United States Environmental Protection Agency
Air

Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

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April, 1998

Quality Assurance Guidance Document

Model Quality Assurance Project Plan for the $PM_{2.5}$ Ambient Air Monitoring Program at State and Local Air Monitoring Stations (SLAMS)

Foreword

EPA policy requires that all projects involving the generation, acquisition, and use of environmental data be planned and documented and have an Agency-approved quality assurance project plan or QAPP prior to the start of data collection. The primary purpose of the QAPP is to provide an overview of the project, describe the need for the measurements, and define QA/QC activities to be applied to the project, all within a single document. The QAPP should be detailed enough to provide a clear description of every aspect of the project and include information for every member of the project staff, including samplers, lab staff, and data reviewers. The QAPP facilitates communication among clients, data users, project staff, management, and external reviewers. Effective implementation of the QAPP assists project managers in keeping projects on schedule and within the resource budget. Agency QA policy is described in the Quality Manual and EPA QA/R-1, *EPA Quality System Requirements for Environmental Programs.*

The following document represents a model QAPP for the environmental data operations involved in monitoring for $PM_{2.5}$ under the Ambient Air Quality Monitoring Network. Due to the accelerated time frame for implementation of this program, OAQPs in cooperation with the EPA Regions and State and Local organizations developed this Model QAPP to serve as an example of the type of information and detail necessary for the QAPPs submitted by State and local organizations to EPA Regions.

This model QAPP was generated using the EPA QA regulations and guidance as described in *EPA QA/R-5*, *EPA Requirements for Quality Assurance Project Plans* and the accompanying document *EPA QA/G-5*, *Guidance for Quality Assurance Project Plans.* All pertinent elements of the QAPP regulations and guidance are addressed in this model. **The model also contains background information and a rationale for each element which are excerpts from *EPA QA/G-5* and are included in text brackets (as seen above), usually found at the beginning of a section or subsection.**

The Model QAPP must not and can not be referenced verbatim. Although $PM_{2.5}$ regulations (40 CFR Parts 50, 53 and 58) and guidance (Network Guidance and Guidance Document 2.12) were used in the development of the document, many elements are unique to each organization and must be addressed at that level. Other elements may meet the organization's needs and can be used as such. Also, there are other ways for organizations to meet the data quality needs of the $PM_{2.5}$ Monitoring Program. Therefore, State and local organizations have the flexibility to develop their own QAPPs that meet their needs and are considered acceptable by their Regional QA Manager.

Due to the tight time frame required to generate this document, standard operating procedures (SOPs) for various data collection activities could not be developed. The QAPP elements or sections allude to these SOPs as if they would be included as part of the QAPP, or referenced to internal Department documents for which this Model QAPP was developed. Appendix E provides a listing of the SOPs that would be included or available for the $PM_{2.5}$ QAPP. SOPs would be developed based upon the document titled *Guidance for the Preparation of Standard Operating Procedures for Quality Related Operations EPA QA/G-6.* This document as well as the others EPA QA/G and QA/R documents are available of the EPA QA Division Homepage *(http://es.epa.gov/ncerqa/qa)*.

This document has been reviewed by EPA Regional QA Managers and/or QA Officers and was found to provide enough detail of the $PM_{2.5}$ program to be considered acceptable (see following approval page). Therefore, QAPPs of similar detail developed by State and Local organizations should meet approval.

The document, mentions trade names, and brand names that are both real and fictitious. Usually these names will be associated with the "@" symbol. Mention of corporation names, trade names, or commercial products does not constitute endorsement or recommendation for use.

Acknowledgments

This Model QAPP is the product of the combined efforts of the EPA Office of Air Quality Planning and Standards, the EPA National Exposure Research Laboratory, the EPA Regional Offices, and the State and local organizations. The development and review of the material found in this document was accomplished through the activities of the $PM_{2.5}$ QA Workgroup. The following individuals are acknowledged for their contributions.

State and Local Organizations

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Jeff Miller, Pennsylvania Department of Environmental Protection, Harrisburg, PA
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Dan Harman, North Dakota Department of Health, Bismarck, ND

EPA Regions

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4 Jerry Burger, Herb Barden
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6 Mary Kemp, Mark Sather, Kuenja Chung, Timothy Dawson
7 Leland Grooms, Mike Davis, Shane Munsch
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Office of Air Quality Planning and Standards

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Acronyms and Abbreviations

AIRS	Aerometric Information Retrieval System
ANSI	American National Standards Institute
APTI	Air Pollution Training Institute
ASTM	American Society for Testing and Materials
AWMA	Air and Waste Management Association
CAA	Clean Air Act
CFR	Code of Federal Regulations
CMD	Contracts Management Division
CMZ	community monitoring zone
CO	Contracting Officer
COC	chain of custody
DAS	data acquisition system
DCO	Document Control Officer
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
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
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
$PM_{2.5}$	particulate matter $\leq$ 2.5 microns
PTFE	polytetrafluoroethylene
Q_a	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
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
V_a	air volume, at ambient or actual conditions
VOC	volatile organic compound
WAM	Work Assignment Manager

Tables

Figures

Region Approval

This Model QAPP has been reviewed by EPA Regional QA Managers and/or QA Officers and was found to provide enough detail of a program specific QAPP for a $PM_{2.5}$ monitoring program to be considered acceptable.

Region 1 With the attached comments

Nancy Barmakian Date 03/27/98

Region 2

[illegible] Date 4/10/98

Region 3

[illegible], RQAM Date [illegible]

Region 4

Gary Bennett [illegible]24-98

Region 5

Dennis Wesolowski with comments Date [illegible]/27/98

Region 6

[illegible] Date 4/8/98

Region 7

Ernest L. Arnold Date 4/14/98

Region 8

[illegible] Date 4/15/98

Region 9 Vance [illegible] Fong, P.E., Regional QA Manager

[illegible] Fong Date 3/27/98

Region 10

[illegible] Date 3/12/98

1.0 QA Project Plan Identification and Approval

The purpose of the approval sheet is to enable officials to document their approval of the QAPP. The title page (along with the organization chart) also identifies the key project officials for the work. The title and approval sheet should also indicate the date of the revision and a document number, if appropriate.

Title: *Palookaville Department of Health QA Project Plan for the $PM_{2.5}$ Ambient Air Monitoring Program.*

The attached QAPP for the $PM_{2.5}$ Ambient Air Quality Monitoring Program is hereby recommended for approval and commits the Department to follow the elements described within.

Palookaville Department of Health

1) Signature: ____ Date:________
Jeff Samuelson - Technical Manager - Monitoring Division

2) Signature: ____ Date:________
Linda Toughy-QA Manager- QA Branch

EPA Region Y

1) Signature: ____ Date:________
Bill Smiley-Technical Project Officer - Air Monitoring Branch

2) Signature: ____ Date:________
George Benson - QA Officer - QA Branch

2.0 Table of Contents

The table of contents lists all the elements, references, and appendices contained in a QAPP, including a list of tables and a list of figures that are used in the text. The major headings for most QAPPs should closely follow the list of required elements. While the exact format of the QAPP does not have to follow the sequence given here, it is generally more convenient to do so, and it provides a standard format to the QAPP reviewer. Moreover, consistency in the format makes the document more familiar to users, who can expect to find a specific item in the same place in every QAPP. The table of contents of the QAPP may include a document control component. This information should appear in the upper right-hand corner of each page of the QAPP when document control format is desired.

3.0 Distribution

All the persons and document files designated to receive copies of the QAPP, and any planned future revisions, need to be listed in the QAPP. This list, together with the document control information, will help the project manager ensure that all key personnel in the implementation of the QAPP have up-to-date copies of the plan. A typical distribution list appears in Table 3-1

A hardcopy of this QAPP has been distributed to the individuals in Table 3-1. The document is also available on the Department's local area network (LAN) for anyone interested.

Table 3-1 Distribution List

Name	**Position**	**Division/Branch**
Palookaville Department of Health		
Linda Toughy	QA Division Director	QA Division
Philip Magart	Air QA Branch	QA/Air QA
John Dinsmore	QA Officer (auditing)	QA/Air QA
Jeff Samuelson	Technical Division Director	Technical
Joe Manard	Ambient Air Monitoring Branch	Technical/ Ambient Air Monitoring
Bill Macky	Field Technician	Technical/ Ambient Air Monitoring
Karin Porter	Field Technician	Technical/ Ambient Air Monitoring
Beverly Deston	Field Technician	Technical/ Ambient Air Monitoring
Angelista Medron	Data Manager	Technical/ Ambient Air Monitoring
Delbert Boyle	Program Support Division	Program Support
Jason Chang	Shipping/Receiving Branch	Program Support/Shipping &Rec.
Sonny Marony	Clerk	Program Support/Shipping &Rec.
Mike Smather	Laboratory Branch	Technical/Laboratory
Fred Nottingham	Lab Technician	Technical/Laboratory
EPA Region Y		
Bill Smiley	Technical Project Officer	Air/ Air Quality Monitoring
George Benson	QA Officer	Air/ QA

4.0 Project/Task Organization

The purpose of the project organization is to provide EPA and other involved parties with a clear understanding of the role that each party plays in the investigation or study and to provide the lines of authority and reporting for the project.

4.1 Roles and Responsibilities

The specific roles, activities, and responsibilities of participants, as well as the internal lines of authority and communication within and between organizations, should be detailed. The position of the QA Manager or QA Officer should be described. Include the principal data users, the decision-maker, project manager, QA manager, and all persons responsible for implementation of the QAPP. Also included should be the person responsible for maintaining the QAPP and any individual approving deliverables other than the project manager. A concise chart showing the project organization, the lines of responsibility, and the lines of communication should be presented. For complex projects, it may be useful to include more than one chart—one for the overall project (with at least the primary contact) and others for each organization.

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), defining the quality of the data necessary to make comparisons to the NAAQS, and identifying a minimum set of QC samples from which to judge data quality. The State and local organizations are responsible for taking this information and developing and implementing a quality system that will meet the data quality requirements. Then, it is the responsibility of both EPA and the State and local organizations to assess the quality of the data and take 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) is responsible for the oversight of the Ambient Air Quality Monitoring Network. MQAG has the following responsibilities:

- 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 EPA Regional Offices and air pollution monitoring community

4.1.2 EPA Region Y Office

EPA 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 responsibilities of EPA's RegionY Office, in regards to the Ambient Air Quality Program, are the coordination of quality assurance matters at the Regional levels with the State and local agencies. This is accomplished by the designation of EPA Regional Project Officers who are responsible for the technical aspects of the program including:

- 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 Regulations and Section 20
- 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

Palookaville will direct all technical and QA questions to Region Y.

4.1.3 Polookaville Department of Health

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 the implementation of a satisfactory monitoring program, which would naturally include the implementation of an appropriate quality assurance program. It is the responsibility of State and local agencies to implement 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 which 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 Department of Health that are responsible for the activities of the $PM_{2.5}$ Ambient Air Quality Monitoring Program. The following information lists the specific responsibilities of each individual and are grouped by functions of the Directors Office, and the divisions related to Quality Assurance, Technical Support, and Program Support.

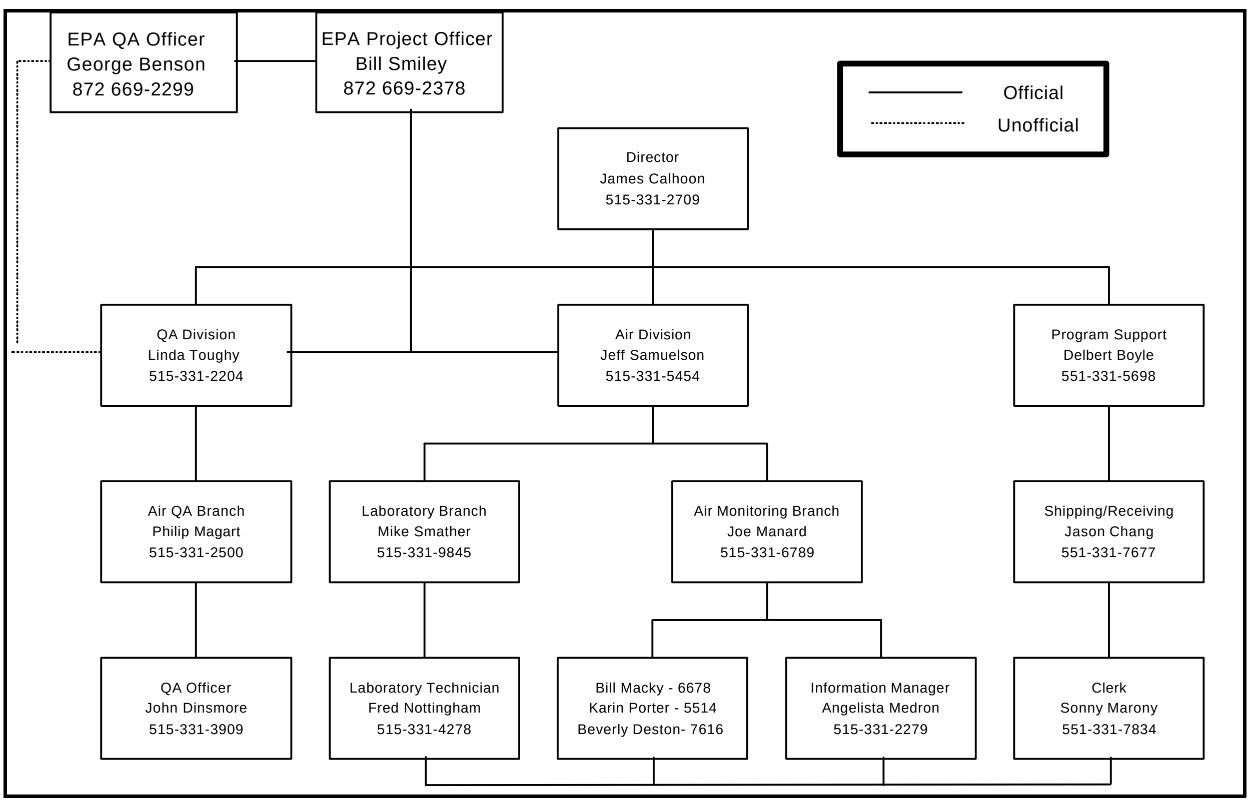

Figure 4.1 Organizational Structure of Palookaville Department of Health for $PM_{2.5}$ air monitoring.

