verification checks can be used to validate the data collection activities. Any data that indicate unacceptable levels of bias or precision, or a tendency (trend on a control chart) will be flagged and investigated. This investigation could lead to a discovery of inappropriate sampling activities.

22.3 SAMPLE HANDLING

In Sections 11, 12, and 17 we delineate the requirements for sample handling, including the preservation methods and the kinds of sample containers. Because of the size of the filters and the nature of the collected particles, sample handling is one of the phases in which inappropriate techniques can have a significant effect on sample integrity and data quality.

22.3.1 VERIFICATION OF SAMPLE HANDLING

Both internal and external technical systems audits will be performed to ensure that the specifications mentioned in the QAPP are being followed. To ensure that the sample

continues to be representative of its native environment as it moves through the data collection operation, the audits will include checks on the identity of the sample and its packaging in the field, and on proper storage conditions.

22.3.2 VALIDATION OF SAMPLE HANDLING

In a manner analogous to the process of validating the sampling activities, the review of data from collocated sampling, the field blanks, and the FRM performance evaluations will be used to validate the sample handling activities. Acceptable precision and bias in these samples will confirm that the sample-handling activities are adequate. Any data that indicate unacceptable levels of bias or precision, or a tendency (trend on a control chart) will be flagged and investigated. This investigation could reveal inappropriate sampling-handling activities requiring corrective action.

22.4 ANALYTICAL PROCEDURES

Section 13 comprises descriptions of the requirements for the analytical method-which includes the pre-sampling weighing activities that give each sample a unique identification and an initial weight, and prepare the sample for the field; and the post-sampling weighing activity, which provides the mass net weight and the final concentration calculations. The methods include acceptance criteria for important components of the procedures, along with suitable codes for characterizing the deviation of each sample from the procedure

22.4.1 VERIFICATION OF ANALYTICAL PROCEDURES

Both internal and external technical systems audits will be performed to ensure the analytical method specifications mentioned in the QAPP are being followed. The audits will include checks on the identity of the sample. Deviations from the analytical procedures will be noted in the audit report, and corrected using the procedures described in Section 20.

22.4.2 VALIDATION OF ANALYTICAL PROCEDURES

Just as in the validation of sampling activities, the review of data from laboratory blanks, the calibration checks, laboratory duplicates, and other laboratory QC will be used to validate the analytical procedures. Acceptable precision and bias in these samples verify that the analytical procedures are adequate. Data that indicate

unacceptable levels of bias or precision, or a tendency (trend on a control chart) will be flagged and investigated requiring corrective action.

22.5 QUALITY CONTROL

Sections 14 and 16 of this QAPP specify the QC checks that are to be perfom1ed during sample collection, handling, and analysis. These checks include analyses of check standards, blanks, spikes, and replicates, which provide indications of the quality of data being produced by specified components of the measurement process. For each specified QC check, the procedure, the acceptance criteria, and the corrective action are specified.

22.5.1 VERIFICATION OF QUALITY CONTROL PROCEDURES

As described above, both internal and external technical-systems audits will be performed to ensure adherence to the quality-control method specifications set forth in the QAPP.

22.5.2 VALIDATION OF QUALITY CONTROL PROCEDURES

Validation activities of many of the other data-collection phases mentioned in this subsection use the quality-control data to validate the proper and adequate implementation of the quality-control phase. Therefore, validation of QC procedures will require a review of the documentation of the corrective actions that were taken when QC samples failed to meet the acceptance criteria, and the potential effect of the corrective actions on the validity of the routine data. Section 14 describes the techniques used to document QC review/corrective action activities.

22.6 CALIBRATION

Section 16, as well as the field (Section 11) and the analytical sections (Section 13), detail the calibration activities and requirements for the critical pieces of equipment for the PM2.5 network.

22.6.1 VERIFICATION OF CALIBRATION PROCEDURES

Both internal and external technical-systems audits will be perfonned to ensure the calibration specifications and corrective actions mentioned in the QAPP are being followed. Deviations from the calibration procedures will be noted in the audit report

and corrected using the procedures described in Section 20.

22.6.2 VALIDATION OF CALIBRATION PROCEDURES

As with the the validation of sampling activities, the review of calibration data described in section 14 and 16, can be used to validate calibration procedures. Calibration data within the acceptance requirements verify that the sample collection measurement devices are operating properly. Any data that indicate unacceptable levels of bias or precision, or a tendency (trend on a control chart) will be flagged and investigated. This investigation could lead to a discovery of inappropriate calibration procedures, to or equipment problems requiring corrective action. Validation will include the review of the documentation to ensure corrective action was taken as prescribed in the QAPP.

22.7 DATA REDUCTION AND PROCESSING

22.7.1 VERIFICATION OF DATA REDUCTION AND PROCESSING PROCEDURES

As mentioned in the above sections, both internal and external technical systems audits will be performed to ensure the data reduction and processing activities mentioned in the QAPP are being followed.

22.7.2 VALIDATION OF DATA REDUCTION AND PROCESSING PROCEDURES

As part of the audits of data quality a number of sample IDs, chosen at random, will be identified. All raw data fIles, including the following, will be selected :

- pre-sampling weighing activity
- pre-sampling
- sampling (sampler download infonnation)
- calibration-the calibration information represented from that sampling period
- sample handling/custody
- post-sampling weighing
- corrective action
- data reduction

These raw data will be reviewed and [mal concentrations will be calculated by hand toe

determine whether the final values submitted to AIRS compare with the hand calculations. The data also will be reviewed to ensure that associated flags and other data qualifiers have been appropriately associated with the data, and that corrective actions were taken when necessary..

23.0 VALIDATION AND VERIFICATION METHODS

Many of the processes for verifying and validating the measurement phases of the PM2.5 data collection operation have been discussed in Section 22. If these processes, as written in the QAPP, are followed, and the sites are representative of the boundary conditions for which they were selected, the PM2.5 DQOs will be achievable. However, exceptional field events may occur; what is more, field and laboratory activities also may affect the integrity of the samples. In addition, it is likely that some of the QC checks will fail to meet the acceptance criteria. Because it is important to determine how various kinds of problems affect the validity of routine data, each kind of possible problem is identified with a specific flag. The review of these routine data and their associated QC data will be verified and validated on a sample-batch basis. The sample batch is the most efficient entity for verification/validation activities. Our assumption is that if measurement uncertainty can be controlled at a batch level within acceptance criteria, then the overall measurement uncertainty will be maintained within the precision and bias DQOs.

23.1 DESCRIBE THE PROCESS FOR VALIDATING AND VERIFYING DATA

23.1.1 VERIFICATION OF SAMPLE BATCHES

After a sample batch is completed, the data will be reviewed thoroughly for completeness and data-entry accuracy. Once the data are entered into the PM2.5 data system, the system will review the data for routine data outliers and data outside of acceptance criteria. These data will be flagged appropriately. All flagged data will be reverified to ensure that the values have been entered correctly.

23.1.2 VALIDATION

Validation of measurement data will require two stages, the first at the measurement value level, and the second at the batch level. Records of all invalid samples will be filed- In addition to the associated flags, the information will include a brief summary

of the reason the sample was invalidated. Because all fIlters that were pre-weighed will be catalogued, this record will be available on the PM2.5 data system. Free-form notes from the field operator or laboratory technician will accompany the flagged samples. The DEQ will submit this information to AIRS as part of the routine data submittal for PM2.5.

23.1.3 VALIDATION OF MEASUREMENT VALUES

Certain criteria (based upon CFR and the expert judgment of field operators and laboratory technicians) have been developed that will be used to invalidate a sample or measurement. In all cases, the sample will be returned to the laboratory for further examination. When laboratory technicians review the field sheet and chain-of-custody forms they will look for flag values. Any filters with a flag related to obvious contamination; fIlter damage; or field accident, will be examined immediately. With the concurrence of the laboratory technician and the laboratory group manager, such samples will be invalidated. The flag for "no analysis result" will be placed in the flag area associated with such samples, along with any other associated flag.

To invalidate samples, other flags may be used alone or in combination. The DEQ will review all flags to determine whether single values or values from a site for a particular time period will be invalidated. The DEQ will keep a record of the combination of flags that caused a sample or set of samples to be invalidated. Following a precise sequence of actions invariably will ensure that the DEQ evaluates and invalidates data consistently from one batch to the next Tables 23-1 and 23-2 contains a listing of criteria that can be used to invalidate single samples based on(l) single flags (Table 23-1); or (2) on a combination of flags (Table 23-2)

TABLE 23-1 SINGLE FLAG INVALIDATION CRITERIA FOR SINGLE SAMPLES

REQUIREMENT	COMMENT
Contamination	Concurrence with lab technician and branch manager
Filter Damage	Concurrence with field operator or group manager
Event	Exceptional, known field event expected to have affected sample. Concurrence with DEQ regional director, group manager, director OAM
Laboratory Accident	Concurrence with lab technician and group manager
Field Accident	Concurrence with field operator lab and lab group manager
Flow Rate Cutoff	Termination of sample collection due to flow rate > 10% design flow rate for 60 seconds.

TABLE 23.2. SINGLE SAMPLE VALIDATION TEMPLATE

REQUIREMENT	ACCEPTANCE CRITERIA	MAJOR[1]	MINOR[2]
Flow rate	≤±5% of 16.67L/min <5 min	>10%	>5%
Flow rate verification	≤4% of transfer standard	>6%	>4%
Filter temperature	>5°C for<30 min	>10°C	>5°C
Elapsed sample time	>1380 or<1500 min	>1530	>1500
Holding times			
Pre-sampling	≤30 days	>32 days	>30 days
Sample recovery	≤96 hours	>100 hours	>96 hours
Post-sampling			
25°C	≤10 days	>12 days	>10 days
4°C	≤30 days	>32 days	>30 days

[1]If 2 majors occur, data is invalidated
2 If 4 minors occur, data is invalidated.