4.1.3.1 Directors Office

Program Director - James Calhoon

The Director has overall responsibility for managing the Department of Health according to Department policy. The direct responsibility for assuring data quality rests with line management. Ultimately, the Director is responsible for establishing QA policy and for resolving QA issues identified through the QA program. Major QA related responsibilities of the Director include:

- approving the budget and planning processes
- assuring that the Department develops and maintains a current and germane quality system
- assuring that the Department develops and maintains a current $PM_{2.5}$ QAPP and ensures adherence to the document by staff, and where appropriate, other extramural cooperators
- establishing policies to ensure that QA requirements are incorporated in all environmental data operations
- maintaining an active line of communication with the QA and technical managers
- conducting management systems reviews

The Director delegates the responsibility of QA development and implementation in accordance with Department policy to the Division Directors. Oversight of the Department's QA program is delegated to the QA Division Director.

4.1.3.2 QA Division

QA Division Director (QAD) - Linda Toughy

The QA Division Director is the delegated manager of the Department's QA Program. She has direct access to the Director on all matters pertaining to quality assurance. The main responsibility of the QAD is QA oversight, and ensuring that all personnel understand the Department's QA policy and all pertinent EPA QA policies and regulations specific to the Ambient Air Quality Monitoring Program. The QAD provides technical support and reviews and approves QA products. Responsibilities include:

- developing and interpreting Department QA policy and revising it as necessary
- developing a QA Annual Report for the Director
- reviewing acquisition packages (contracts, grants, cooperative agreements, inter-agency agreements) to determine the necessary QA requirements
- developing QA budgets
- assisting staff scientists and project managers in developing QA documentation and in providing answers to technical questions
- ensuring that all personnel involved in environmental data operations have access to any training or QA information needed to be knowledgeable in QA requirements, protocols,

and technology of that activity
- reviewing and approving the QAPP for the $PM_{2.5}$ Ambient Air Quality Monitoring Program
- ensuring that environmental data operations are covered by appropriate QA planning documentation (e.g., QA project plans and data quality objectives)
- ensuring that reviews, assessments and audits are scheduled and completed, and at times, conducting or participating in these QA activities
- tracking the QA/QC status of all programs
- recommending required management-level corrective actions
- serving as the program's QA liaison with EPA Regional QA Managers or QA Officers and the Regional Project Officer

The QAD has the authority to carry out these responsibilities and to bring to the attention of the Director any issues associated with these responsibilities. The QAD delegates the responsibility of QA development and implementation in accordance with Department policy to the QA Division Branch Managers. Oversight of the QA program as it relates to individual programs is delegated to the QA Division Branch Managers.

Quality Assurance Division Branch Managers - Philip Magart

The QA Division Branch Manager is the main point of contact within each of the four QA Branch's of the Department. The QA Branch Manager's responsibilities include:

- implementing and overseeing the Department's QA policy within the branch
- acting as a conduit for QA information to branch staff
- assisting the QAD in developing QA policies and procedures
- coordinating the Branch's input to the QA Annual Report (QAAR)
- assisting in solving QA-related problems at the lowest possible organizational level

This branch is responsible for overseeing the QA activities of the Ambient Air Quality Monitoring Program and is therefore responsible for:

- ensuring that a QAPP is in place for all environmental data operations associated with the $PM_{2.5}$ Ambient Air Quality Monitoring Program and that it is up-to-date
- ensuring that technical systems audits, audits of data quality, and data quality assessments occur within the appropriate schedules and conducting or participating in these audits
- tracking and ensuring the timely implementation of corrective actions
- ensuring that a management system review occurs every 3 years
- ensuring that technical personnel follow the QAPP

Each QA Branch Manager has the authority to carry out these responsibilities and to bring to the attention of his or her respective Division Director any issues related to these responsibilities. The QA Branch Manager delegates the responsibility of QA development and implementation in accordance with Department policy to the QA Officers.

Quality Assurance Officers- John Dinsmore

The QA Officer is the official staff QA contacts appointed by the QA Branch Manager. John Dinsmore is the QA Officer responsible for the QA aspects of the $PM_{2.5}$ Ambient Air Quality Monitoring Program. Mr. Dinsmore's responsibilities include:

- remaining current on Department QA policy and general and specific EPA QA policies and regulations as it relates to the $PM_{2.5}$ Ambient Air Quality Monitoring Program
- reviewing and approving the QAPP for the $PM_{2.5}$ Ambient Air Quality Monitoring Program
- reviewing and initializing pre and post sampling filter weighing activities
- scheduling and implementing technical systems audits
- performing data quality assessments
- reviewing precision and bias data
- providing QA training to Air and Program Support Division technical staff
- ensuring timely follow-up and corrective actions resulting from auditing and evaluation activities.
- facilitating management systems reviews implemented by the QA Division Director

4.1.3.3 Technical Division

The technical divisions are responsible for all routine environmental data operations (EDOs) for the $PM_{2.5}$ monitoring program.

Air Division Director - Jeff Samuelson

The Air Division Director is the delegated manager of the routine $PM_{2.5}$ Monitoring Program which includes the QA/QC activities that are implemented as part of normal data collection activities. Responsibilities of the Director include:

- communication with EPA Project Officers and EPA QA personnel on issues related to routine sampling and QA activities
- understanding EPA monitoring and QA regulations and guidance, and ensuring subordinates understand and follow these regulations and guidance
- understanding Department QA policy and ensuring subordinates understand and follow the policy
- understanding and ensuring adherence to the $PM_{2.5}$ QAPP
- reviewing acquisition packages (contracts, grants, cooperative agreements, inter-agency agreements) to determine the necessary QA requirements.
- developing budgets and providing program costs necessary for EPA allocation activities
- ensuring that all personnel involved in environmental data collection have access to any

training or QA information needed to be knowledgeable in QA requirements, protocols, and technology
- recommending required management-level corrective actions

The Air Director delegates the responsibility for the development and implementation of individual monitoring programs, in accordance with Department policy, to the Air Division Branch Managers.

Air Monitoring Branch Manager - Joe Manard
Laboratory Branch Manager - Mike Smather

These two branchs are responsible for overseeing the routine field/lab monitoring and QA activities of the Ambient Air Quality Monitoring Program. The Branch Manager's responsibilities include:

- implementing and overseeing the Department's QA policy within the branch
- acting as a conduit for information to branch staff
- training staff in the requirements of the QA project plan and in the evaluation of QC measurements.
- assisting staff scientists and project managers in developing network designs, field/lab standard operating procedures and appropriate field/lab QA documentation
- coordinating the Branch's input to the QAAR
- ensuring that a QAPP is in place for all environmental data operations associated with the $PM_{2.5}$ Ambient Air Quality Monitoring Program and that it is up-to-date
- ensuring that technical personnel follow the $PM_{2.5}$ QAPP

Field Personnel - Bill Macky, Karin Porter, Beverly Deston

The field personnel are responsible for carrying out a required task(s) and ensuring the data quality results of the task(s) by adhering to guidance and protocol specified by the $PM_{2.5}$ QAPP and SOPs for the field activities. Responsibilities include:

- participating in the development and implementation of the $PM_{2.5}$ QAPP.
- participating in training and certification activities
- participating in the development data quality requirements (overall and field) with the appropriate QA staff
- writing and modifying standard operating procedures (SOPs)
- verifying that all required QA activities are performed and that measurement quality standards are met as required in the QAPP
- following all manufacturer's specifications
- performing and documenting preventative maintenance
- documenting deviations from established procedures and methods
- reporting all problems and corrective actions to the PO, and QA Officer

- assessing and reporting data quality
- preparing and delivering reports to the Branch Manager
- flagging suspect data
- preparing and delivering data to the Information Manager.

Laboratory Personnel - Fred Nottingham

Laboratory personnel are responsible for carrying out a required task(s) and ensuring the data quality results of the task(s) by adhering to guidance and protocol specified by the $PM_{2.5}$ QAPP and SOPs for the lab activities. Responsibilities include:

- participating in the development and implementation of the QAPP
- participating in training and certification activities
- participating in the development of data quality requirements (overall and laboratory) with the appropriate QA staff
- writing and modifying standard operating procedures (SOPs) and good laboratory practices (GLPs)
- verifying that all required QA activities were performed and that measurement quality standards were met as required in the QAPP
- following all manufacturer's specifications
- performing and documenting preventative maintenance
- documenting deviations from established procedures and methods
- reporting all problems and corrective actions to the PO, PMs, and QA Officer
- assessing and reporting data quality
- preparing and delivering reports to the branch manager
- flagging suspect data
- preparing and delivering data to the information manager

Information Manager- Angelista Medron

The Information Manager is responsible for coordinating the information management activities of the $PM_{2.5}$ Ambient Air Monitoring Program. The main responsibilities of the Information Manager include ensuring that data and information collected for the $PM_{2.5}$ Monitoring Program are properly captured, stored, and transmitted for use by program participants. Responsibilities include:

- developing local data management standard operating procedures
- ensuring that information management activities are developed within reasonable time frames for review and approval
- following good automated data processes
- coordinating the development of the information management system with data users
- ensuring the development of data standards for data structure, entry, transfer, and archive
- ensuring the adherence to the QAPP where applicable

- ensuring access to data for timely reporting and interpretation processes
- ensuring the development of data base guides (data base structures, user guidance documents)
- ensuring timely delivery of all required data to the AIRS system

4.1.3.4 Program Support

The Program Support Division include the areas of human resources, facilities maintenance, and shipping and receiving.

Program Support Division Director - Delbert Boyle

Responsibilities of the Director include:

- communication with QA and Air Monitoring Division on specific needs.
- understanding EPA monitoring and QA regulations and guidance, and ensuring subordinates understand and follow these regulations and guidance
- understanding Department QA policy and ensuring subordinates understand and follow the policy
- understanding and ensuring adherence to the $PM_{2.5}$ QAPP as it relates to program support activities
- ensuring that all support personnel have access to any training or QA information needed to be knowledgeable in QA requirements, protocols, and technology

Shipping/Receiving Branch Manager - Jason Ching

This branch is responsible for shipping and receiving equipment, supplies and consumables for the routine field/lab monitoring and QA activities of the Ambient Air Quality Monitoring Program. The Branch Managers responsibilities include:

- implementing and overseeing the Department's QA policy within the branch
- acting as a conduit for information to branch staff
- training staff in the requirements of the QA project plan as it relates to shipping/receiving
- assisting staff in developing standard operating procedures
- coordinating the Branch's input to the Quality Assurance Annual Report
- ensuring that technical personnel follow the QAPP
- reviewing and evaluating staff performance and conformance to the QAPP

Clerk -Sonny Marony

Mr. Marony has been delegated to provide support for all shipping/receiving of all equipment and consumable supplies for the $PM_{2.5}$ Ambient Air Monitoring Program. Responsibilities include:

- assisting in the development of standard operating procedures for shipping/receiving
- following SOPs for receiving, storage, chain-of-custody and transfer of filters
- informing appropriate field /lab staff of arrival of consumables, equipment, and samples
- documenting, tracking, and archiving shipping/receiving records

5.0 Problem Definition/Background

The background information provided in this element will place the problem in historical perspective, giving readers and users of the QAPP a sense of the project's purpose and position relative to other project and program phases and initiatives

5.1 Problem Statement and Background

This discussion must include enough information about the problem, the past history, any previous work or data, and any other regulatory or legal context to allow a technically trained reader to make sense of the project objectives and activities. This discussion should include:

- a description of the problem as currently understood, indicating its importance and programmatic, regulatory, or research context;
- a summary of existing information on the problem, including any conflicts or uncertainties that are to be resolved by the project;
- a discussion of initial ideas or approaches for resolving the problem that were considered before selecting the approach described in element A6, "Project/Task Description"; and
- the identification of the principal data user or decision-maker (if known).

Note that the problem statement is the first step of the DQO Process and the decision specification is the second step of the DQO Process.

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 (PM_{10}, $PM_{2.5}$), 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 provides the framework for all pertinent organizations to protect air quality. This framework provides for the monitoring of these criteria pollutants by State and local organizations through the Air Quality Monitoring Program.

The criteria pollutant defined as particulate matter is a general term 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 will measure two particle size fractions; those less than or equal to 10 micrometers (PM_{10}), and those less than or equal to 2.5 micrometers ($PM_{2.5}$). This QAPP focuses on the QA activities associated with $PM_{2.5}$.

The background and rationale for the implementation of the $PM_{2.5}$ ambient air monitoring network can be found in the Federal Register. In general, some of the findings are listed below.

- The characteristics, sources, and potential health effects of larger or "coarse" particles (from 2.5 to 10 micrometers in diameter) and smaller or “fine" particles (smaller than 2.5 micrometers in diameter) are very different.

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

- Fine particles are generally emitted from activities such as industrial and residential combustion and from vehicle exhaust. Fine particles are also formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and 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 contribute to health effects such as aggravation of asthma. EPA's "staff paper" concludes that fine particles, which also deposit deeply in the lungs, are more likely than coarse particles to contribute to the health effects (e.g., premature mortality and hospital admissions) found in a number of recently published community epidemiological studies.

- 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 a year to several years) periods.

- These health effects include premature death and increased hospital admissions and emergency room visits (primarily among the elderly and individuals with cardiopulmonary disease); increased respiratory symptoms and disease (among children and individuals with cardiopulmonary disease such as asthma); decreased lung function (particularly in children and individuals 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:

1. To judge compliance with and/or progress made towards meeting the National Ambient Air quality standards.
2. To develop, modify or activate control strategies that prevent or alleviate air pollution episodes.
3. To observe pollution trends throughout the region, including non-urban areas.
4. 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 designed to meet one of six basic monitoring objectives listed below:

- Determine the highest concentrations to occur in the area covered by the network

- Determine representative concentrations in areas of high population density
- Determine the impact on ambient pollution levels of significant source or source categories
- Determine general background concentration levels
- Determine the extent of Regional pollutant transport among populated areas, and in support of secondary standards
- Determine the welfare-related impacts 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 below.

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 (SIP's) 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. This term represents individuals that are the ultimate users of ambient air data and therefore may be responsible for activities such as setting and making comparisons to the NAAQS, and evaluating trends. Since there is more than one objective for this data, and more than one decision maker, the quality of the data (see Section 7) will be based on the highest priority objective, which was identified as the determination of violations of the NAAQS. This QAPP will describe the how the Palookaville $PM_{2.5}$ Ambient Air Quality Monitoring Program intends to control and evaluate data quality to meet the NAAQS data quality objectives.

6.0 Project/Task Description

The purpose of the project/task description element is to provide the participants with a background understanding of the project and the types of activities to be conducted, including the measurements that will be taken and the associated QA/QC goals, procedures, and timetables for collecting the measurements.

6.1 Description of Work to be Performed

(1) Measurements that are expected during the course of the project. Describe the characteristic or property to be studied and the measurement processes and techniques that will be used to collect data.

(2) Applicable technical quality standards or criteria. Cite any relevant regulatory standards or criteria pertinent to the project. For example, if environmental data are collected to test for compliance with a permit limit standard, the standard should be cited and the numerical limits should be given in the QAPP. The DQO Process refers to these limits as "action levels," because the type of action taken by the decision-maker will depend on whether the measured levels exceed the limit (Step 5 of the DQO Process).

(3) Any special personnel and equipment requirements that may indicate the complexity of the project. Describe any special personnel or equipment required for the specific type of work being planned or measurements being taken.

(4) The assessment techniques needed for the project. The degree of quality assessment activity for a project will depend on the project's complexity, duration, and objectives. A discussion of the timing of each planned assessment and a brief outline of the roles of the different parties to be involved should be included.

(5) A schedule for the work performed. The anticipated start and completion dates for the project should be given. In addition, this discussion should include an approximate schedule of important project milestones, such as the start of environmental measurement activities.

(6) Project and quality records required, including the types of reports needed. An indication of the most important records should be given.

In general, the measurement goal of the $PM_{2.5}$ Ambient Air Quality Monitoring Program is to estimate the concentration, in units of micrograms per cubic meter ($\mu g/m^3$), of particulates less than or eqaul to 2.5 micrometers (μm) that have been collected on a 46.2mm poletetrafluoroethylene (PTFE) filter. For the SLAMS/NAMS network, which is what this QAPP describes, the primary goal is to compare the $PM_{2.5}$ concentrations to the annual and 24-hour National Ambient Air Quality Standard (NAAQS). The national primary and secondary ambient air quality standards for $PM_{2.5}$ are 15.0 micrograms per cubic meter ($\mu g/m^3$) annual arithmetic mean concentration and 65 $\mu g/m^3$ 24-hour average concentration measured in ambient air. A description of the NAAQS and its calculation can be found in the 1997 Federal Register[1]

Notice.
In addition, Appendix L of part 50 also provides the following summary of the measurement principle:

> " An electrically powered air sampler draws ambient air at a constant volumetric flow rate into a specially shaped inlet and through an inertial particle size separator (impactor) where the suspended particulate matter in the $PM_{2.5}$ size range is separated for collection on a polytetrafluoroethylene (PTFE) filter over the specified sampling period. The air sampler and other aspects of this reference method are specified either explicitly in this appendix or generally with reference to other applicable regulations or quality assurance guidance.
>
> Each filter is weighed (after moisture and temperature equilibration) before and after sample collection to determine the net weight (mass) gain due to collected $PM_{2.5}$. The total volume of air sampled is determined by the sampler from the measured flow rate at actual ambient temperature and pressure and the sampling time. The mass concentration of $PM_{2.5}$ in the ambient air is computed as the total mass of collected particles in the $PM_{2.5}$ size range divided by the actual volume of air sampled, and is expressed in micrograms per actual cubic meter of air ($\mu g/m^3$)."

The following sections will describe the measurements required for the routine field and laboratory activities for the network. In addition to these measurements, an initial set of measurements will be required to fulfill the requirements of the AIRS data base.

6.2 Field Activities

The performance requirements of the air sampler has been specified in Part 50, Appendix L of the 7/18/97 Federal Register Notice[1] . Table 6-1 summarizes some of the more critical performance requirements.

Table 6-1 Design/Performance Specifications

Equipment	Frequency	Acceptance Criteria	Reference
Filter Design Specs.	Vendor Cert.	see reference	40 CFR Pt. 50, App.L Sec 6.0
Size	"	46.2 mm dia $\pm$ 0.25mm	" Sec 6.1
Medium	"	Polytetrafluoroethylene	" Sec 6.2
Support ring	"	Polymethylpentene	" Sec 6.3
	"	0.38mm thick	"
	"	46.2 mm $\pm$ 0.25mm outer dia.	"
	"	3.68 ($\pm$0.00, -0.51mm) width	"
Pore size	"	2 μm	"Sec 6.4
Filter thickness	"	30-50 μm	"Sec 6.5
Max. pressure drop	"	30 cm H_2O @ 16.67L/min	"Sec 6.6
Max. Moisture pickup	"	10 μg increase in 24 hr.	"Sec 6.7
Collection efficiency	"	99.7%	"Sec 6.8
Filter weight stability	"	<20 μg	"Sec 6.9.1 and 6.9.2
Alkalinity	"	< 25.0 microequivalents/gram	"Sec 6.10

Equipment	Frequency	Acceptance Criteria	Reference
Sampler Performance Specs.	All Instruments		
Sample Flow Rate	“	1.000 m^3/hr.	40 CFR Pt. 50, App.L Sec7.4
Flow Regulation	“	1.000 ± 5% m^3/hr.	“
Flow Rate Precision	“	2% CV	
Flow Rate Accuracy	“	±2%	“
External Leakage	“	Vendor specs	“
Internal Leakage	“	Vendor specs	“
Ambient Temp Sensor	“	-30° - 45° C 1° C res. ±1.6°C accuracy	Vol-II -MS. 2.12 40 CFR Pt. 50, App.L Sec7.4
Filter Temp Sensor	“	-30° - 45° C 0.1° C res. ±1.0°C accuracy	“
Barometric Pressure	“	600-800 mm Hg 5 mm res. ±10mm accuracy	“
Clock/Timer	“	Date/time. 1 sec. res. ± 1 min/month accuracy	“

The air samplers will be purchased, distributed, and certified by the EPA as meeting the requirements specified in the Federal Register. Therefore, the Department assumes the sampling instruments to be adequate for the sampling for $PM_{2.5}$. Other than the required federal reference or equivalent air sampler, there are no special personnel or equipment requirements. Section 15 lists all the equipment requirements for the Department’s $PM_{2.5}$ data collection operations.

6.2.1 Field Measurements

Table 6-2 represents the field measurements that must be collected. This table is presented in the Federal Register[1] as Table L-1 of Appendix L. These measurements are made by the air sampler and are stored in the instrument for downloading by the field operator during routine visits.

Table 6-2 Field Measurement Requirements

Information to be provided	Appendix L section reference	Availability				Format	
		Anytime[a]	End of period[b]	Visual display[c]	Data output[d]	Digital reading[e]	Units
Flow rate, 30-second maximum interval	7.4.5.1	✔	—	✔	✱	XX.X	L/min
Flow rate, average for the sample period	7.45.2	✱	✔	✱	✔	XX.X	L/min
Flow rate, CV, for the sample period	7.4.5.2	✱	✔	✱	✔●	XX.X	%
Flow rate, 5-min average out of spec. (FLAG)[f]	7.4.5.2	✔	✔	✔	✔●	On/Off	
Sample volume, total	7.4.5.2	✱	✔	✔	✔●	XX.X	m^3
Temperature, ambient, 30-second interval	7.4.8	✔	—	✔	—	XX.X	°C
Temperature, ambient, min., max., average for the sample period	7.4.8	✱	✔	✔	✔●	XX.X	°C

Information to be provided	Appendix L section reference	Availability				Format	
		Anytime[a]	End of period[b]	Visual display[c]	Data output[d]	Digital reading[e]	Units
Barometric pressure, ambient, 30-second interval	7.4.9	✔	—	✔	—	XXX	mm Hg
Barometric pressure, ambient, min., max., average for the sample period	7.4.9	✱	✔	✔	✔●	XXX	mm Hg
Filter temperature, 30-second interval	7.4.11	✔	—	✔	—	XX.X	°C
Filter temperature, differential, 30-minute interval, out of spec. (FLAG)[f]	7.4.11	✱	✔	✔	✔●	On/Off	
Filter temperature, maximum differential from ambient, date, time of occurrence	7.4.11	✱	✱	✱	✱	X.X, YY/MM/DD HH:mm	°C, Yr/Mo/ Day Hr min
Date and time	7.4.12	✔	—	✔	—	YY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Sample start and stop time settings	7.4.12	✔	✔	✔	✔	YY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Sample period start time	7.4.12	—	✔	✔	✔●	YYYY/MMM/DD HH:mm	Yr/Mo/ Day Hr min
Elapsed sample time	7.4.13	✱	✔	✔	✔●	HH:mm	Hr min
Elapsed sample time out of spec. (FLAG)[f]	7.4.13	—	✔	✔	✔●	On/Off	
Power interruptions >1 min, start time of first 10	7.4.15.5	✱	✔	✱	✔	1HH:mm, 2HH:mm, etc.	Hr min
User-entered information, such as sampler and site identification	7.4.16	✔	✔	✔	✔●	As entered	

✔ Provision of this information is required.
✱ Provision of this information is optional. If information related to the entire sample period is optionally provided prior to the end of the sample period, the value provided should be the value calculated for the portion of the sampler period completed up to the time the information is provided.
● Indicates that this information is also required to be provided to the AIRS data bank.
a Information is required to be available to the operator at any time the sampler is operating, whether sampling or not.
b Information relates to the entire sampler period and must be provided following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.
c Information shall be available to the operator visually.
d Information is to be available as digital data at the sampler's data output port following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.
e Digital readings, both visual and data output, shall have no less than the number of significant digits and resolution specified.
f Flag warnings may be displayed to the operator by a single-flag indicator or each flag may be displayed individually. Only a set (on) flag warning must be indicated; an off (unset) flag may be indicated by the absence of a flag warning. Sampler users should refer to Section 10.12 of Appendix L regarding the validity of samples for which the sampler provided an associated flag warning.