Because of the nature of routine samples, and the specified holding times for them, it is critical that the DEQ minimize the amount of data that is invalidated. Therefore, the DEQ will validate data on sample batches. Based on the kinds of QC samples that are included, and on the field and laboratory conditions that are reported along with the batch, the DEQ will develop a validation template that will be used as a standard to determine when routine data will be invalidated, and when major corrective actions must be instituted. Table 23.3 is an example of such a validation template.

TABLE 23.3. VALIDATION TEMPLATE

REQUIREMENT	#PER BATCH	ACCEPTANCE CRITERIA	MAJOR[1]	MINOR[2]
Blanks				
Field blanks	3	≤± 30 µg	both blanks ≤± 30 µg	one blank ≤± 30 µg
Lab blanks	3	≤±15 µg	both blanks ≤±15 µg	one blank ≤±15 µg
Precision Checks				
Collocated pairs	2	PD≤10%	both samples>15%	one sample 15%
Duplicate weight	1	≤±15 µg	duplicate >±20 µg	duplicate>±15 µg
Accuracy				
Balance checks	7	≤±3 µg	4 checks >±3 µg	3 checks >±3 µg
Lab Conditions				
Temperature	1	Mean 20 to 23°C;≤±2°C	Mean >25° or<18°) >±4°	Mean 23 to 25°; >±2°, ±4°
Humidity	1	30 t° 40% ≤±5%"	Mean>45% or<20% ±7%	Mean>45% or<20%; >±5%<±7%

[1]If 2 majors occur, data is invalidated
2 If 4 minors occur, data is invalidated.

A batch may be invalidated because of the number of major and minor flags associated with it. The data validation team will evaluate questionable batches against a validation template, and generate a report based upon the results. If the results suggest invalidating the batch of data, the batch will be reanalyzed. However, before initiating reanalysis, every efforts will be made to take corrective actions, depending on the kind of QC checks that were outside of acceptance criteria.. If the batch remains outside the criteria- the routine samples will be flagged as invalid.

24.0 Reconciliation with Data Quality Objectives

This section of the QAPP outlines the procedures that the DEQ Office of Air Monitoring will follow to determine whether the monitors and laboratory analyses are producing data that comply with the DQOs and what action will be taken as a result of the assessment process. Such as assessment is termed a Data Quality Assessment (DQA) and is thoroughly described *in EPA QA/G-9: Guidance for Data Quality Assessment.*

24.1.1 Five Steps of DQA Process

The DQA process is comprised of five steps which are detailed below.

1. Review the DQOs and the sampling network design. Ascertain that the DQOs are still valid and that the monitoring network is providing the necessary data with which to make attainment decisions.

2. Conduct a preliminary data review. This review is perfofl1led to uncover potential limitation to the use of the data, to reveal outliers, and for general data review. During data review, summary statistics, quality assurance reports, and some graphical representations of the data will be generated. Particular attention will be directed to the detection of anomalies in the data, missing values, and any deviations from standard operating procedures. The summary statistics will be generated for each monitoring site. Collocated site percent differences will also be calculated.

3 Select the statistical test. The primary objective for the mass monitoring of PM25 is for the determination of compliance with the PM2.5 NAAQS. These calculations are specified in 40 CFR

Part 50, Appendix N. Virginia will utilize these calculations in the determination of NAAQS attainment/nonattainment determinations.

4. Verify assumptions of statistical test. EPA has already verified the assumptions of the statistical test prior to their inclusion in the regulations. To the extent possible, Virginia will use three full years of data for NAAQS determinations, but as much data as is available will be used if there is less than three years. Acceptable measurement and decision error limits have been specified by EPA, and these limits will be applied during DEQ's DQO review. The review will identify any monitoring sites that violate the 24-hour standard, have apparent non-normal measurement errors, have less that the required data capture rate, and have a measurement CV > 10%. Bias and precision limits will be estimated and compared to the established three year limit of +/- 10% (bias) and less than 10% (precision). Quarterly, annual, and three year bias and precision estimates will be calculated.

5. Draw conclusions from the data. The DEQ will determine if any of the assumptions upon which the statistical tests are based have been violated. This determination will be made prior to any determinations of compliance with the PM2.5 NAAQS. If the tests indicate that the assumptions are valid, the DEQ will proceed with the calculations for determination of NAAQS attainment as described in 40 CFR Part 50, Appendix N. If not, further investigation will be needed before any attainment/nonattainment decisions can be made.

24.1.2 Action Plan Resulting from Data Quality Assessment

The DEQ will conduct a DQA each year. In addition, quarterly determinations of precision and bias will be made to check for any changes in field or laboratory operations that needs to be addressed before the annual review. Based upon the results of the DQA, the DEQ may take one or more of the following actions:

1. Modify the QA monitoring network. Virginia will operate QA samplers in accordance with 40 CFR Part 58, Appendix A, at a minimum. The number of QA samplers may be increased if additional data is necessary to characterize the precision and bias of the PM2.5 monitoring network.

2. Modify other *QA/QC* activities. At a minimum, Virginia will perform all *QA/QC* operations in accordance with federal regulations and *Guidance Document* 2.12. These operations include field and laboratory activities, equipment malfunctions, site problems, and operator training.

3. Determine level of aggregation at which DQOs are violated. Specific problem samplers may be identified as part of the DQA process. Should this occur, it will be determined if the problem is unique to a specific site(s) or whether there is a broader problem. If an investigation cannot determine a specific site problem, national reports will be reviewed for specific type sampler problems. In addition, neighboring reporting organizations' precision and bias reports will be reviewed.

4. Communication with the EPA Regional Office. The DEQ will maintain close contact with the EPA Region II Office concerning any problems with achieving bias and precision DQOs.

5. Review of quarterly data The DEQ will review the quarterly QA reports and the QC summaries to ensure attainment of bias and precision limits.

APPENDICES

APPENDIX A

GLOSSARY*

*The following glossary is taken from the document
EPA Guidance for Quality Assurance Project Plans EPA *QA/G-5*

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS

Acceptance criteria - Specified limits placed on characteristics of an item, process, or service defined in requirements documents. (ASQC Definitions)

Accuracy - A measure of the closeness of an individual measurement or the average of a number of measurements to the true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; the EPA recommends using the terms *{'precision"* and *{'bias",* rather than "accuracy," to convey the information usually associated with accuracy. Refer to *Appendix D, Data Quality Indicators* for a more detailed definition.

Activity - An all-inclusive term describing a specific set of operations of related tasks to be performed, either serially or in parallel (e.g., research and development, field sampling, analytical operations, equipment fabrication), that, in total, result in a product or service.

Assessment - The evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive tenI1 used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance.

Audit (quality)- A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Audit of Data Quality (ADQ) - A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Authenticate - The act of establishing an item as genuine, valid, or authoritative.

Bias - The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). Refer to *Appendix D, Data Quality Indicators,* for a more detailed definition.

Blank - A sample subjected to the usual analysis 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.

Calibration - A comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration drift - The deviation in instrument response from a reference value over a period of time before recalibration.

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.

Characteristic - Any property or attribute of a datum, item, process, or service that is distinct, describable, and/or measurable.

Check standard - A standard prepared independently of the calibration standards and analyzed exactly like the samples. Check standard results are used to estimate analytical precision and to indicate the presence of bias due to the calibration of the analytical system.

Collocated samples - Two or more portions collected at the same point in time and space so as to be considered identical. These samples are also known as field replicates and should be identified as such.

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. Refer to *AppendixD, Data Quality Indicators,* for a more detailed definition.

Computer program - A sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution. A computer program may be stored on magnetic media and referred to as "software," or it may be stored permanently on computer chips, referred to as "firmware." Computer programs covered in a QAPP are those used for design analysis, data acquisition, data reduction, data storage (databases), operation or control, and database or document control registers when used as the controlled source of quality information.

Confidence Interval - The numerical interval constructed around a point estimate of a population parameter, combined with a probability statement (the confidence coefficient) linking it to the population's true parameter value. If the same confidence interval construction technique and assumptions are used to calculate future intervals, they will include the unknown population parameter with the same specified probability.

Confidentiality procedure – A procedure used to protect confidential business information (including proprietary data and personnel records) from unauthorized access.

Configuration - The functional, physical, and procedural characteristics of an item, experiment, or document.

Conformance – An affirmative indication or judgment that a product or service has met the requirements of the relevant specification, contract, or regulation; also, the state of meeting the requirements.

Consensus standard - A standard established by a group representing a cross section of a particular industry or trade, or a part thereof.

Contractor – Any organization or individual contracting to furnish services or items to perform work.

Corrective action - Any measures taken to rectify conditions adverse to quality and, where possible, to preclude their recurrence.

Correlation coefficient – A number between –1 and 1 that indicated the degree of linearity between two variables or sets of numbers. The closer to –1 or +1, the stronger the linear relationship between the two (i.e., the better the correlation). Values close to zero suggest no correlation between the two variables. The most common correlation coefficient is the product-moment, a measure of the degree of linear relationship between two variables.

Data of known quality - Data that have the qualitative and quantitative components associated with their derivation documented appropriately for their intended use, and when such documentation is verifiable and defensible.

Data Quality Assessment (DQA) - The scientific and statistical evaluation of data to detemrine if data obtained from environmental operations are of the right type, quality, and quantity to support their intended use. The five steps of the DQA Process include: 1) reviewing the DQOs and sampling design, 2) conducting a preliminary data review, 3) selecting the statistical test, 4) verifying the assumptions of the statistical test, and 5) drawing conclusions from the data.

Data Quality Indicators (DQIs) – The quantitiative statistics and qualitative descriptors that are used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are bias, precision, accuracy (bias is preferred), comparability, completeness, representativeness.

Data Qualtiy Objectives (DQOs) – The qualitative and quantitative statements derived from the DQO Process that clarify study's technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be uses as the basis for establishing the quality and quantity of data needed to support decisions.

Data Quality Objectives (DQO) Process - A systematic strategic planning tool based on the scientific method that identifies and defines the type, quality, and quantity of data needed to satisfy a specified use. The key elements of the DQO process include the following:

- state the problem,
- identify the decision,
- identify the inputs to the decision,
- define the boundaries of the study,
- develop a decision rule,
- specify tolerable limits on decision errors, and
- optimize the design for obtaining data.

DQOs are the qualitative and quantitative outputs from the DQO Process.

Data reduction - The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail.

Data usability - The process of ensuring or determining whether the quality of the data produced meets the intended use of the data.

Deficiency An unauthorized deviation from acceptable procedures or practices, or a defect in an item.

Demonstrated capability - The capability to meet a procurement's technical and quality specifications through evidence presented by the supplier to substantiate its claims and in a manner defined by the customer.

Design - The specifications, drawings, design criteria, and performance requirements. Also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.
Design change - Any revision or alteration of the technical requirements defined by approved and issued design output documents and approved and issued changes thereto.

Design review - A documented evaluation by a team, including personnel such as the responsible designers, the client for whom the work or product is being designed, and a quality assurance (QA) representative but excluding the original designers, to determine if a proposed design will meet the established design criteria and perform as expected when implemented.

Detection Limit (DL) - A measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. DLs are analyte- and matrix-specific and may be laboratory-dependent.

Distribution - 1) The appointment of an environmental contaminant at a point over time, over an area, or within a volume; 2) a probability function (density function, mass function, or distribution function) used to describe a set of observations (statistical sample) or a population from which the observations are generated.

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

Document control - The policies and procedures used by an organization to ensure that its documents and their revisions are proposed, reviewed, approved for release, inventoried, distributed, archived, stored, and retrieved in accordance with the organization's requirements.

Duplicate samples - Two samples taken from and representative of the same population and carried through all steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variance of the total method, including sampling and analysis. See also *collocated sample.*

Environmental conditions -The description of a physical medium (e.g., air, water, soil, sediment) or a biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental data - Any parameters or pieces of information collected or produced from measurements, analyses, or models of environmental processes, conditions, and effects of pollutants on human health and the ecology, including results from laboratory analyses or from experimental systems representing such processes and conditions.

Environmental data operations - Any work performed to obtain, use, or report information pertaining to environmental processes and conditions.

Environmental monitoring - The process of measuring or collecting environmental data.

Environmental processes - Any manufactured or natural processes that produce discharges to, or that impact, the ambient environment.

Environmental programs - An all-inclusive term pertaining to any work or activities involving the environment, including but not limited to: characterization of environmental processes and conditions; environmental monitoring; environmental research and development; the design, construction, and operation of environmental technologies; and laboratory operations on environmental samples.

Environmental technology - An all-inclusive term used to describe pollution control devices and systems, waste treatment processes and storage facilities, and site remediation technologies and their components that may be utilized to remove pollutants or contaminants from, or to prevent them from entering, the environment. Examples include wet scrubbers (air), soil washing (soil), granulated activated carbon unit (water), and filtration (air, water). Usually, this term applies to hardware-based systems; however, it can also apply to methods or techniques used for pollution prevention, pollutant reduction, or containment of contamination

to prevent further movement of the contaminants, such as capping, solidification or vitrification, and biological treatment.

Estimate A characteristic from the sample from which inferences on parameters can be made.

Evidentiary records - Any records identified as pan of litigation and subject to restricted access, custody, use, and disposal.

Expedited change - An abbreviated method of revising a document at the work location where the document is used when the normal change process would cause unnecessary or intolerable delay in the work.

Field blank - A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport. A clean sample, carried to the sampling site, exposed to sampling conditions, returned to the laboratory, and treated as an environmental sample.

Field (matrix) spike - A sample prepared at the sampling point (i.e., in the field) by adding a known mass of the target analyte to a specified amount of the sample. Field matrix spikes are used, for example, to detem1ine the effect of the sample preservation, shipment, storage, and preparation on analyte recovery efficiency (the analytical bias).

Field split samples - Two or more representative portions taken from the same sample and submitted for analysis to different laboratories to estimate interlaboratory precision.

Financial assistance - The process by which funds are provided by one organization (usually governmental) to another organization for the purpose of performing work or furnishing services or items. Financial assistance mechanisms include grants, cooperative agreements, and governmental interagency agreements.

Finding - An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative, and is normally accompanied by specific examples of the observed condition.

Goodness-of-fit test - The application of the chi square distribution in comparing the frequency distribution of a statistic observed in a sample with the expected frequency distribution based on some theoretical model.

Grade - The category or rank given to entities having the same functional use but different requirements for quality.

Graded approach - The process of basing the level of application of managerial controls applied to an item or work according to the intended use of the results and the degree of confidence needed in the quality of the results. (See also *Data Quality Objectives (DQO) Process.*)

Guidance - A suggested practice that is not mandatory, intended as an aid or example in complying with a standard or requirement

Guideline A suggested practice that is not mandatory in programs intended to comply with a standard.

Hazardous waste - Any waste material that satisfies the definition of hazardous waste given in 40 CFR 261, "Identification and Listing of Hazardous Waste."

Holding time - The period of time a sample may be stored prior to its required analysis. While exceeding the holding time does not necessarily negate the veracity of analytical results, it causes the qualifying or "flagging" of any data not meeting all of the specified acceptance criteria.

Identification error - The misidentification of an analyte. In this error type, the contaminant of concern is unidentified and the measured concentration is incorrectly assigned to another contaminant.

Independent assessment - An assessment performed by a qualified individual, group, or organization that is not a part of the organization directly performing and accountable for the work being assessed.

Inspection - The examination or measurement of an item or activity to verify conformance to specific requirements.

Internal standard - A standard added to a test portion *of* a sample in a known amount and carried through the entire determination procedure as a reference for calibrating and controlling the precision and bias *of* the applied analytical method.

Item - An all-inclusive term used in place of the following: appurtenance, facility, sample, assembly, component, equipment, material, module, part, product, structure, subassembly, subsystem, system, unit, documented concepts, or data.

Laboratory split samples - Two or more representative portions taken from the same sample and analyzed by different laboratories to estimate the interlaboratory precision or variability and the data comparability .

Limit of quantitation - The minimum concentration of an analyte or category of analytes in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions.

Management - Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system - A structured, nontechnical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Management Systems Review (MSR) - The qualitative assessment of a data collection operation and/or organization(s) to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained.

Matrix spike - A sample prepared by adding a known mass of a target analyte to a specified amount of matrix sample for which an independent estimate of the target analyte concentration is available. Spiked samples are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

May - When used in a sentence, a term denoting permission but not a necessity.

Mean (arithmetic) - The sum of all the values of a set of measurements divided by the number of values in the set; a measure of central tendency.

Mean squared error A statistical term for variance added to the square of the bias.

Measurement and Testing Equipment (M&TE) - Tools, gauges, instruments, sampling devices, or systems used to calibrate, measure, test, or inspect in order to control or acquire data to verify conformance to specified requirements.

Memory effects error - The effect that a relatively high concentration sample has on the measurement of a lower concentration sample of the same analyte when the higher concentration sample precedes the lower concentration sample in the same analytical instrument.

Method - A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method blank - A blank prepared to represent the sample matrix as closely as possible and analyzed exactly like the calibration standards, samples, and quality control (QC) samples. Results of method blanks provide an estimate of the within-batch variability of the blank response and an indication of bias introduced by the analytical procedure.

Mid-range check - A standard used to establish whether the middle of a measurement method's calibrated range is still within specifications.

Mixed waste - A hazardous waste material as defined by 40 CFR 261 Resource Conservation and Recovery Act (RCRA) and mixed with radioactive waste subject to the requirements of the Atomic Energy Act.

Must - When used in a sentence, a term denoting a requirement that has to be met.

Nonconformance - A deficiency in a characteristic, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate; nonfulfillment of a specified requirement.

Objective evidence - Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measurements, or tests that can be verified.

Observation - An assessment conclusion that identifies a condition (either positive or negative) that does not represent a significant impact on an item or activity. An observation may identify a condition that has not yet caused a degradation of quality.

Organization - A company, corporation, flrn1, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Organization structure - The responsibilities, authorities, and relationships, arranged in a pattern, through which an organization performs its functions.

Outlier - An extreme observation that is shown to have a low probability of belonging to a specified data population.

Parameter - A quantity, usually unknown, such as a mean or a standard deviation characterizing a population. Commonly misused for "variable," "characteristic," or "property."

Peer review - A documented critical review of work generally beyond the state of the art or characterized by the existence of potential uncertainty. Conducted by qualified individuals (or an organization) who are independent of those who performed the work but collectively equivalent in technical expertise (i.e., peers) to those who performed the original work. Peer reviews are conducted to ensure that activities are technically adequate, competently performed, properly documented, and satisfy established technical and quality requirements. An in-depth assessment of the assumptions, calculations, extrapolations, alternate interpretations, methodology, acceptance criteria, and conclusions pertaining to specific work and of the documentation that supports them. Peer reviews provide an evaluation of a subject where quantitative methods of analysis or measures of success are unavailable or undefined, such as in research and development.