In addition to the measurements collected in Table 6-2, the following information identified in Table 6-3 will be recorded. These parameters are explained in *Guidance Document 2.12*[2]

Table 6-3 Additional Field Measurements

Parameter	Parameter Code	Frequency	Units	Comment
Monitor ID	MONID	Every sample event	see AIRS	Unique AIRS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields
Site Name	SITENAM	Every sample event	AAA...	Unique site name associated with the site
Sampler ID	SAMPID	Every sample event	AAXXX	Sampler model number or unique bar code number associated with the model number
QC Thermometer ID Initial	QCTIDI	Every sample event	AAAXXX	Unique ID number of QC thermometer used for ambient air temp check at the beginning of sampling
QC Temperature Measurement Initial	QCTEMPI	Every sample event	XX°C	QC temp reading at the beginning of sampling
QC Baromter ID Initial	QCBIDI	Every sample event	AAAXXX	Unique alpha-numeric ID of QC barometric pressure device used for barometric pressure reading check
QC Bar. Pressure Reading Initial	QCBI	Every sample event	XXX mm Hg	QC temp reading at the beginning of sampling
QC Thermometer ID Final	QCTIDF	Every sample event	AAAXXX	Unique ID number of QC thermometer used for ambient air temp check at the beginning of sampling
QC Temperature Measurement Final	QCTEMPF	Every sample event	XX°C	QC temp reading at the end of sampling
QC Baromter ID Final	QCBIDF	Every sample event	AAAXXX	Unique alpha-numeric ID of QC barometric pressure device used for barometric pressure reading check
QC Bar. Pressure Reading Final	QCBF	Every sample event	XXX mm Hg	QC temp reading at the end of sampling
Filter ID	FID	Every sample event	AAYYXXXX	Unique filter ID of filter given by the weighing laboratory.
Filter Integrity flag	FFIF	Every sample event	QFI/ VFI/GFI	QFI -Questionable filter integrity VFI- Void Filter Integrity GFI-Good Filter Integrity
Site Operator Initial	SOI	Every sample event	AAA	Initials of the site operator setting up the sampling run
Site Operator Final	SOF	Every sample event	AAA	Initials of the site operator completing the sampling run
Free Form Notes	FFM	As needed	AAA....	Free form notes about the sampling run

6.3 Laboratory Activities

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

Pre-Sampling weighing

- Receiving filters from the 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 environmental conditions
- Equipment maintenance and calibrations

Shipping/Receiving

- Receiving filters from the field and logging these in
- Storing filters
- Associated QA/QC activities (see Section 12)

Post-Sampling Weighing

- Checking filter integrity
- Stabilizing/weighing filters
- Data downloads from field data loggers
- Data entry/upload to AIRS
- Storing filters/archiving
- Associated QA/QC activities

The details for these activities are included in various sections of this document as well as *Guidance Document 2.12*[2]. Table 6-4 provides the performance specifications of the laboratory environment and equipment.

Table 6-4 Laboratory Performance Specifications

Equipment	Acceptance Criteria
Microbalance	Resolution of 1 µg, repeatability of 1 µg
Microbalance environment	Climate-controlled, draft-free room or chamber or equivalent. Mean relative humidity between 30 and 40 percent, with a variability of not more than ±5 percent over 24 hours. Mean temperature should be held between 20 and 23 °C, with a variability of not more than ±2 °C over 24 hours.
Mass reference standards	Standards bracket weight of filter, individual standard's tolerance less than 25 µg, handle with smooth, nonmetallic forceps

6.3.1 Laboratory Measurements

With the exception of the shipping/receiving, which is discussed in detail in Section 12, Table 6-5 lists the parameters that will be required to be recorded for pre and post-sampling weighing laboratory activities.

Table 6-5 Laboratory Measurements

Parameter	Parameter Code	Frequency	Units	Comments
Filter Conditioning Start Date	CNSDATE	every filter	YY/MM/DD	Date of start of conditioning period
Start Time	CNSHOUR	every filter	XX.XX	Start hour and minute of conditioning
Filter Number	RFID LBFID FBID	every filter	RFYYXXXX LBYYXXXX FBYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB) .
Relative Humidity	CONRH	1/run	XX%	Average % relative humidity value for conditioning session based upon readings every 10 min.
Temperature	CONTEMP	1/run	XX°C	Average temperature value for conditioning session based upon readings every 10 min.
End Date	CONDATE	every filter	YY/MM/DD	Date of start of conditioning period
End Time	CNEHOUR	every filter	XX.XX	End hour and minute of conditioning
Pre-Sampling Filter Weighing Date	PREDATE	1/run [1/]	YY/MM/DD	Date for pre-sampling run of filters that can then be associated with each filter
Filter Lot Number	FLN	every filter	AAAXXX	Lot number associated with filter
Balance Number	BALID	1/run	AAAXXX	Unique balance ID for balance used in pre-weighing
Analyst	PREANL	1/run	AAA	Initials of the technician preweighing filters
QA Officer	PREQC	1/run	AAA	Initials of the QA Officer overseeing preweighing filters
Relative Humidity	PRERH	1/run	XX%	Average % relative humidity value for weighing session based upon readings every 10 min.
Temperature	PRETEMP	1/run	XX°C	Average temperature value for weighing session based upon readings every 10 min.

Parameter	**Parameter Code**	**Frequency**	**Units**	**Comments**
Filter Number	RFID LBFID FBID FCID DFID[2/]	every filter	RFYYXXXX LBYYXXXX FBYYXXXX FCYYXXXX DFYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB) Flow Check Filter (FC) and Duplicate Filter.
QC Sample Number	PREQC	every QC check	C1XXX C2XXX C3XXX	Unique ID for calibration checks and or other types of QC samples used.
Pre-Sampling Mass	PREMASS	every filter	XXX.XXX mg	Mass weight in mg of the filter
Transport container ID	CONTID	every filter	AAAXXX	Identification of the filter transport container
Monitor ID	MONID	Every sample	see AIRS	Unique AIRS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields
Free Form Notes	PREFFM	As needed		Pre-weighing Free Form notes
Post-Sampling Filter Weighing Date	PSTDATE	1/run	YY/MM/DD	Date for post-sampling run of filters that can then be associated with each filter
Balance Number	BALID	1/run	AAAXXX	Unique balance ID for balance used in post-weighing
Analyst	PSTANL	1/run	AAA	Initials of the technician post-weighing filters
QA Officer	PSTQC	1/run	AAA	Initials of the QA Officer overseering preweighing filters
Relative Humidity	PSTRH	1/run	XX%	Average % relative humidity value for weighing period based upon readings every 10 min
Temperature	PSTEMP	1/run	XX°C	Average temperature value for weighing period based upon readings every 10 min.
Filter Number	RFID LBID FBID DFID[2/]	every filter	RFYYXXXX LBYYXXXX FBYYXXXX DFYYXXXX	Unique filter ID of routine filter (RF) Lab Blanks (LB) Field Blanks (FB) and Dulicate Sample.
QC Sample Number	PSTQC	every QC check	C1XXX C2XXX C3XXX	Unique id for calibration checks and or other types of QC samples used.

Parameter	Parameter Code	Frequency	Units	Comments
Post Sampling Mass	PSTMASS	every filter	XXX.XXX mg	Mass weight in mg of the filter
Net Mass	NETMASS	every filter	XX.XXX mg	Net weight (PSTMASS-PREMASS)- in mg of $PM_{2.5}$ catch.
Weighing Flag	PSTFLAG	as needed	AAA	Flags associated with concentration
Free Form Notes	PSTFFM	as needed	AAA...	Past weighing free form notes

1- information is associated with a “session” and the values will be able to be associated with individual filters.
2- this identifies a second weighing of a routine filter and not a unique filter.

6.4 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance. Definitions for each of these activities can be found in the glossary (Appendix A). Section 20 will discuss the details of the Department’s assessments.

Table 6-6 will provide information on the parties implementing the assessment and there frequency.

Table 6-6 Assessment Schedule

Assessment Type	Assessment Agency	Frequency
Technical Systems Audit	EPA Regional Office Departmemt’s QA Office	1 every 3 years 1 every 3 years
Network Review	EPA Regional Office Department’s Air Division	every year App D 1/year App E 1 every 3 years
FRM Performance Evaluation	EPA Regional Office	25% of sites/year/4 times per year.
Data Qulity Assessment	Department	every year

6.5 Schedule of Activities

Table 6-7 contains a list of the critical activities required to plan, implement, and assess the $PM_{2.5}$ program.

Table 6-7 Schedule of Critical $PM_{2.5}$ Activities

Activity	Due Date	Comments
Network development	January 15, 1998	Preliminary list of sites and samplers required
Sampler order	March 2, 1998	Samplers ordered from National contract
Laboratory design	February 1, 1998	Listing of laboratory requirements
Laboratory procurement	April 1, 1998	Ordering/purchase of all laboratory and miscellaneous field equipment
Personnel Requirements	April 1, 1998	Advertising for field and laboratory personnel (if required)
QAPP development	May-Sept., 1998	Development of the QAPP
Network design completion	July 1, 1998	Final network design
Samplers arrive	July 1, 1998	Arrival of FRM samplers
Sampler siting/testing	July-December, 1998	Establishment of sites and preliminary testing of samplers
Field/Laboratory Training	August, 1998	Field and laboratory training activities and certification.
QAPP Submittal	October 1, 1998	QAPP submittal to EPA
QAPP Approval	November 30, 1998	Approval by EPA
Pilot testing	August-December 1998	Pilot activities to ensure efficiency of measurement system
Installation of 1998 sites	December 31, 1998	Sites must be established and ready to collect data
Routine Sampling	January 1, 1999	Routine activities must start

6.6 Project Records

The Department will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. Table 6-8 represents the categories and types of records and documents which are applicable to document control for $PM_{2.5}$ information. Information on key documents in each category are explained in more detail in Section 9.

Table 6-8 Critical Documents and Records

Categories	Record/Document Types
Management and Organization	State Implementation Plan Reporting agency information Organizational structure Personnel qualifications and training Training Certification Quality management plan Document control plan EPA Directives Grant allocations Support Contract
Site Information	Network description Site characterization file Site maps Site Pictures
Environmental Data Operations	QA Project Plans Standard operating procedures (SOPs) Field and laboratory notebooks Sample handling/custody records Inspection/maintenance records
Raw Data	Any original data (routine and QC data) including data entry forms
Data Reporting	Air quality index report Annual SLAMS air quality information Data/summary reports Journal articles/papers/presentations
Data Management	Data algorithms Data management plans/flowcharts $PM_{2.5}$ Data Data Management Systems
Quality Assurance	Good Laboratory Practice Network reviews Control charts Data quality assessments QA reports System audits Response/Corrective action reports Site Audits

References

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 $PM_{2.5}$ in Ambient Air Using Designated Reference or Class I Equivalent Methods. March, 1998

7.0 Quality Objectives and Criteria for Measurement Data

The purpose of this element is to document the DQOs of the project and to establish performance criteria for the mandatory systematic planning process and measurement system that will be employed in generating the data.

7.1 Data Quality Objectives (DQOs)

This element of the QAPP should discuss the desired quality of the final results of the study to ensure that the data user's needs are met. The Agency strongly recommends using the DQO Process, a systematic procedure for planning data collection activities, to ensure that the right type, quality, and quantity of data are collected to satisfy the data user's needs. DQOs are qualitative and quantitative statements that:

- clarify the intended use of the data,
- define the type of data needed to support the decision,
- identify the conditions under which the data should be collected, and
- specify tolerable limits on the probability of making a decision error due to uncertainty in the data.

DQOs are qualitative and quantitative statements derived from the DQO Process 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 $PM_{2.5}$, the EPA guards 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 $PM_{2.5}$. The DQOs were based on the data requirements of the decision maker(s). Regarding the quality of the $PM_{2.5}$ 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 $PM_{2.5}$ standards are a 15 µg/m^3 annual average and a 65 µg/m^3 24-hour average. The annual standard is met when the 3-year average of annual arithmetic means is less than or equal to 15 µg/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 $PM_{2.5}$ concentrations is less than or equal to 65 µg/m^3.

AIRS $PM_{2.5}$ data were reviewed for two purposes: (a) to determine the relative "importance" of

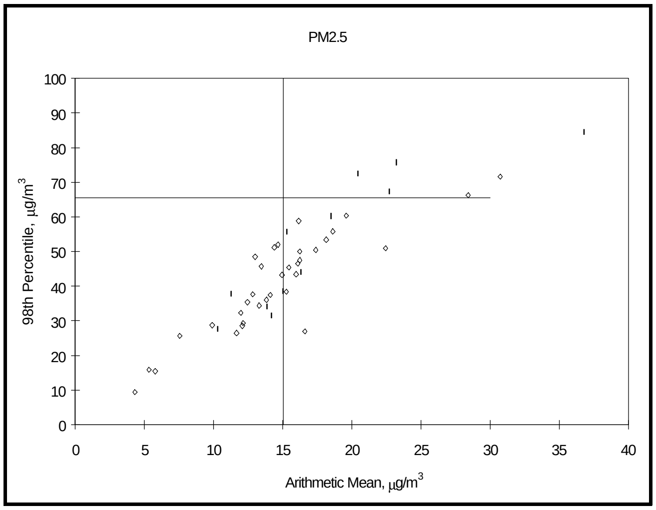

Figure 7.1 Annual arithmetic mean and 24-hour 98th percentiles associated with selected data sets

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 $PM_{2.5}$ 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.

2. Normal distribution for measurement error.

Error in environmental measurements is often assumed to be normal or lognormal. Figures 7.2 and 7.3 attempt to 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 $PM_{2.5}$, 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 its simplicity in modeling, the normal distribution of error was selected.

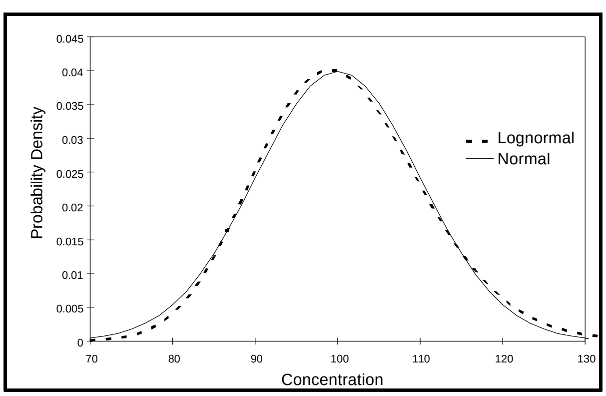

Figure 7.2 Comparison of normal and lognormal density functions at low measurement error (10% CV)

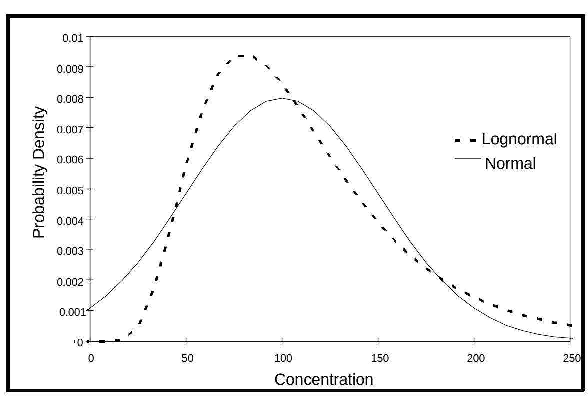

Figure 7.3 Comparison of normal and lognormal density functions at higher measurement errors (50% CV)

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

Errors in the estimate are due to population uncertainty (sampling less frequently than every day) and measurement uncertainty (bias and imprecision). The false positive decision error occurs whenever the estimated 3-year average exceeds the standard and the actual 3-year average is less than the standard. The false negative decision error occurs whenever the estimated 3-year average is less than the standard and the actual 3-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 3-year period.

Since the requirements allow 1 in 6 day sampling and a 75% data completeness requirement, the minimum number of values in a 3-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" (i.e., annual average values that are farther from the standard), the decision maker will make the correct decision more often. This limit was 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 of variation (CV).*

By reviewing available AIRS data and other $PM_{2.5}$ comparison studies, it was determined that it was 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 finctions were developed (case 1 and 2) to represent distributions where decision makers began to be concerned about decision errors. Table 7-1 summarizes 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(2πD/365)+δ_D	12.75	Attainment	F(+) = nonattainment	5%
Case 2	C_D=18.4+12.85 sin(2πD/365)+δ_D	18.4	Nonattainment	F(-) = attainment	5%

Table 7-2. Measurement System Decision

Precision CV (%)	Bias (%)	Decision Error Probability 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 1: With this model (case 1), the 3-year average is 12.75 µg/m^3. 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 Table7-2 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.

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

Table 7-3. Measurement System Decision

Precision CV(%)	Bias(%)	Decision Error Probability 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

Case 2: With this model (case 2) , the 3-year average is 18.4 µg/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% were 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.

7.2 Measurement Quality Objectives (MQOs)

While the quality objectives state what the data user's needs are, they do not provide sufficient information about how these needs can be satisfied. The specialists who will participate in generating the data need to know the measurement performance criteria that must be satisfied to achieve the overall quality objectives. One of the most important features of the QAPP is that it links the data user's quality objectives to verifiable measurement performance criteria. Although the level of rigor with which this is done and documented will vary widely, this linkage represents an important advancement in the implementation of QA. Once the measurement performance criteria have been established, sampling and analytical methods criteria can be specified under the elements contained in Group B

Once 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 which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, 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 to the amount that was expected to be obtained under correct, normal 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 to 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 CFR and in some of the sections of this document. If possible, the Department will attempt to 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 $PM_{2.5}$ 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.

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 $PM_{2.5}$ in Ambient Air Using Designated Reference or Class I Equivalent Methods. April, 1998

Table 7-4 Measurement Quality Objectives - Parameter PM2.5

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^{o} C < 30 days at 4^{o}C	" "	Sec. 7.10
Reporting Units	All data	μg/m^3	Part 50.3	Sec. 11.1
Detection Limit				
Lower DL	All data	2 μg/m^3	Part 50, App.L Sec 3.1	
Upper Conc. Limit	All data	200 μg/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^{o} C	"	"
Temp. Control	"	$\pm$ 2^{o} C over 24 hr	"	"
Humidity Range	"	30% - 40% RH	"	"
Humidity Control	"	$\pm$ 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	$\pm$30 μg change between weighings	Part 50, App.L Sec 8.2	Sec. 7.7
Lab Filter Blank	3 per weighing session	$\pm$15 μg change between weighings	"	"
Balance Check	beginning, every 10th samples, end	$\leq$3 μg		Sec. 7.9
Duplicate Filter Weighing	1 per sample batch	$\pm$15 μg change between weighings		Sec 7.7

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	±10 mm Hg	"	Sec. 6.5
Pressure Verification	weeks	±10 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 (?)	±10 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 & 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 ± 0.5° C accuracy	not described not described	Sec 4.2 and 8.3 “
Field Barometer	1/yr	± 1 mm Hg resolution ± 5 mm Hg accuracy	not described 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	"

8.0 Special Training Requirements/Certification

The purpose of this element is to ensure that any specialized or unusual training requirements necessary to complete the projects are known and furnished and the procedures are described in sufficient detail to ensure that specific training skills can be verified, documented, and updated as necessary.

8.1 Training

Requirements for specialized training for nonroutine field sampling techniques, field analyses, laboratory analyses, or data validation should be specified. Depending on the nature of the environmental data operation, the QAPP may need to address compliance with specifically mandated training requirements.

Personnel assigned to the $PM_{2.5}$ ambient air monitoring activities will meet the educational, work experience, responsibility, personal attributes, and training requirements for their positions. Records on personnel qualifications and training will be maintained in personnel files and will be accessible for review during audit activities.

Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. Training is aimed at increasing the effectiveness of employees and the Department. Table 8-1 represents the general training requirements for all employees, depending upon there job classification.

Table 8-1 Department of Health Employee Training Requirements.

Job Classification	Training Title	Time/Frequency Requirement
Directors	Executive Development Program	As available
Branch Chief and above	Framework for Supervision Keys to Managerial Excellence EEO for Managers and Supervisors Sexual Harassment Contract Administration for Supervisors 40 hours of developmental activities	1st 6 months After comp. of above As available " " "
Project Officers and Above	Contract Administration Contract Administration Recertification EEO for Managers and Supervisors Grants Training Project Officer Training (contract/grants) Ethics in Procurement Work statements for Negotiated Procurements	Prior to responsibility Every three years As available Prior to responsibility " " "
All Employees	Ethics Cultural Diversity	If filing SF450 As available

Job Classification	Training Title	Time/Frequency Requirement
Support Staff	English grammar Proofreading Telephone Etiquette Professionalism in the Office Filing Department Style of Correspondence Travel Procedures Procurement Request Procedures Timekeeping Introduction to WordPerfect E-MAIL	As available " " " " " " " " " "
Field Personnel	24 Hour Field Safety 8 hour Field Safety Refresher 8 hour First Aid/CPR Blood borne pathogens	1st time Yearly Yearly 1st time
Field Personnel (Superfund sites)	40 Hour Field Safety 8 hour Field Safety Refresher 8 Hour First Aid/CPR Blood borne pathogens	1st time Yearly Yearly 1st time
Laboratory Personnel	24 Hour Laboratory Safety 4 Hour Refresher R/V Safety Video/Discussion Chemical Spill Emergency Response Blood borne pathogens	1st time Yearly Yearly 1st time 1st time

8.1.1 Ambient Air Monitoring Training

Appropriate training is 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 (AWMA) *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

Table 8-2 presents a sequence of core ambient air monitoring and QA courses for ambient air monitoring staff, and QA managers (marked by asterisk). The suggested course sequences assume little or no experience in QA/QC or air monitoring. Persons having experience in the subject matter described in the courses would select courses according to their appropriate experience level. Courses not included in the core sequence would be selected according to individual responsibilities, preferences, and available resources.

Table 8-2. Core Ambient Air Training Courses

Sequence	Course Title (SI = self instructional)	Department Number	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 Implementation (Video)	PM1	OAQPS

* Courses recommended for QA Managers

Based upon the activities for the $PM_{2.5}$, the following training will be required by personnel in the following categories, prior to implementing environmental data operations.

Field Personnel- 422, 434, 435, 443, PM1

Laboratory- 422, 434, 435, 464, 443, PM1

Data Management - 434, AIRS1

QA Personnel - 422, 434, 435, 443, QA1, QA3, QA4, QA6, QA7, PM1

During the month of August 1998, training will occur for all field, laboratory, sample custody and data management personnel. Training will be based on the conforming to the SOPs listed in Appendix E. The QA Division will coordinate training activities for the Department.

8.2 Certification

Usually, the organizations participating in the project that are responsible for conducting training and health and safety programs are also responsible for ensuring certification. Various commercial training courses are available that meet some government regulations. Training and certification should be planned well in advance for necessary personnel prior to the implementation of the project. All certificates or documentation representing completion of specialized training should be maintained in personnel files.

For the $PM_{2.5}$ program, the QA Division will issue training certifications for the successful completion of field, laboratory, sample custody and data management training. Certification will be based upon the qualitative and quantitative assessment of individuals adherence to the SOPs. Certification will require a qualitative acceptance rating of “adequate” and quantitative rating of 80%. Appendix B contains the QA Division Certification Evaluation Forms for field and laboratory activities. Forms for sample custody and data management will also be developed.

9.0 Documentation and Records

The purpose of this element is to define which records are critical to the project and what information needs to be included in reports, as well as the data reporting format and the document control procedures to be used. Specification of the proper reporting format, compatible with data validation, will facilitate clear, direct communication of the investigation and its conclusions and be a resource document for the design of future studies.

For the Ambient Air Monitoring Program, there are number of documents and records that need to be retained. A document, from a records management perspective, is a volume that contains information which describes, defines, specifies, reports, certifies, or provides data or results pertaining to environmental programs. As defined in the *Federal Records Act of 1950 and the Paperwork Reduction Act of 1995* (now 44 U.S.C. 3101-3107), records are: "...books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the United States Government under Federal Law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the informational value of data in them..."

The following information describes the Department of Health's document and records procedures for $PM_{2.5}$ Program. In EPA's QAPP regulation and guidance, EPA uses the term reporting package. Although this is not a term currently used by the Department, it will be defined as 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 Department under its policies and records management procedures. Table 9-1 identifies these documents and records.

9.1 Information Included in the Reporting Package

The selection of which records to include in a data reporting package must be determined based on how the data will be used. Different "levels of effort" require different supporting QA/QC documentation. For example, organizations conducting basic research have different reporting requirements from organizations collecting data in support of litigation or in compliance with permits. When possible, field and laboratory records should be integrated to provide a continuous track of reporting.

9.1.1 Routine Data Activities

The Department of Health has a structured records management retrieval system that allows for the efficient archive and retrieval of records. The $PM_{2.5}$ information will be included in this system. It is organized in a similar manner to the EPA's records management system (EPA-220-

B-97-003) and follows the same coding scheme in order to facilitate easy retrieval of information during EPA technical systems audits and network reviews. Table 9-1 includes the documents and records that will be filed according to the statute of limitations discussed in Section 9.3. In order to archive the information as a cohesive unit, all the $PM_{2.5}$ information will be filed under the major code “PM25", followed by the codes in Table 9-1

Table 9-1 $PM_{2.5}$ Reporting Package Information

Categories	Record/Document Types	File Codes
Management and Organization	State Implementation Plan Reporting agency information Organizational structure Personnel qualifications and training Training Certification Quality management plan Document control plan EPA Directives Grant allocations Support Contract	AIRP/217 AIRP/237 ADMI/106 PERS/123 AIRP/482 AIRP/216 ADMI/307 DIRE/007 BUDG/043 CONT/003 CONT/202
Site Information	Network description Site characterization file Site maps Site Pictures	AIRP/237 AIRP/237 AIRP/237 AUDV/708
Environmental Data Operations	QA Project Plans Standard operating procedures (SOPs) Field and laboratory notebooks Sample handling/custody records Inspection/Maintenance records	PROG/185 SAMP/223 SAMP/502 TRAN/643 AIRP/486
Raw Data	Any original data (routine and QC data) including data entry forms	SAMP/223
Data Reporting	Air quality index report Annual SLAMS air quality information Data/summary reports Journal articles/papers/presentations	AIRP/484 AIRP/484 AIRP/484 PUBL/250
Data Management	Data algorithms Data management plans/flowcharts PM2.5 Data Data Management Systems	INFO/304 INFO/304 INFO/160 - INFO/173 INFO/304 - INFO/170
Quality Assurance	Good Laboratory Practice Network reviews Control charts Data quality assessments QA reports System audits Response/Corrective action reports Site Audits	COMP/322 OVER/255 SAMP/223 SAMP/223 OVER/203 OVER/255 PROG/082 OVER/658 OVER/203

9.1.2 Annual Summary Reports Submitted to EPA

As indicated in 40 CFR Part 58, the department shall submit to the EPA Administrator, through the Region Y 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 ($\mu g/m^3$) as specified in 40 CFR part 50, Appendix N (Annual arithmetic mean NAAQS is 15$\mu g/m^3$)
- All daily PM-fine values above the level of the 24-hour PM-fine NAAQS (65 $\mu g/m^3$) 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 $PM_{2.5}$ Summary Report Ranges

Range	Number of Values
0 to 15 ($\mu g/m^3$)	
16 to 30	
31 to 50	
51 to 70	
71 to 90	
91 to 110	
greater than 110	

Dr. James Calhoon, as the senior air pollution control officer for the Department, 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, in particular, the Annual QA Report discussed in Section 21 that documents the quality of the $PM_{2.5}$ data and the effectiveness of the quality system.