Performance Evaluation (PE) - A type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory.

Pollution prevention - An organized, comprehensive effon to systematically reduce or eliminate pollutants or contaminants prior to their generation or their release or discharge into the environment.

Population The totality of items or units of material under consideration or study.

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. Refer to *Appendix D, Data Quality Indicators,* for a more detailed definition.

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.

Project - An organized set of activities within a program

Qualified data - Any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations.

Qualified services - An indication that suppliers providing services have been evaluated and determined to meet the technical and quality requirements of the client as provided by approved procurement documents and demonstrated by the supplier to the client's satisfaction.

Quality - The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

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 Assurance Program Description/Plan - See *quality management plan.*

Quality Assurance Project Plan (QAPP) - A formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (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.*

Quality Control (QC) - The overall system of technical activities that measures the attributes and perfonnance 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 control (QC) sample - An uncontaminated sample matrix spiked with known amounts of analytes from a source independent of the calibration standards. Generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system.

Quality improvement - A management program for improving the quality of operations. Such management programs generally entail a formal mechanism for encouraging worker recommendations with timely management evaluation and feedback or implementation.

Quality management - That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality Management Plan (QMP) - A formal document that describes the quality system in terms of the organization's structure, the functional responsibilities of management and staff, the lines of authority, and the required interfaces for those planning, implementing, and assessing all activities conducted.

Quality system - A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC).

Radioactive waste - Waste material containing, or contaminated by, radionuclides, subject to the requirements of the Atomic Energy Act.

Readiness review - A systematic, documented review of the readiness for the start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and prior to initiation of a major phase of work.

Record (quality) - A document that furnishes objective evidence of the quality of items or activities and that has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data recording media.

Recovery - The act of determining whether or not the methodology measures all of the analyte contained in a sample. Refer to *Appendix D, Data Quality Indicators,* for a more detailed definition.

Remediation - The process of reducing the concentration of a contaminant (or contaminants) in air, water, or soil media to a level that poses an acceptable risk to human health.

Repeatability - The degree of agreement between independent test results produced by the same analyst, using the same test method and equipment on random aliquots of the same sample within a short time period.

Reporting limit - The lowest concentration or amount of the target analyte required to be reported from a data collection project. Reporting limits are generally greater than detection limits and are usually not associated with a probability level.

Representativeness - A measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition. See also *Appendix D, Data Quality Indicators.*

Reproducibility - The precision, usually expressed as variance, that measures the variability among the results of measurements of the same sample at different laboratories.

Requirement A formal statement of a need and the expected manner in which it is to be met.

Research (applied) - A process, the objective of which is to gain the knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.

Research (basic) - A process, the objective of which is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.

Research development/demonstration - The systematic use of the knowledge and understanding gained from research and directed toward the production of useful materials, devices, systems, or methods, including prototypes and processes.

Round-robin study - A method validation study involving a predetermined number of laboratories or analysts, all analyzing the same sample(s) by the same method. In a round-robin study, all results are compared and used to develop summary statistics such as interlaboratory precision and method bias or recovery efficiency.

Ruggedness study - The carefully ordered testing of an analytical method while making slight variations in test conditions (as might be expected in routine use) to determine how such variations affect test results. **If** a variation affects the results significantly, the method restrictions are tightened to minimize this variability.

Scientific method - The principles and processes regarded as necessary for scientific investigation, including rules for concept or hypothesis foffi1ulation, conduct of experiments, and validation of hypotheses by analysis of observations.

Self-assessment - The assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing and/or performing the work.

Sensitivity - the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest. Refer to *Appendix D, Data Quality Indicators,* for a more detailed definition.

Service - The result generated by activities at the interface between the supplier and the customer, and the supplier internal activities to meet customer needs. Such activities in environmental programs include design, inspection, laboratory and/or field analysis, repair, and installation.

Shall - A term denoting a requirement that is mandatory whenever the criterion for conformance with the specification permits no deviation. This term does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled.

Should - A term denoting a guideline or recommendation whenever noncompliance with the specification is permissible.

Significant condition - Any state, status, incident, or situation of an environmental process or condition, or environmental technology in which the work being performed will be adversely affected sufficiently to require corrective action to satisfy quality objectives or specifications and safety requirements.

Software life cycle - The period of time that starts when a software product is conceived and ends when the software product is no longer available for routine use. The software life cycle typically includes a requirement phase, a design phase, an implementation phase, a test phase, an installation and check-out phase, an operation and maintenance phase, and sometimes a retirement phase.

Source reduction - Any practice that reduces the quantity of hazardous substances, contaminants, or pollutants.

Span check - A standard used to establish that a measurement method is not deviating from its calibrated range.

Specification - A document stating requirements and referring to or including drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

Spike - A substance that is added to an environmental sample to increase the concentration of target analytes by known amounts; used to assess measurement accuracy (spike recovery). Spike duplicates are used to assess measurement precision.

Split samples - Two or more representative portions taken from one sample in the field or in the laboratory and analyzed by different analysts or laboratories. Split samples are quality control CQC) samples that are used to assess analytical variability and comparability.

Standard deviation - A measure of the dispersion or imprecision of a sample or population distribution expressed as the positive square root of the variance and has the same unit of measurement as the mean.

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.

Supplier - Any individual or organization furnishing items or services or performing work according to a procurement document or a financial assistance agreement An all-inclusive term

used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

Surrogate spike or analyte - A pure substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them to establish that the analytical method has been performed properly.

Surveillance (quality) - Continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specified requirements are being fulfilled

Technical review - A documented critical review of work that has been performed within the state of the art. The review is accomplished by one or more qualified reviewers who are independent of those who performed the work but are collectively equivalent in technical expertise to those who performed the original work. The review is an in-depth analysis and evaluation of documents, activities, material, data, or items that require technical verification or validation for applicability, correctness, adequacy, completeness, and assurance that established requirements have been satisfied.

Technical Systems Audit (TSA) - A thorough, systematic, on-site qualitative audit of facilities, equipment, personnel, training, procedures, recordkeeping, data validation, data management, and reporting aspects of a system.

Traceability - The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.

Trip blank - A clean sample of a matrix that is taken to the sampling site and transported to the laboratory for analysis without having been exposed to sampling procedures.

Validation - Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled. In design and development, validation concerns the process of examining a product or result to determine conformance to user needs. See also *Appendix* G, *Data Management.*

Variance (statistical) - A measure or dispersion of a sample or population distribution. Population variance is the sum of squares of deviation from the mean divided by the population size (number of elements). Sample variance is the sum of squares of deviations from the mean divided by the degrees of freedom (number of observations minus one).

Verification - Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. In design and development, verification concerns the process of examining a result of a given activity to determine conformance to the stated requirements for that activity.

Appendix B

Training Certification Evaluation Forms

Training certification evaluation forms will be used by the DEQ to certify that personnel involved in the various aspects ofPM2.s operations have performed at a satisfactory level. These forms currently are under development and will be added to the QAPP upon completion. An outline of the operational areas for forms development is included in this QAPP.

TRAINING CERTIFICATION EV ALUA TION FORM

AREAS UNDERDEVELOPMENT

I. Field Sampling Procedures

A. Presampling filter operations

1. Filter preparation

B Sampler operations

1. Filter sample removal
2. Clean sample removal
3. Data QA and documentation

C. Sampler Calibrations

1. Multipoint calibrations
2. Flow checks
3. Temperature calibrations
4. Barometric pressure calibrations

D. Performance audits

E. Sampler maintenance

1. Preventive maintenance
2. Major maintenance

II. Laboratory Procedures

A. Clean filter preparation

B. Filter weighing

C. Data documentation and OA

APPENDIX C

ANALYTICAL AND CALIBRATION PROCEDURES (SOPS)

Procedures for filter weighing and quality assurance have been developed. These procedures accord with all requirements described in 40 CFR, Part 50, Appendix L, and *EPA Guidance Document* 2.12. Copies of all SOPS have been be sent to the EP A Regional Office for review and approval.

A copy of the Quality Assessment and Improvement plan for the Division of Consolidated Laboratory Services is included in this appendix. This document describes the responsibilities of laboratory staff members, defines the scope of services, establishes indicators of performance, and addresses data collection, data assessment, and problem resolution.

Also included is the Quality Assurance (QA) Plan for the Metals Laboratory This document provides an example of the kind of QA plan that is under development for the PM2.5 laboratory operations.

DIVISION OF CONSOLIDATED LABORATORY SERVICES

1. PURPOSE

To delineate the planned, systematic, and ongoing process for monitoring, assessing, and improving the quality of services provided within the Division of Consolidated Laboratory Services (DCLS).

2. OBJECTIVES

To ensure the quality of laboratory services provided to the Commonwealth meets or exceeds the highest standards possible. To communicate the goals of the Quality Assessment and Improvement (QA/QI) plan to DCLS staff, encourage and stimulate the pursuit of quality by all employees. To enforce the policies that bring or improve quality to the laboratory. To assess tasks and eliminate potential problems that can lead to error. To provide a safe and growth stimulating work environment. To continually strive to improve the services we provide. To investigate complaints and problems, document efforts to improve services and make every effort learn from our mistakes.

3. ORGANIZA TION

The organizational structure that demonstrates levels of authority/ responsibility, and supports conducting and communicating QA/QI activities within the laboratory is delineated in enclosure.

4. SCOPE

This plan was developed and approved by laboratory members and is applicable to all administrative, technical and support staff assigned to the division.

5. MONITORING AND EVALUATION

A ten-step plan is used to monitor, evaluate, and improve the quality of laboratory services. Although these steps are explained in detail below, a brief overview of the tiered approach used to implement this plan is as follows. Lab sections define the processes or events critical to the services provided, methods to monitor those

processes, and thresholds of performance. For each section assigned to a Group, this information is consolidated into that Group's QA plan. All Group QA plans are in turn incorporated into the Division QA plan. Monitoring data are routinely collected and evaluated at the lab section level. Periodically, these data are collected and presented for evaluation and review at the Group and Division levels. At any stage in this process, the monitoring data may indicate that there is an opportunity for improvement, and staff may act to improve services. All such corrective actions will be documented and carefully monitored to ensure the intended outcome was achieved. All problems are tracked and trended at the Division level. The entire staff is responsible for ensuring that problems are resolved quickly, finally, and at the lowest level possible.

STEP 1. ASSIGN RESPONSIBILITY

(a) *DCLS Director:* The Director has primary responsibility for implementing and maintaining the division QA/QI plan. This includes directing all activities associated with monitoring, assessing, and improving the quality of services provided by DCLS.

(b) *QA Coordinator:* The QA coordinator will be appointed by the director, report directly to the director, chair the QA/QI Committee and function as liaison between the director and the QA Committee. General responsibilities for the QA coordinator include: 1) Directing the preparations of the QA/QI plan for annual review by the director, 2) Scheduling and chairing monthly QA/QI Committee meetings, and 3) Documenting actions and providing a quarterly report of meeting minutes to director.

(c) *QA Committee Members:* The QA Committee members will be nominated by the QA coordinator and selected by the director. The members serving on the committee will ensure Group plans are prepared, evaluated and approved annually. Group OA plans will be attached to the division QA/QI plan. While serving, the committee, members will prepare and review monthly Group QA reports, initiate corrective actions, recommend additional corrective actions, monitor and assess corrective action for effect, and assist in processes employed to document actions

taken to improve services. Committee members will need to work closely with Group Managers and Assistant Bureau Directors directing staff in the preparation Group QA plans, monitoring Group Qa Indicators, and implementing corrective actions.

(d) *QA Officer:Staff* will be assigned to the QA Office to serve as members of the QA Committee and provide administrative assistance documenting QA Committee actions, tracking Group and Division actions, graphing data and preparing statistical analyses for committee or director review and coordinating external quality control measures.

(e) *Managers:* Bureau directors, assistant bureau directors, and group managers, with assistance from Group QA Officers, prepare Group QA plans, identify indicators, establish thresholds, and define and direct data collection methodologies. Directors and managers also will supervise data collection procedures as scheduled within the Group QA plan, ensure staff are informed of the director's policies and ensure those that policies are enforced.

f.Division Audit Teams: An audit team may be appointed by the director or QA coordinator to examine compliance with DGS/DCLS policies, procedures oc accreditation standards, review Group QA activities, evaluate and provide corrective actions for problems unresolved by "normal" QA measures. The number of staff appointed will vary with the task. Audit repons will be directed to director through the QA/QI Committee.

g.Laboratory Staff: It is the responsibility of all within DCLS to read and proactively support the Director's QA/QI plan,

STEP II. DEFINE SCOPE OF SERVICE

a.Mission Statement: DCLS is committed to providing our customers with high quality and responsive laboratory service, training and developing our staff to become the best in their professions, and enhancing our community through the promotion of health and the protection our environment.

b.SitesIHoursIStaff. DCLS serves the Commonwealth through our main laboratory in Richmond and two regional laboratories in Abingdon and Luray, Virginia. These labs

are fully staffed during normal working hours (8 AM to 430 PM) Monday through Friday, excluding holidays. Limited weekend coverage is provided primarily to complete time-dependent procedures. Around-the-clock coverage is provided for Emergency Services. Staffing includes not only analytical chemists, microbiologists, and administrative personnel, but also an excellent support staff performing purchasing, stockroom, mail room, quality assurance, lab certification, security, shop, accounting, and a variety of clerical functions.

c.Services Provided: Over 3 million assays are performed within DCLS annually. Tainted food, contaminated soil, polluted air and water, animal brain and tissue, gasoline and motor fuels, drinking water, environmental waters and body fluids are a few of the samples analyzed. These specimens are collected by DCLS customers and mailed or hand delivered to the laboratory. Within the Richmond lab, these specimens may be processed and distributed to anyone or several of the 10 analytical testing Groups. Within these groups a strong technical staff and customer support group works closely with the customer to provide the best laboratory services available.

d.Those Served: The primary customers of DCLS are state and local agencies that serve the residents of the Commonwealth. These include the Department of Agriculture and Consumer Services, Department of Environmental Quality, Department of Health, Department of Emergency Services, Department of Transportation, and the Poison Control Center. DCLS also serves federal, state and local law enforcement agencies, fire departments, hospitals, clinics and physicians, local water control boards, private laboratories and a variety of environmental and clinical federal agencies. The citizens of the Commonwealth, however, are our final customers, because the testing performed assists state agencies who monitor, improve, and protect the health of our citizens or the environment in which they live.

STEP III: IDENTIFY IMPORTANT ASPECTS OF SERVICE

To evaluate the quality of services provided by any lab, the important elements required to deliver those services must first be identified. These elements will be referred to as "aspects of service." Several examples of aspects of service are sample collection instructions, sample preservation, sample transport, method of analysis, test

reagents, equipment maintenance, internal quality control, external quality control, analyst performance, training, supervisor reviews, data reduction, record storage, and customer satisfaction. Aspects of service will be identified for each lab section and Group and incorporated into each Group's QA plan. All lab staff should be actively involved in identifying these elements. Priority should be given to "high risk" (i.e. serious consequences may result if the service is not performed correctly), "problem prone" (i.e. aspects of service that have tended to produce more problems than others) and "high volume", (i.e. events that occur frequently or that affect a large number of users) aspects of service.

STEP IV: ESTABLISH MONITORS AND INDICATORS OF PERFORMANCE

Within any aspect of service there are certain measurable events or variables that relate to the structure, process, or outcome of the service provided. These events are often found in lab accreditation standards, *Good Laboratory Practices,* or within standard operating procedures. As measurable events, an acceptable level of performance can be established and performance conclusions made from monitored data. A list of events monitored within each lab section will be identified and reviewed annually as attachments to each Group QA plan. A schedule for periodic evaluation of monitors selected as indicators of service performance will also be attached to these plans. At least one indicator should be selected for each important aspect of service. Lab staff are strongly encouraged to be pro-active defining group monitors and selecting indicators of performance.

STEP V: THRESHOLDS OF ACCEPTABLE PERFORMANCE

Each indicator should have a pre-established level or point that when reached will direct attention to those evaluating the data that a problem or an opportunity for improvement exists. These levels or points are defined as "thresholds." Every indicator listed by the Division will have an defined threshold. Some indicators are so critical to performance that corrective action is warranted whenever the measured event occurs or fails to occur. These indicators usually have a threshold of 0% or 100% as appropriate. Other indicators allow for a level of performance that is usually consistent with established professional standards or historical performance.

Thresholds for these indicators are often expressed as a range (eg. less than 5% or greater than 90%).

STEP VI: COLLECT AND ORGANIZE DATA

The source of data (WHAT/WHERE), method of documentation (HOW /WHEN) and responsibility for documentation, collection and review (WHO) will be identified for each monitored event. Data collection sheets and other data collection tools will be provided as enclosures to Group QA plans. Monthly, data selected and identified for review will be collected by QA. Committee Members and presented to the QA Committee in a Group QA report (Appendix 2). These reports will be attachments to the QA Committee minutes and the director's quarterly QA report.

STEP VII: EVALUATE DATA

Evaluation or assessment is managed by division professionals and all staff are encouraged to participate in this process. Evaluation is to determine the cause and scope of detected problems, and should be conducted using pre-established criteria. Discussions, literature searches, standard operating procedures, maintenance manuals, accreditation, division and agency standards are but some of the examples of criteria that may be used to enhance problem evaluation. Suggestions or recommendations for improving or expanding initial assessments may occur at any management or quality improvement level. A team approach is encouraged to focus on complex or reoccurring problems, and those problems that cross group or division boundaries.

STEP III: INITIATE CORRECTIVE ACTION

Actions for problem resolution will be implemented. These actions will be aimed at eliminating the problem whenever possible. It is encouraged that action be taken at the lowest level to resolve problems. Corrective actions will reported through management and documented (Appendix 3) for quality assessment where additional actions may be taken. Examples of corrective actions include: education and training, revising policy or procedures, and making staffing, equipment or facility change(s).

STEP IX: FOLLOW UP CORRECTIVE ACTIONS and ASSESS FOR GAIN

Groups will report monthly to the QA Committee the following information: monitoring data, identified problems, problem assessments, corrective actions

initiated to improve services, follow up plans and outcomes. Suggestions and recommendations may be provided by committee members. Each identified problem will be given a control number and the outcome of actions taken tracked by the QA Committee. A "problem" file will not be closed by the Committee until follow up plans have been completed and a successful outcome achieved.