9.2 Data Reporting Package Format and Documentation Control

The format of data reporting packages, whether for field or lab data, must be consistent with the requirements and procedures used for data validation and data assessment. All individual records that represent actions taken to achieve the objective of the data operation and the performance of specific QA functions are potential components of the final data reporting package. This element of the QAPP should discuss how these various components will be assembled to represent a concise and accurate record of all activities impacting data quality. The discussion should detail the recording medium for the project, guidelines for hand-recorded data (e.g., using indelible ink), procedures for correcting data (e.g., single line drawn through errors and initialed by the responsible person), and documentation control. Procedures for making revisions to technical documents should be clearly specified and the lines of authority indicated.

Table 9-1 represents the documents and records, at a minimum, that 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 $PM_{2.5}$ concentration, the submission to the AIRS database, and QA/QC data, are collected electronically or on data forms that are included in the field and analytical methods sections. All hardcopy information will be filled out in indelible ink. Corrections will be made by inserting one line through the incorrect entry, initialing this correction, and placing the correct entry alongside the incorrect entry, if this can be accomplished legibly, or by providing the information on a new line.

9.2.1 Notebooks

The Department will issue notebooks to each field and laboratory technician. This notebook will be uniquely numbered and associated with the individual and the $PM_{2.5}$ 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 3-ring binders that will contain the appropriate data forms for routine operations as well as inspection and maintenance forms and SOPs.

Lab Notebooks - Notebooks will also be issued for the laboratory. These notebooks will be uniquely numbered and associated with the $PM_{2.5}$ Program. One notebook will be available for general comments/notes; others will be associated with, the temperature and humidity recording instruments, the refrigerator, calibration equipment/standards, and the analytical balances used for this program.

Sample shipping/ receipt- One notebook will be issued to the shipping and receiving facility. This notebook will be uniquely numbered and associated with the $PM_{2.5}$ program. It will include standard forms and areas for free form notes.

9.2.2 Electronic data collection

It is anticipated that certain instruments will provide an automated means for collecting information that would otherwise be recorded on data entry forms. Information on these systems are detailed in Sections 18 and 19. In order to reduce the potential for data entry errors, automated systems will be utilized where appropriate and will record the same information that is found on data entry forms. In order to provide a back-up, a hardcopy of automated data collection information will be stored for the appropriate time frame in project files.

9.3 Data Reporting Package Archiving and Retrieval

The length of storage for the data reporting package may be governed by regulatory requirements, organizational policy, or contractual project requirements. This element of the QAPP should note the governing authority for storage of, access to, and final disposal of all records

As stated in 40 CFR part 31.42, in general, all the information listed in Table 9-1 will be retained for 3 years from the date the grantee submits its 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 3-year period, the records will be retained until completion of the action and resolution of all issues which arise from it, or until the end of the regular 3-year period, whichever is later. The Department will extend this regulation in order to store records for three full years past the year of collection. For example, any data collected in calendar year 1999 (1/1/99 - 12/31/99) will be retained until, at a minimum, January 1, 2003; unless the information is used for litigation purposes.

10.0 Sampling Design

The purpose of this element is to describe all the relevant components of the experimental design; define the key parameters to be estimated; indicate the number and type of samples expected; and describe where, when, and how samples are to be taken. The level of detail should be sufficient that a person knowledgeable in this area could understand how and why the samples will be collected. This element provides the main opportunity for QAPP reviewers to ensure that the "right" samples will be taken. Strategies such as stratification, compositing, and clustering should be discussed, and diagrams or maps showing sampling points should be included. Most of this information should be available as outputs from the final steps of the planning (DQO) process.

The purpose of this Section is to describe all of the relevant components of the SLAMS gravimetric mass $PM_{2.5}$ monitoring network to be operated by Palookaville, including the network design for evaluating the quality of the data. This entails describing the key parameters to be estimated, the rationale for the locations of the $PM_{2.5}$ 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 stipulated in 40 CFR Part 58 Section 58.13, Appendix A, and Appendix D and further described in *Guidance for Network Design and Optimum Site Exposure for* $PM_{2.5}$ *and* PM_{10}.

10.1 Scheduled Project Activities, Including Management Activities

This element should give anticipated start and completion dates for the project as well as anticipated dates of major milestones, such as the following:

- schedule of sampling events;
- schedule for analytical services by offsite laboratories;
- schedule for phases of sequential sampling (or testing), if applicable;
- schedule of test or trial runs; and
- schedule for peer review activities.

The use of bar charts showing time frames of various QAPP activities to identify both potential bottlenecks and the need for concurrent activities is recommended.

As explained in Section 10.4, Palookaville will be monitoring $PM_{2.5}$ concentrations at five locations using five primary samplers and two QA samplers. The order of installation of the primary samplers has been determined based on anticipated $PM_{2.5}$ concentrations at each of the locations. The sites with the highest anticipated $PM_{2.5}$ concentrations will be installed first, and the QA samplers will be installed in compliance with the requirements of 40 CFR Part 58 Appendix A. Due to the common practice of burning wood during the winter months within Palookaville's jurisdiction, it is important to have the samplers installed and operational as early in the fall/winter as possible. Table 10-1 represents the activities associated with the ordering and deployment of the primary and QA $PM_{2.5}$ samplers.

Table 10-1. Schedule of PM2.5 Sampling-Related Activities

Activity	Due Date	Comments
Order samplers: 5 sequentials (4 primary, 1 QA), 2 single-days (1 primary, 1 QA)	March 2, 1998	Ordered from National contract.
Receive samplers	July 1, 1998	
Install sequential sampler at site A1[1]	September 1998	Contingent upon timely receipt of samplers under National contract.
Install collocated sampler at site A1[1]	September 1998	Contingent upon timely receipt of samplers under National contract.
Install sequential sampler at site A2[1]	October 1998	Contingent upon timely receipt of samplers under National contract.
Install single-day sampler at site B1[1]	October 1998	Contingent upon timely receipt of samplers under National contract.
Install collocated sampler at site B1[1]	October 1998	Contingent upon timely receipt of samplers under National contract.
Install sequential sampler at site A3[1]	November 1998	Contingent upon timely receipt of samplers under National contract.
Begin routine sampling at sites A1, A2, A3, and B1[1]	January 1, 1999	
Begin routine sampling at collocated sites A1 and B1[1]	January 1, 1999	
Install sequential sampler at site A4[1]	April 1999	Deferred to 1999 due to weather and minimal population impact.
Begin routine sampling at site A4[1]	January 1, 2000	
Report routine data to AIRS-AQS	Ongoing - due within 90 days after end of quarterly reporting period	Required according to 40 CFR Part 58, Section 35(c).
FRM Performance Evaluations	Ongoing - according to national audit time frame	FRM audits not the responsibility of Palookaville. Item included in schedule since some coordination will be required.
Report QA data to AIRS-AQS	Ongoing - due within 90 days after end of quarterly reporting period	Required according to 40 CFR Part 58, Section 35(c).
Review QA reports generated by AIRS	Ongoing	Needed to determine which, if any, monitors fail bias and/or precision limits.
Primary network review	Annually	Evaluate reasonableness of siting, CMZ definitions, decommissioning of PM10 monitors, number of samplers.
Evaluate location of collocated sequential sampler	Annually	Need to collocate sequential sampler measuring concentrations closest to PM2.5 NAAQS.

[1]Site names/number defined in section 10.4.

10.2 Rationale for the Design

The objectives for an environmental study should be formulated in the planning stage of any investigation. The requirements and the rationale of the design for the collection of data are derived from the quantitative outputs of the DQO Process. The type of design used to collect data depends heavily on the key characteristic being investigated. For example, if the purpose of the study is to estimate overall average contamination at a site or location, the characteristic (or parameter) of interest would be the mean level of contamination. This information is identified in Step 5 of the DQO Process. The relationship of this parameter to any decision that has to be made from the data collected is obtained from Steps 2 and 3 of the DQO Process.

10.2.1 Primary Samplers

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

(1) The three-year average of the annual 98th percentiles of $PM_{2.5}$ concentrations at any population-oriented monitoring site is not to exceed 65 µg/m^3.
(2) The three-year average of the annual mean of $PM_{2.5}$ concentrations is not to exceed 15 µg/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).

Thus the key characteristics being measured are annual 98th percentiles and annual means of twenty-four hour average $PM_{2.5}$ concentrations.

To determine whether these characteristics are quantified with sufficient confidence, Palookaville must address sampler type, sampling frequency, and sampler siting. By employing FRM/FEM samplers, Palookaville is assured to be measuring the $PM_{2.5}$ concentrations as well as possible with regards to evaluating compliance with the $PM_{2.5}$ NAAQS. By complying with the sampling frequency requirements of 40 CFR Part 58 Section 58.13, Palookaville assumes that the sampling frequency is sufficient to attain the desired confidence in the annual 98th percentile and annual mean of $PM_{2.5}$ concentrations in the vicinity of each monitor. By selecting sampler locations using the rules in 40 CFR Part 58 Appendix D, Palookaville can be confident that the $PM_{2.5}$ concentrations within its jurisdiction are adequately characterized. Sampler type, frequency, and siting are further described in section 10.4.

10.2.2 QA Samplers

The purpose of collocated samplers and the FRM performance evaluation is to estimate the precision and bias of the various $PM_{2.5}$ samplers. The DQOs developed in Section 7.0 state that, for a 3-year period, the concentrations measured by a sampler must be within ±10% of the true concentration as measured by an 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 decision makers can make decisions about attainment and/or non-attainment of the $PM_{2.5}$ 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. Thus the key characteristics being measured with the QA samplers are bias and precision.

To determine whether these characteristics are measured with sufficient confidence, Palookaville must address sampler type, sampling frequency, and sampler siting for the QA network. As with the primary $PM_{2.5}$ network, by using FRM/FEM samplers, maintaining the sampling frequency specified in 40 CFR Part 58 Appendix A, and collocating the number of samplers as specified in 40 CFR Part 58 Appendix A, Palookaville assumes its QA network will measure bias and precision with sufficient confidence. These issues are described in more detail in section 10.4.

10.3 Design Assumptions

The planning process usually recommends a specific data collection method (Step 7 of the DQO Process), but the effectiveness of this methodology rests firmly on assumptions made to establish the data collection design. Typical assumptions include the homogeneity of the medium to be sampled (for example, sludge, fine silt, or wastewater effluent), the independence in the collection of individual samples (for example, four separate samples rather than four aliquot derived from a single sample), and the stability of the conditions during sample collection (for example, the effects of a rainstorm during collection of wastewater from an industrial plant). The assumptions should have been considered during the DQO Process and should be summarized together with a contingency plan to account for exceptions to the proposed sampling plan. An important part of the contingency plan is documenting the procedures to be adopted in reporting deviations or anomalies observed after the data collection has been completed. Examples include an extreme lack of homogeneity within a physical sample or the presence of analytes that were not mentioned in the original sampling plan. Chapter 1 of EPA QA/G-9 provides an overview of sampling plans and the assumptions needed for their implementation, and EPA QA/G-5S provides more detailed guidance on the construction of sampling plans to meet the requirements generated by the DQO Process.

The sampling design is based on the assumption that following the rules and guidance provided in

CFR 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 Palookaville's discretion is the sampler siting, and to a degree, sampling frequency. The siting assumes homogeneity of $PM_{2.5}$ concentrations within CMZs and heterogeneity between CMZs. MPA and CMZ boundaries will be regularly reviewed, as part of the network reviews (Section 20). The basis for creating and revising the boundaries is described in the following section.

10.4 Procedure for Locating and Selecting Environmental Samples

The most appropriate plan for a particular sampling application will depend on: the practicality and feasibility (e.g., determining specific sampling locations) of the plan, the key characteristic (the parameter established in Step 5 of the DQO Process) to be estimated, and the implementation resource requirements (e.g., the costs of sample collection, transportation, and analysis).

This element of the QAPP should also describe the frequency of sampling and specific sample locations (e.g., sample port locations and traverses for emissions source testing, well installation designs for groundwater investigations) and sampling materials. Sometimes decisions on the number and location of samples will be made in the field; therefore, the QAPP should describe how these decisions will be driven whether by actual observations or by field screening data. When locational data are to be collected, stored, and transmitted, the methodology used must be specified and described (or referenced) and include the following:

- procedures for finding prescribed sample locations,
- contingencies for cases where prescribed locations are inaccessible,
- location bias and its assessment, and
- procedures for reporting deviations from the sampling plan.

When appropriate, a map of the sample locations should be provided and locational map coordinates supplied. EPA QA/G-5S provides nonmandatory guidance on the practicality of constructing sampling plans and references to alternative sampling procedures.