STEP X: DOCUMENT AND COMMUNICATE RESULTS

Team leaders will receive informal reports daily from their staff communicating information about monitoring data deviations and corrective actions taken. This information may again be summarized informally at monthly Group meetings. Groups will prepare a QA report monthly for submission to the QA Committee. The QA Committee will meet monthly and the minutes of these meetings provided to Laboratory Director, managers and staff. Quarterly the QA Coordinator will submit a report to the Director summarizing divisional QA activities, follow up, outcomes and future plans. The Director's recommendations will be returned to the QA Committee for review and action.

DCLS CORRECTIVE ACTION FORM

DATE:

GROUP/SECTION:

SUBJECT:

PROBLEM:

THRESHOLD:

CORRECTIVE ACTION:

SUMMARY /CONCLUSTION:

ATTACHED DOCUMENTATION: Yes _____No_____

SUBMITTED BY _____ _____ _____
Signature Title Date

REVIEWED BY _____ _____
Group Manager's Signature Date

APPROVED BY
Bureau Director Date

qacoract 3/96

_____ QA/QI REPORT FOR _____
(Group or Section) (Month)

Prepared by: _____

1. INDICATOR: _____

   Threshold: _____

   #Occurrences Exceeding Threshold/Total # Occurrences _____

   Problem: _____

   Corrective Action: _____

2. INDICATOR: _____

   Threshold: _____

   #Occurrences Exceeding Threshold/Total # Occurrences _____

   Problem: _____

Corrective Action: _____

3. INDICATOR: _____

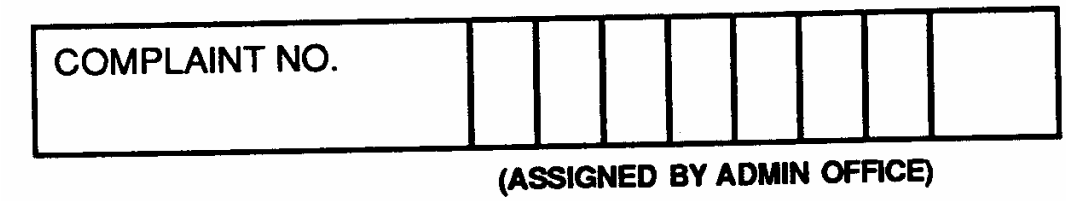
   Threshold: _____

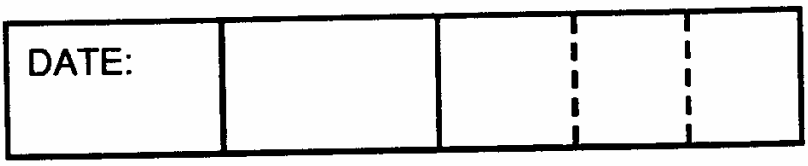
   #Occurrences Exceeding Threshold/Total # Occurrences _____

   Problem: _____

   Corrective Action: _____

CORRECTIVE ACTION FORM





GROUP/SECTION:

SUBJECT:

PROBLEM:

LABORATORY RESULTS/FILE NUMBER: (If applicable)

CORRECTIVE ACTIONS:

SUMMARY/CONCLUSIONS:

ATTACHED DOCUMENTATION: Yes_____No_____

SUBMITTED BY:

Date Signature Title

REVIEWED BY:

Group Manager

Date

REVIEWED BY:

Bureau

Director Date

APPROVED BY:

Laboratory Director

Date

January 28, 1998

DEPARTMENT OF GENERAL SERVICES

DIVISION OF CONSOLIDATED LABORATORY SERVICES

QUALITY ASSURANCE (QA) PLAN FOR THE METALS LABORATORY

_____

Norma Roadcap-Metals Group Manager

_____

Jim Anderson-Principal Chemist

_____

Becky Perdue- QA/QI Coordinator

Current version effective _____2003

PURPOSE:

To provide a planned, systematic and on-going process to monitor, evaluate and improve the services provided by the Metals Laboratory. The goal is to provide the citizens of the Commonwealth of Virginia with accurate, precise, and timely data.

OBJECTIVE

To support and adhere to the objectives of the Division QA plan. To strive to meet cr exceed the highest standards of quality possible. To provide our customers with the quality of data required to ensure proper actions are taken to protect the environment and health of the citizens we serve.

RESPONSIBILITIES:

Director: Provide an effective Quality Assurance Plan for the Division and ensure adequate resources to carry out that plan. Direct the processes necessary to effectively monitor, evaluate, and take corrective action to ensure the services provided meet the needs of the Commonwealth, the Division, and the customers served.

QA Coordinator: Implement the Division QA Plan as directed by Director. Prepare a Division QA plan annually for review and approval by Director. Chair the QA Committee and maintain minutes of those meetings. Keep the Director apprised of all actions taken to improve the quality of services provided, and to prepare a quarterly QA report of these actions for Director's review. Communicate actions taken and lessons learned to staff.

Metals Group Manger: Provide and manage Group resources to effectively implement the Group QA plan; also to review procedures, quality control, safety, instrument maintenance, and staff performance. Provide assistance developing and maintaining Group training programs.

Principal Chemists: Provide technical guidance to the Group. Work with managers to implement the QA plan; to monitor and implement change; and to improve the quality of services provided.

Metals QA Committee Member: Review the actions taken to implement the Group QA plan and report problems to the Group Manager, QA Officer, or QA Coordinator. Assist the Group in monitoring scheduled indicators, and in maintaining documentation of data collected and corrective actions taken. Collate data and repon monthly on actions taken to implement the Group QA plan to the QA Committee Communicate proceedings of the QA Committee to the Group.

Staff: Be knowledgeable about the QA plan, to support it pro-actively; and to implement it as directed.

SCOPE OF SERVICE:

The Metals Section analyzes numerous types of samples for metal content ranging from trace level to percentage levels using a variety of procedures and equipment Some examples of such samples include agricultural products, animal feed, milk, fertilizers, soil, surface and drinking water, air, and human blood. Customers served are the Departments of Environmental Quality, Agriculture and Consumer Services, Health, Labor and Industry, other State Agencies, municipalities, numerous local hospitals, clinics, fire departments, and law enforcement agencies.

ASPECTS OF SERVICE:

Services provided to the customers of the Metals Laboratory are categorized into functional groups, or aspects, or service. Methods have been developed within each of these functional groups to evaluate the quality of service provided within each group. Important aspects of service within the Metals Laboratory include:

(1) Sample collection, preservation, transport, and accessioning. Sample Records Management screens samples and requests received to ensure sample integrity and records management, giving each sample a unique identification number before bringing samples to the laboratory. Sample requirements are identified within each analytical method. The criteria for accepting and rejecting samples is within Metals and Sample Records Management standard operating procedure manuals.

(2) Sample storage. Acceptable storage techniques and holding times are defined for each method. Refrigerator and freezer temperatures containing samples are routinely monitored.

(3) Policies and procedures. Analytical methods are available to all analysts. Methods are validated, drafted, reviewed, and revised according to Division policy. In brief, new methods are not accepted until competence for each matrix has been demonstrated though the use of standard reference materials, blanks, duplicates and spiked samples. Validation data will be retained in the lab. Methods are reviewed by the Director annually. Changes must be approved by the Principals, Group Managers and Assistant Bureau Director.

(4) Personnel and training. An organizational chart for the Metals Laboratory is provided in Attachment (1.). A written position description for each job is kept on record within the Division. Within these position descriptions are the credentials/skills needed and duties of the position. A performance plan is prepared annually for each employee and his or her performance is judged by a minimum of one interim and one close-out evaluation. Training is conducted at the Division and Group level. Perfonnance evaluation samples may be used to determine proficiency in an area. The Group Manager is responsible for ensuring that orientation and rotation schedules are met. The Division maintains a record of all training-on-site and off-site.

(5) Sample analysis.
(a) *Reagents and standards* used will be of the grade or quality specified by the method. Reagents will be dated when received, dated and initialed when opened, and have a legible expiration date. Reagents and standards will not be used beyond the expiration date (with the exception of purchased stock standards that can be verified by an alternate source). Purchased standards will be traceable to NIST. Documentation of reagent solutions and calibration standards will be maintained,

including the date of preparation; the data on concentration and purity, or both; the assigned expiration date; and the preparer's initials.

(b) *Equipment calibration and maintenance* will be performed as described by each method. Maintenance will be performed as scheduled, and documented in a maintenance logbook. Instrument calibration will be verified initially using a reference standard prepared from a source other than the calibration standards. Continuing verification standards may be from the same source as the calibration standards, and are analyzed periodically to check for drift in the calibration curve. Linear range studies will be conducted annually in accordance with the specific test method. Acceptance criteria will be stated in the method.

(c) Accuracy and precision. Matrix-spiked samples, duplicates, and method blanks will be analyzed with a minimum frequency of 5% of the samples for each matrix, a-one per batch. Reference-control samples will be prepared and analyzed with each matrix for each batch. Quality-control materials and acceptance limits for those materials will be defined for each method. When possible, acceptance limits will be established by statistical evaluation of data generated from control material tested within the lab. Instruments will be calibrated before each analytical run. The number and types of standards used will be defined and will be run at intervals as described in each method.

(d) Data reduction. validation and reporting. Calibration and quality-control data, calculations, and lab results are reviewed by an analyst's peer, a senior chemist, a principal chemist, or group manager before results are reported. The chemist reporting the data also reviews final reports for clerical errors, omitted information, and correct reporting technique. Errors will be corrected by amending data in the Laboratory Information Management System, and submitting amended reports to the customer. Any handwritten data must be transcribed in ink and be legible. Report forms should be reviewed periodically for accuracy (e.g, correct action and detection limits). Corrections to worksheets or workbooks are done in ink, initialed and dated

with a single line through the erroneous result and correction written next to this value.

(6) Performance Validation. Each staff member must be supervised when learning to perform a new method, and the supervisor must document in the employee's training record the date when the employee can successfully perform the method. Each staff member should be challenged periodically to complete tasks as described by method, and these validation processes documented.

(7) Initial Demonstration of Performance. Each analytical method must have method-detection limits and linear dynamic ranges determined annually or when significant changes occur within the instrument (e.g, a new detector) or in the analytical technique.

(8) External Quality Control and Proficiency Checks. The Metals Lab subscribes to the following proficiency checks:

- Wisconsin State Laboratory of Hygiene Blood Lead Proficiency Testing
- CLIA Proficiency Testing through WSLH
- EPA Water Proficiency Testing
- USGS Surveys
- AAFCO Feed Check Samples
- Magruder Fenilizer Check Samples
- PAT Studies
- ELPAT Rounds/Lead

Proficiency samples are analyzed in a manner as close to that used for client- submitted samples as possible. Results are reviewed by the Metals staff, the QA Committee, and the Director. Each unacceptable result is investigated, and corrective

actions are taken and then reported to the QA Committee. Proficiency sample analysis is used for method-performance validation and in training documentation. Proficiency data is tracked and charted by the division QA officer to look for trends or bias, or both.

(9) Record storage. Records are stored according to Division policy. Raw data will be stored consistent with respective accreditation policies.

(10) Safety- The Metals lab adheres to Division Safety Policy. The Division Safety Officer conducts training in accordance with OSHA policies. Any incidents or accidents are documented and actions are taken to correct problems.

(11) Customer satisfaction. The Metals Lab responds immediately to suggestions and complaints made by its customers. When received, these are documented on a Customer Complaint form and action taken. Operational indicators such as test turn- around times and accuracy of reporting are monitored, and the data made available to our customers. The cost of Metals services are reviewed annually and cost savings will be passed on to our customers.

MONITORS AND INDICATORS: .

A great many events must occur in a defined manner within all areas of the laboratory. Most of these events are measurable, and therefore, defined thresholds of performance can be made. These measurable performance standards are known as "monitors." The information obtained by reviewing the data collected from selected monitors can be used to periodically evaluate the quality of service provided. Those monitors selected are called "indicators." Indicators will be selected and scheduled for monitoring annually by the Metals Laboratory. The entire Metals staff will become involved in selecting these monitors, in giving attention to high-risk and error-prone areas. Attachment (2) is a listing of all the monitors for which data are routinely collected routinely in the Metals Laboratory. The QA Committee will review all Group monitors and indicators annually. Attachment (3) are the indicators selected to evaluate the quality of the Metals laboratory services for the current year.

THRESHOLDS:

The range of acceptable performance will be established for each monitor or indicator. Some of these thresholds will be predetermined by Division policies, accreditation standards, or customer expectations. Many however will be established by the Metals staff. All will be reviewed by the QA Committee. Changing established thresholds should occur only with QA Committee's approval.

RECORDS AND DATA COLLECTION:

Metals data is stored in a variety of forms, including written procedures and policies; test requests; report forms; charts; and computer files. Metals Lab staff collect, store, and review data as defined by Division and Group policies. Accessioning staff review customer requests with each sample submitted; analysts review quality control data with each test run. Senior chemists also review quality-control information, maintenance records, and lab reports; as well as external quality-control data. In addition, quality-control data is monitored by the QA committee member, the principal manager, the QA officer, the QA coordinator, and the QA committee. All records will include information on the method/schedule of data review, and will contain a definition of the the reviewer's responsibility. The QA committee member will ensure that indicator data is collected as scheduled, and reported monthly to the QA Committee.

DATA EVALUATION AND CORRECTIVE ACTIONS:

Problems will be resolved at the lowest level possible. When monitored data exceeds a threshold of acceptable limits, corrective action will be taken immediately. All such actions will be documented. Metals staff members will notify the senior chemist or supervisor when unsure of the appropriate corrective action. Corrective actions will be reviewed by the QA committee member, senior chemists, principals, and managers. Each month the QA committee member will compile and submit to the QA Committee. information on monitored data and corrective actions. The QA Committee will provide recommendations and continue to monitor the situation to

ensure that detected problems are resolved. If the initial corrective actions fail to resolve the problem, or if a trend is observed, the QA Committee may make additional recommendations or establish an action team to seek a resolution.

COMMUNICATION:

Senior chemists meet with staff daily to discuss problems and corrective actions. Quality assurance and safety are regular agenda items at monthly staff meetings. The QA Committee meets monthly in a session that is open to all staff members. QA Committee minutes and quarterly reports to the director are posted for staff to review. Weekly and monthly meetings with our primary customers are held routinely.

APPENDIX D

DATA QUALIFIERS/FLAGS

A sample qualifier or a result qualifier consists of three alphanumeric characters that indicate that the subject analysis either (a) did not produce a numeric result; (b) produced a numeric result that is qualified in some respect relating to its type or validity; or (c) produced a numeric result that for administrative reasons is not to be reported outside the laboratory. Tables D-I and D-2 provide an example listing of data qualifiers as well as potential qualifier codes.

EPA must develop the capability to process PM2.5 data within the AIRS data system. During this development, EP A must designate certain sample and result qualifiers. Once this is accomplished, the DEQ will adopt these qualifiers and codes, and will use them in all processing of data within the Virginia PM2.5 monitoring program.

TABLE D-1. FIELD DATA QUALIFIERS

CODE	DEFINITION	DESCRIPTION
CON	Contamination	Contamination including observations of insects or other debris
DAM	Filter Damage	Filter appeared damaged
EST 1/	Elapsed Sample Time	Elapsed sample time out of specification
EVT	Event	exceptional event expected to have effected sample (dust, fire , spraying etc)
FAC	Field accident	There was an accident in the field that either destroyed the sample or rendered it not suitable for analysis.
FAT	Failed Temperature Check Ambient	Ambient temperature check out of specification
FIT	Failed Temperature Check Internal	Internal temperature check out of specification
FLR 1/	Flow Rate	Flow rate 5 min avg out of specification
FLT 1/	Filter Temperature	Filter temperature differential, 30 minute interval out of specification
FMC	Failed Multi point Calibration Verification	Failed the initial Multi point calibration verification
FPC	Failed Pressure Check	Barometric pressure check out of specification
FSC	Failed Single Point Calibration Verification	Failed the initial single point calibration verification
FVL	Flow volume	Flow volume suspect
GFI	Good Filter Integrity	Filter intgrity, upon post sampling field inspection looks good
LEK	Leak suspected	internal/external leak suspected
SDM	Sampler Damaged	Sampler appears to be damaged which may have affected filter

1/- Flag generated by sampling equipment

TABLE D-2. LABORATORY QUALIFIERS

CODE	DEFINITION	DESCRIPTION
ALT	alternate measurement	The subject parameter was determined using an alternate measurement method. Value is believed to be accurate but could be suspect.
AVG	average value	Average value - used to report a range of values
BDL	below detectable limits	There was not a sufficient concentration of the parameter in the sample to exceed the lower detection limit in force at the time the analysis was performed. Numeric results field, if present is at best, an approximate value.
BLQ	below limit of quantitation	The sample was considered above the detection limit but there was not a sufficient concentration of the parameter in the sample to exceed the lower quantitation limit in force at the time the analysis was performed

	TABLE D-2. LABORATORY QUALIFIERS	
CODE	DEFINITION	DESCRIPTION
BLQ	below limit of quantitation	The sample was considered above the detection limit but there was not a sufficient concentration of the parameter in the sample to exceed the lower quantitation limit in force at the time the analysis was performed
CAN	canceled	The analysis of this parameter was canceled and not preformed.
CBC	cannot be calculated	The calculated analysis result cannot be calculated because an operand value is qualified
EER	entry error	The recorded value is known to be incorrect but the correct value cannot be determined to enter a correction.
FBK	found in blank	The subject parameter had a measurable value above the established QC limit when a blank was analyzed using the same equipment and analytical method. Therefore, the reported value may be erroneous.
FCS	failed collocated sample	Collocated sample exceeded acceptance criteria limits
FFB	failed field blank	Field blank samples exceeded acceptance criteria limits.
FIS	failed internal standard	Internal standards exceeded acceptance criteria limits.
FLB	failed laboratory blank	Laboratory blank samples exceeded acceptance criteria limits.
FLD	failed laboratory duplicate	Laboratory duplicate samples exceeded acceptance criteria limits.
FLH	failed laboratory humidity	Laboratory humidity exceeded acceptance criteria limits
FLT	failed laboratory temperature	Laboratory temperature exceeded acceptance criteria limits.
FQC	failed quality control	The analysis result is not reliable because quality control criteria were exceeded when the analysis was conducted. Numeric field, if present, is estimated value.
GSI	Good Shipping Integrity	Integrity of filter upon receipt by shipping/receiving looked good
HTE	holding time exceeded	Filter holding time exceeded acceptance criteria limits
ISP	improper sample preservation	Due to improper preservation of the sample, it was rendered not suitable for analysis.
INV	invalid sample	due to single or a number or flags or events, the sample was determined to be invalid.
LAC	laboratory accident	There was an accident in the laboratory that either destroyed the sample or rendered it not suitable for analysis.
LLS	less than lower standard	The analysis value is less than the lower quality control standard.
LTC	less than criteria of detection	Value reported is less than the criteria of detection

TABLE D-2. LABORATORY QUALIFIERS		
CODE	DEFINITION	DESCRIPTION
NAR	no analysis result	There is no analysis result required for this subject parameter
REJ	rejected	The analysis results have been rejected for an unspecified reason by the laboratory. For any results where a mean is being determined, this data was not utilized in the calculation of the mean.
REQ	reque for re-analysis	The analysis is not approved and must be re-analyzed using a different method.
RET	return(ed) for re-analysis	The analysis result is not approved by laboratory management and reanalysis is required by the bench analyst with no change in the method.
RIN	re-analyzed	The indicated analysis results were generated from a re-analysis
STD	internal standard	The subject parameter is being utilized as an internal standard for other subject parameters in the sample. There is no analysis result report, although the theoretical and/or limit value(s) may be present
UND	analyzed but undetected	Indicates material was analyzed for but not detect

Appendix E

Standard Operating Procedures

The following listing provides an example of the types of standard operating procedures that are currently under development or have been developed for the PM2.s air monitoring program. All procedures will be available for EPA review and approval upon completion. Once approved, these SOPs will be distributed to all personnel as previously identified in this QAPP.