10.4.1 Primary Samplers

The design of the SLAMS $PM_{2.5}$ network must achieve one of six basic monitoring objectives, as described in 40 CFR Part 58, Appendix D. These are:

(1) To determine the highest concentrations 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 or source categories.
(4) To determine general background concentrations levels.
(5) To determine the extent of Regional pollution transport among populated areas.
(6) In support of secondary standards, to determine the welfare-related impacts in more rural and remote areas.

The procedure for siting the $PM_{2.5}$ 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.

Palookaville is responsible for monitoring air quality for Parsley, Sage, Rosemary, and Thyme counties in California. The number of SLAMS sites where gravimetric mass $PM_{2.5}$ monitoring will occur and their location was determined based upon the information provided 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 steps were used to define the Monitoring Planning Areas (MPAs), to define the community monitoring zones (CMZs), and to site the monitors.

10.4.2 Primary Samplers - Defining MPAs

Two MPAs were identified within Palookaville's four counties. The boundaries were determined based on (1) the 1990 census data by census tract, (2) the boundaries of the existing MSAs, and (3) the surrounding geography. Figure 10-1 shows the geography, city centers, and current PM_{10} monitoring locations for the region for which Palookaville is responsible. One of the MPAs corresponds to the Scarborough Metropolitan Statistical Area (MSA). According to the 1990 census, the Scarborough MSA, which is located entirely in Parsley County, has a population of

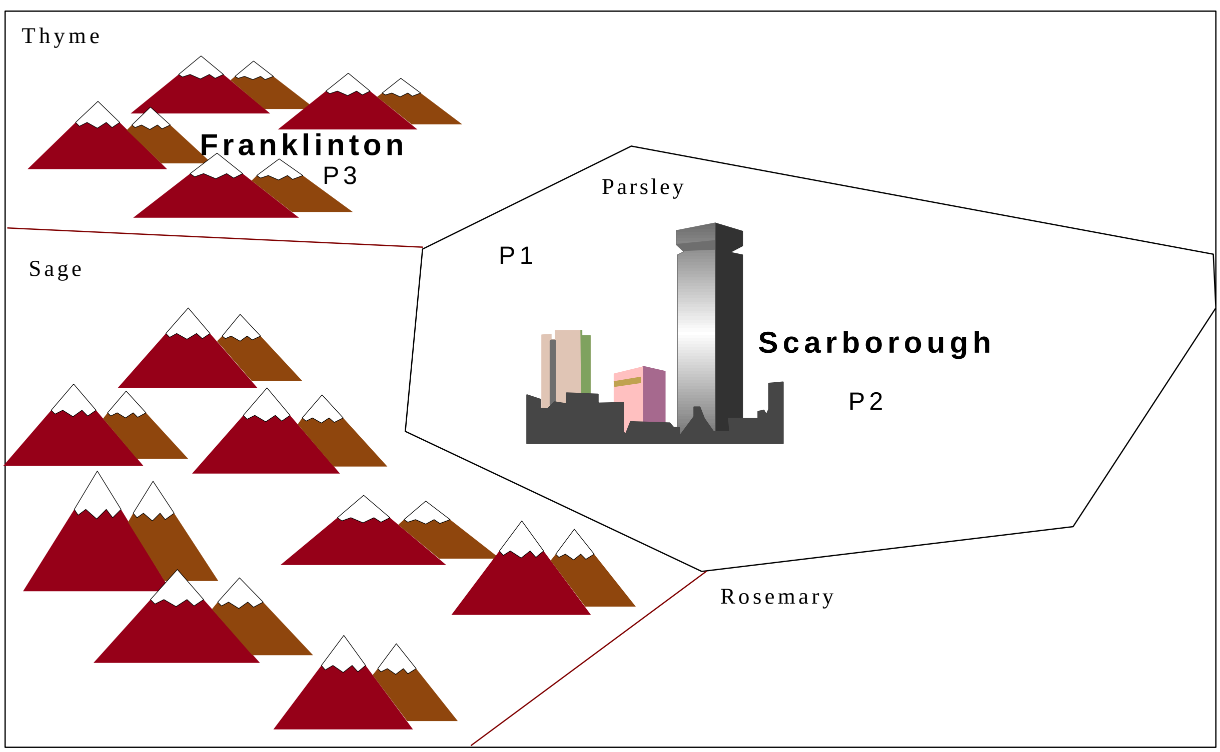

Figure 10-1. Geography, population centers, and PM10 sampler locations for Palookaville

357,420. The population is evenly distributed through the MSA except in the downtown area. As a result, the boundaries of the MPA are taken to be those of the MSA, that is, the county boundary.

The second MPA is centered around Franklinton, a town located in Thyme County. Four census tracts in Franklinton contain over 50,000 people. These four tracts were identified as a unique MPA because: (1) of the density of the population, (2) Franklinton is the center of a pulp mill, and (3) Franklinton is located in a depression, surrounded by mountains. The boundary of the Franklinton MPA is the boundary of the four census tracts.

Since there are no other concentrated population centers in Palookaville's jurisdiction, no other MPAs were identified.

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}*. Since spatial averaging is to be used in Scarborough, the Scarborough MPA was divided into CMZs.

Within the Scarborough MPA, the major industries include transportation, commerce, and tourism (skiing in the nearby mountains during the winter), and these industries are spread fairly evenly through the MPA. A study of the point sources in the area confirms that the emission sources are evenly spread, as is the transportation as indicated by traffic studies. However, a study of the wind patterns using wind roses indicates that winds predominately blow from the Northwest to the Southeast. This is of particular concern because of the potential transport of particulate matter from the mill operations in Franklinton into the Northwestern portion of the Scarborough MPA. Review of the data from the current PM_{10} monitoring sites adds support to this concern in that the daily PM_{10} concentrations at site P1 are generally higher than those at either P2 or P3. As a result, the Scarborough MPA was divided into two CMZs, one area to the Northwest of the downtown area that is likely to be influenced by transport from Franklinton, and the other area being the remainder of the MPA. The names for the CMZs are NW Scarborough and Scarborough. This division of the Scarborough MPA will need to be reviewed as $PM_{2.5}$ data is collected to determine if the two CMZs can be combined into one.

10.4.4 Primary Samplers - Siting Monitors

As mentioned previously, the procedure for siting the $PM_{2.5}$ samplers is based on judgmental sampling. Palookaville requires five $PM_{2.5}$ sites to characterize adequately the aerosol in the four counties for which it is responsible to monitor air quality. Three of the monitors will be located in the Scarborough MPA, one in Franklinton, and one in Sage County. Figure 10-2 shows a map of the locations of the SLAMS sites for $PM_{2.5}$, where an "A" indicates a site using a sequential sampler and "B" indicates a site using a single-day sampler.

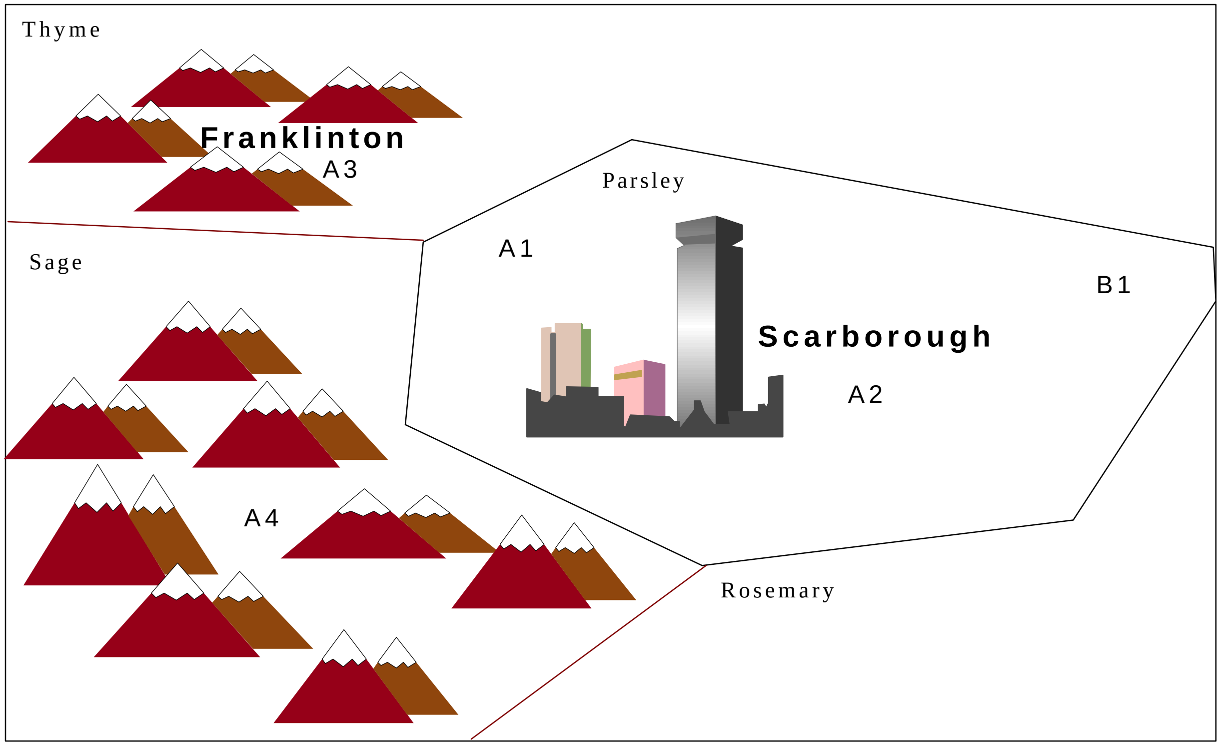

Figure 10-2. PM2.5 sites for Palookaville

Sage County is comprised predominately of federal lands that are low in population. One $PM_{2.5}$ site, A4, will be established in this county to monitor regional background $PM_{2.5}$ concentration and is therefore representative of a regional-scale. This is a new monitoring site.

One $PM_{2.5}$ site, A3, will be located in Franklinton to quantify the neighborhood-scale exposures in the area. There currently is a PM_{10} monitor in Franklinton and the $PM_{2.5}$ monitor will be collocated with the PM_{10} monitor. The data from these two monitors will be reviewed after one year of collection to see if the PM_{10} site can be de-commissioned. The decision on whether to de-commission the PM_{10} site will based on discussions with Region Y

Three sites will be used in the Scarborough MPA. A1, located in the northwestern part of the MPA, will be sited to answer concerns about possible transport from Franklinton. The site location will correspond to that for the PM10 sampler, P1. The core site, named A2 and located just downwind of the downtown area, will be collocated on a platform that currently has both a CO sampler and a PM_{10} sampler. The information gained by having the collocated samplers will be invaluable. The second site, named B1 and located further downwind of downtown, represents a neighborhood scale and also will address possible questions about transport out of Scarborough. Sites A1, A2, and B3 all represent neighborhood-scale sites.

The site in Sage county will be designated a NAMS site and the other four sites will be designated

SLAMS.

The network design as described meets all six of the basic monitoring objectives:

(1) The highest concentrations are expected to occur at or near site A1.
(2) The monitoring network has been designed to characterize the $PM_{2.5}$ concentrations in the high population centers, those being Scarborough and Franklinton.
(3) The significant sources of $PM_{2.5}$ are anticipated to be the mill operations, wood burning, and automotive activities. Site A3 will determine the impact of the mill operations and sites A1, A2, A3, and B1 will determine both the impact of wood burning and automobile-related activities.
(4) Site A4 is expected to experience background $PM_{2.5}$ concentrations.
(5) Site A3 will measure transport from Franklinton into Scarborough and B1 may provide some information about the transport out of Scarborough.
(6) Site A3 is a rural site and A4 is a remote area.

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 (Section 20). The number and boundaries of MPAs will be reviewed and potentially revised as new census data become available or in the event that MSA definitions change.

The CMZ definitions will also be reviewed as part of the network review (Section 20). In particular, the division of the Scarborough MPA will be reviewed as $PM_{2.5}$ data are collected to determine if the two CMZs can be combined into one or if the Scarborough CMZ should be further subdivided. The review will be based on actual data collected and a review of emission sources in the area. According to 40 CFR Part 58 Appendix D Section 2.8.1.6, the annual average air quality is sufficiently homogenous, that is, monitors may be averaged for comparison with the annual $PM_{2.5}$ 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, and
(3) all sites in the CMZ are affected by the same major emission sources of $PM_{2.5}$.

To address these three issues, Palookaville will use the following five-step procedure, which 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 sites A1, A2, and B1 are within 20 percent of the spatial average. The calculations for achieving this are provided in detail in 40 CFR Part 50 Appendix N. Decision: if A1 differs from the spatial average by more than 20 percent, then the NW Scarborough CMZ and the Scarborough CMZ should not be

combined into one. If A1 is similar to the spatial average, the CMZs possibly should be combined, based on the information from steps 3, 4, and 5.

(2) Determine if the average concentration at sites A2 and B1 are within 20 percent of the spatial average. The calculations for achieving this are provided in detail in 40 CFR Part 50 Appendix N. Decision: if A2 and B1 differ by more than 20 percent, then the Scarborough CMZ should be split into two CMZs. If they do not differ, the air in the Scarborough CMZ is possibly homogenous, but steps 3, 4, and 5 should be taken to verify further.