PROGRAM AREAS FOR STANDARD OPERATING PROCEDURES DEVELOPMENT

Equipment/Consumables

Receipt, inspection, acceptance procedures for PM2.5 equipment

Receipt, inspection, acceptance procedures for PM2.5 consumables

- Filter handling
- Filter integrity check
- Sample storage
- Sample chain-of -custody

Laboratory Activities

Standard operating procedures for preparation, weighing, and data recording for the *PM2.5* monitoring program.

- Mass reference standards
- Filter conditioning (pre and post sampling)
- Electrostatic charge neutralization
- Pre-sampling filter weighing
- Sample chain-of-custody
- Temperature calibration/verification
- Relative humidity verification
- Laboratory maintenance
- Sample storage/archiving

Field Activities

Standard procedures for operation of field monitoring sites for the PM2.5 monitoring program.

- Monitor set-up and installation
- Filter selection

- Filter installation and recovery
- Filter transport, packaging, and shipping
- Sample chain-or-custody
- Flow rate calibration and verification
- Temperature calibration and verification
- Sampler pressure verification
- Internal/external leak checks
- Field maintenance

Shipping/Receiving

Standard operating procedures for receiving PM2.5 filters from the field

- Receiving and inspection
- Sample chain-of -custody
- Sample storage

Information Management

Data acquisition procedures for the PM2.5 monitoring program.

- Data entry
- Filter conditioning
- Filter pre-weighing
- Filter post-weighing
- Field data acquisition
- Sample Chain-of-custody

Data processing procedures for the PM2.5 monitoring program.

- Data review
- Data editing
- Data verification
- Calculations, algorithms, and data reduction
- Backup and security procedures
- Data validation

AIRS data transmittal procedures for the PM2.5 monitoring program.

- Upload to AIRS
- AIRS checks and edits
- Security

APPENDIX F

PM2.5 REFERENCE MATERIAL GUIDANCE DOCUMENTS

The following documents provide guidance on various aspects of the PM2.5 Ambient Air Quality Monitoring Program. It is anticipated that many of these documents will be available on the Internet and the AMTIC Bulletin Board. Internet addresses are included in the status column.

DOCUMENT TITLE	STATUS
GENERAL	
PM2.5 Implementation Plan, March 1998	Presently on AMTIC *www.epa.gov/ttn/amtic*
PM2.5 Quality Assurance Program Overview October, 1997	Presently on AMTIC *www.epa.gov/ttn/amtic*
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I: A Field Guide to Environmental Quality Assurance, U.S. Environmental Protection Agency, EPA-600/R-94-038a, April 1994.	Current
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Specific Methods, EPA-600/R-94-038b, April 1994.	Interim edition [replaces EPA-600/4-77-027a (revised 1990)]; final updated edition expected May 1998. With new EPA number "EPA-454/R-98-004"
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, EPA-600/R-94/038d, Revised April 1994.	
Quality Assurance Handbook for Air Pollution Measurement Systems, Volume V: Precipitation Measurement Systems (Interim Edition), EPA-600/R-94- 038e, April 1994.	Interim edition (replaces EPA-600/4-82-042a-b); final updated edition expected early 1996.
Model Quality Assurance Project Plan for the $PM_{2.5}$ Ambient Air Monitoring Program, March 1998	Presently on AMTIC *www.epa.gov/ttn/amtic/pmqa.html*
QUALITY MANAGEMENT	
EPA Quality Systems Requirements for Environmental Programs, EPA QA/R-1	Available in Summer, 1998
Guidance for Developing Quality Systems for Environmental Data Operations EPA QA/G-1	Fall, 1998.
EPA Requirements for Quality Management Plans," EPA QA/R-2 U.S. Environmental Protection Agency, QAD, August 1994.	Draft available on Internet *es.epa.gov/ncerqa/qa* Final Summer, 1998.
Guidance for the Management Systems Review Process EPA QA/G-3: Draft January, 1994	Available in Summer, 1998.
EPA Requirements for Quality Assurance Project Plans, QA/R-5, Current Version: Draft - November, 1997	Draft available on Internet *es.epa.gov/ncerqa/qa*
"Guidance on Quality Assurance Project Plans" EPA/G- 5, EPA/600/R-98/018.	Draft available on Internet *es.epa.gov/ncerqa/qa* Final - February 1998

DOCUMENT TITLE	STATUS
Policy and Program Requirements to Implement the Mandatory Quality Assurance Program, Order 5360.1, April 1984.	Current, basis for EPA QA program (updated in 1995 draft Order)
DATA QUALITY OBJECTIVES	
Guidance on Applying the Data Quality Objectives Process for Ambient Air Monitoring Around Superfund Sites (Stages I and II), EPA-450/4-89-015, August 1989.	Basically current guidance
Guidance on Applying the Data Quality Objectives Process for Ambient Air Monitoring Around Superfund Sites (Stage III), EPA-450/4-90-005, March 1990.	Basically current guidance
Decision Error Feasibility Trials (DEFT) Software for the Data Quality Objectives Process, QA/G-4D: EPA/600/R-96/056,	Draft Available in Internet *es.epa.gov/ncerqa/qa* Final: September, 1998
Guidance for the Data Quality Objectives Process, U.S. *QA/G-4*, EPA/600/R-96/055,	Draft Available in Internet *es.epa.gov/ncerqa/qa* Final: September, 1998
P&A	
Guideline on the Meaning and Use of Precision and Accuracy Data Required by 40 CFR Part 58, Appendices A and B, U.S. Environmental Protection Agency, EPA-600/4-83-023, June 1983.	Some items out of date (e.g., SAROAD versus AIRS, no PM-10, etc.)
Guidance for the Data Quality Assessment: Practical Methods for Data Analysis EPA QA/G-9 EPA/600/R-96/084,	Draft Available in Internet *es.epa.gov/ncerqa/qa* Final: January, 1998
SYSTEM AUDITS	
National Air Audit System Guidance Manual for FY 1988-FY 1989, U.S. Environmental Protection Agency, EPA-450/2-88-002, February 1988.	National audit report discontinued in FY89
NETWORK DESIGN AND SITING	
Guidance for Network Design and Optimum Site Exposure for PM2.5 and PM10, December, 1997	Presently on AMTIC *www.epa.gov/ttn/amtic* Draft published 12/15/97.
SLAMS/NAMS/PAMS Network Review Guidance, Draft March 1998	Presently on AMTIC *www.epa.gov/ttn/amtic*

DOCUMENT TITLE	STATUS
Network Design and Optimum Site Exposure Criteria for Particulate Matter, EPA-450/4-87-009, May 1987.	Basically current; could be revised when new PM standard is proposed
Network Design and Site Exposure Criteria for Selected Noncriteria Air Pollutants, EPA-450/4-84-022, September 1984.	Partially out of date
Appendix E and F to Network Design and Site Exposure Criteria for Selected Noncriteria Air Pollutants, EPA- 450/4-84-022a, October 1987.	Partially out of date
AMBIENT AIR MONITORING METHODS	
Filter Conditioning and Weighing Facilities and Procedures for PM2.5 Reference and Class I Equivalent Methods, February 1998	Presently on AMTIC *www.epa.gov/ttn/amtic*
Guidance Document 2.12 *Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods*	
EPA QA/G-6: Guidance for the Preparation of Standard Operating Procedures for Quality-Related Operations Final - EPA/600/R-96/027, November, 1995	Draft Available in Internet *es.epa.gov/ncerqa/qa*
Static Control for Balances	Presently on AMTIC *www.epa.gov/ttn/amtic*
AMBIENT AIR MONITORING COSTS	
Guidance for Estimating Ambient Air Monitoring Costs for Criteria Pollutants and Selected Air Toxic Pollutants, EPA-454/R-93-042, October 1993.	Partially out of date; need longer amortization schedule
OTHER	
Guideline on the Identification and Use of Air Quality Data Affected by Exceptional Events, EPA-450/4-86-007, July 1986.	Currently being updated
IntraAgency Task Force Report on Air Quality Indicators, EPA-450/4-81-015, February 1981.	Not a policy or guidance document; could be updated to include more modern analysis and presentation techniques
Screening Procedures for Ambient Air Quality Data, EPA-450/2-78-037, July 1978.	Could be updated to include more modern computer programs and newer screening procedures

DOCUMENT TITLE	STATUS
Validation of Air Monitoring Data, U.S. Environmental Protection Agency, EPA-600/4-80-030, June 1980.	Partially out of date
Quality Assurance Manual for Air Pollution Measurement Systems, Vol. I, Commonweath of Virginia, 1995	Current
Administrative Policies and Procedures Manual, Virginia Department of Environmental Quality, Revised August 12, 1998	Current