(3) Determine if the monitoring sites exhibit similar day to day variability. To accomplish this, calculate the correlation coefficient between the concentrations measured at A1 and B1, between A1 and A2, and between B1 and A2. In general, the correlation coefficient between site X and site Y is calculated using all days for which concentrations exist for BOTH sites, using the following equation:

$$\rho(X,Y) = \frac{\sum X_i Y_i - \frac{\sum X_i \sum Y_i}{n}}{\sqrt{\left(\sum X_i^2 - \frac{\sum X_i^2}{n}\right)\left(\sum Y_i^2 - \frac{\sum Y_i^2}{n}\right)}}$$

where all summations are for $i=1, 2, ..., n$ and n is the number of days for which both site X and site Y have data. If the correlation coefficient is greater than 0.6, then we conclude that the sites exhibit similar day to day variability. Decision: if the correlation coefficient between A1 and either A2 or B1 is less than 0.6, this indicates that the NW Scarborough and Scarborough CMZs should remain separate. If the correlation coefficient between A2 and B1 is less than 0.6, this indicates that the Scarborough CMZ should be split into two CMZs. If the correlation coefficients are greater than 0.6, this adds support to the idea that the ambient air is homogenous, but steps 4 and 5 should be taken to verify further.

(4) Review the location of existing and new emission sources. Decision: if an emission source is located close to a monitoring site, then the site does not represent a neighborhood scale, hence is not eligible for spatial averaging.

(5) Review any data from speciation monitors or air quality models. Decision: if the emission profiles look similar near each of the monitors, then we will conclude that the sites are impacted by the same major sources of emissions.

The information from these five 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 $PM_{2.5}$ air quality data are required before a final evaluation can be made.

10.4.6 Primary Samplers - Sampling Frequency

According to 40 CFR Part 58 Section 58.13 and Appendix D, the required sampling frequency for the samplers operated by Palookaville is once every three days. Hence, all samplers will operate on a 1 in 3 day sampling frequency, except for possibly during some critical times during the wood-burning months in which case daily sampling may be conducted at the core site and at the transport site between Franklinton and Scarborough.

10.4.7 Primary Samplers - Types of Samplers

Of the five $PM_{2.5}$ samplers that Palookaville will be operating, four of them will be sequential samplers and one will be a single-day sampler. Palookaville would prefer to purchase all sequential samplers to accommodate potential increases in sampling frequency; however, due to budget constraints, only four of the five will be sequential. All samplers will be FRM or FEM.

Since the single-day sampler must be visited by field personnel at least every three days to collect the used filter and load a new one, the single-day sampler will be placed in Scarborough, for ease of access. In particular, the location most downwind from the downtown area of Scarborough, site B1, will have the single-day sampler. By operating sequential samplers at the regional background site and at the Franklinton site, field personnel will have to visit these sites only every six days, as shown in Table 10-2. Such a schedule will minimize field costs because the operator must visit the site only once every six days instead of after every sample, as would be the case with a single-day sampler. In addition, the sample recovery date is staggered in order to eliminate weekend activities. This schedule complies with 40 CFR Part 50 Appendix L, that stipulates filters remain in the sampler for no more than 96 hours after sampling. The core site located in downtown Scarborough, site A2, and the transport site located in the northwestern part of Scarborough, site A1, will both have sequential samplers to expedite possible increases in the sampling frequency.

10.4.8 Primary Sampling - Other $PM_{2.5}$ Monitoring

This network design does not include any special purpose monitoring or monitoring that will provide speciated data. Special purpose and speciation monitoring are extremely important components of the $PM_{2.5}$ monitoring network. However, this document will not address these two components. They will be addressed in a separate document.

Table 10-2 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*	

10.4.9 QA Samplers

According to the primary $PM_{2.5}$ network design, Palookaville will deploy and operate one site using a single-day sampler and four sites using sequential samplers. According to 40 CFR Part 58, Appendix A, Section 3.5.2, for each method designation, at least 25% (minimum of one) of the samplers must be collocated. As a result, Palookaville must collocate the single-day sampler since a single-day sampler will have a different designation than the sequential samplers. Also, since there are four sequential samplers, all the same designation, Palookaville must operate one site (which is 25% of 4) with a collocated sequential sampler, and the site will be the one most likely to be in violation of the $PM_{2.5}$ NAAQS. Based on the data collected by the PM_{10} network, it is assumed that the site most likely to monitor concentrations at or above the $PM_{2.5}$ NAAQS is site A1 in the northwestern part of Scarborough. However, as data from the $PM_{2.5}$ network becomes available, the data will be reviewed on an annual basis to determine if a different site operating a sequential sampler is more appropriate for collocation. The two collocation samplers will be operated on a six-day sampling schedule, regardless of the sampling frequency of the primary samplers and will coincide with the sampling run time of the primary sampler so that the primary and collocated samplers are operating on the same days. Section 14.1.3 discusses this precision check in more detail.

A complementary method for estimating bias and precision is the FRM Performance Evaluation. Even though Palookaville is not responsible for performing these evaluations, it is important for to recognize that these evaluations will be performed. First, Palookaville will need to coordinate with the Regional QA Coordinator to provide access to the sites and offer other needed support. Secondly, the performance evaluation data will be reviewed by Palookaville. According to 40 CFR Part 58, Appendix A, Section 3.5.3, for Palookaville, the number of sites to be evaluated annually under is two and at a frequency of four times during the year. The number of sites is two for the same reason that the number of collocated sites is two, that is, each method designation and at least 25% of each method designation within a reporting organization must be audited each year. Hence, the primary single-day sampler will be evaluated each year and one of the primary sequential samplers will be evaluated each year.

Table 10-3 provides some basic information about each of the seven gravimetric mass $PM_{2.5}$ samplers to be operated by Palookaville. Latitude and Longitudes will be recorded using a global positioning instrument that meets the EPA locational data policy goals of 25 meters accuracy.

Table 10-3. Identifying Information for Palookaville $PM_{2.5}$ Samplers

AIRS ID		Lat	Long	Sampling Frequency	Scale of Representativeness	Type of Monitor	MPA	CMZ	Standard
Primary Samplers									
A1	060021125811041	38.9	120.5	1 in 3, daily during $PM_{2.5}$ episodes	Neighborhood	Sequential	Scarborough	NW Scarborough	Annual and 24-hour
A2	060021245811041	39.1	120.0	1 in 3, daily during $PM_{2.5}$ episodes	Neighborhood	Sequential	Scarborough	Scarborough	Anmual and 24-hour
A3	060030125811041	38.5	120.9	1 in 3	Neighborhood	Sequential	Franklinton	N/A	Annual and 24-hour
A4	060051625811041	39.5	121.1	1 in 3	Regional	Sequential	N/A	N/A	Annual and 24-hour
B1	060021126811041	38.9	119.6	1 in 3	Neighborhood	Single Filter	Scarborough	Scarborough	Annual and 24-hour
QA Samplers									
A1	060021125811049	38.9	120.5	1 in 6		Sequential			
B1	060021126811049	38.9	119.6	1 in 6		Single Filter			

10.5 Classification of Measurements as Critical/Noncritical

All measurements should be classified as critical (i.e., required to achieve project objectives or limits on decision errors, Step 6 of the DQO Process) or noncritical (for informational purposes only or needed to provide background information). Critical measurements will undergo closer scrutiny during the data gathering and review processes and will have first claim on limited budget resources. It is also possible to include the expected number of samples to be tested by each procedure and the acceptance criteria for QC checks (as described in element B5, “Quality Control Requirements”).

10.5.1 Primary Samplers

The critical information collected at the primary samplers is that specified in Table 6-2 that will be provided to AIRS. Also critical is the site information such as the MPA, CMZ (if applicable), and the NAAQS to which the data will be compared. These data are critical because they are necessary for determining compliance with the $PM_{2.5}$ standards.

10.5.2 QA Samplers

The critical information collected at collocated samplers is the same as that presented in Table 6-2 of Section 6.2.1 for primary samplers. All of the measurements in Table 6-2 are considered critical because they form the basis for estimating bias and precision which are critical for evaluating the ability of the decision makers to make decisions at desired levels of confidence. The measurements described in Table 6-3 will also be collected for the collocated samplers. With the exception of the filter integrity flags, these measurements are considered to be noncritical.

10.6 Validation of Any Non-Standard Measurements

For nonstandard sampling methods, sample matrices, or other unusual situations, appropriate method validation study information may be needed to confirm the performance of the method for the particular matrix. The purpose of this validation information is to assess the potential impact on the representativeness of the data generated. For example, if qualitative data are needed from a modified method, rigorous validation may not be necessary. Such validation studies may include round-robin studies performed by EPA or by other organizations. If previous validation studies are not available, some level of single-user validation study or ruggedness study should be performed during the project and included as part of the project's final report. This element of the QAPP should clearly reference any available validation study information.

Since Palookaville is deploying only FRMs/FEMs and will be operating them according to *Guidance Document 2.12*, then there will not be any non-standard measurements from either the primary or QA samplers. Also, since Palookaville will be sending its filters to a certified laboratory for weighing, there will not be any non-standard measurements from the analysis of the filters. Hence, all sampling and analysis measurements will be standard.

11.0 Sampling Methods Requirements

Environmental samples should reflect the target population and parameters of interest. As with all other considerations involving environmental measurements, sampling methods should be chosen with respect to the intended application of the data. Just as methods of analysis vary in accordance with project needs, sampling methods can also vary according to these requirements. Different sampling methods have different operational characteristics, such as cost, difficulty, and necessary equipment. In addition, the sampling method can materially affect the representativeness, comparability, bias, and precision of the final analytical result.

In the area of environmental sampling, there exists a great variety of sample types. It is beyond the scope of this document to provide detailed advice for each sampling situation and sample type. Nevertheless, it is possible to define certain common elements that are pertinent to many sampling situations with discrete samples (see EPA QA/G-5S).

If a separate sampling and analysis plan is required or created for the project, it should be included as an appendix to the QAPP. The QAPP should simply refer to the appropriate portions of the sampling and analysis plan for the pertinent information and not reiterate information..

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 ($PM_{2.5}$) in ambient air over a 24-hour period for purposes of determining whether the primary and secondary national ambient air quality standards for particulate matter specified in 40 CFR Part 50.6 are met. The measurement process is considered to be non-destructive, and the $PM_{2.5}$ sample obtained can be subjected to subsequent physical or chemical analyses.

11.2 Sample Collection and Preparation

(1) *Select and describe appropriate sampling methods from the appropriate compendia of methods.* For each parameter within each sampling situation, identify appropriate sampling methods from applicable EPA regulations, compendia of methods, or other sources of methods that have been approved by EPA. When EPA-sanctioned procedures are available, they will usually be selected. When EPA-sanctioned procedures are not available, standard procedures from other organizations and disciplines may be used. A complete description of non-EPA methods should be provided in (or attached to) the QAPP. Procedures for sample homogenization of nonaqueous matrices may be described in part (2) as a technique for assuring sample representativeness. In addition, the QAPP should specify the type of sample to be collected (e.g., grab, composite, depth-integrated, flow- weighted) together with the method of sample preservation.

(2) *Discuss sampling methods' requirements.* Each medium or contaminant matrix has its own characteristics that define the method performance and the type of material to be sampled. Investigators should address the following:

- actual sampling locations,
- choice of sampling method/collection,
- delineation of a properly shaped sample,
- inclusion of all particles within the volume sampled, and
- correct subsampling to reduce the representative field sample into a representative laboratory aliquot.

Having identified appropriate and applicable methods, it is necessary to include the requirements for each method in the QAPP. If there is more than one acceptable sampling method applicable to a particular situation, it may be necessary to choose one from among them. DQOs should be considered in choosing these methods to ensure that: a) the sample accurately represents the portion of the environment to be characterized, b) the sample is of sufficient volume to support the planned chemical analysis, and c) the sample remains stable during shipping and handling.

(3) *Describe the decontamination procedures and materials.* Decontamination is primarily applicable in situations of sample acquisition from solid, semi-solid, or liquid media, but it should be addressed, if applicable, for continuous monitors as well. The investigator must consider the appropriateness of the decontamination procedures for the project at hand. For example, if contaminants are present in the environmental matrix at the 1% level, it is probably unnecessary to clean sampling equipment to parts-per-billion (ppb) levels. Conversely, if ppb-level detection is required, rigorous decontamination or the use of disposable equipment is required. Decontamination by-products must be disposed of according to EPA policies and the applicable rules and regulations that would pertain to a particular situation, such as the regulations of OSHA, the Nuclear Regulatory Commission (NRC), and State and local governments.

FRM samplers will be used as the monitor for collection of $PM_{2.5}$ samples for comparison to the NAAQS. In the Palookaville network there are two models of the *XYZ sampler* employed. The *XYZ sampler model 1000* is a single day sampler that meets FRM designation. The *XYZ sampler model 2000* is a multiple day sampler that meets FRM designation. Each model sampler shall be installed with adherence to procedures, guidance, and requirements detailed in 40 CFR Parts 50[1] , 53 and 58[2] ; Section 2:12 of the QA Hand Book[3]; the sampler manufacturers operation manual[4,5] Pallokavilles Field SOPs[6] and this QAPP.

11.2.1 Sample Set-up

Sample set-up of the FRM or equivalent sampler in the Palookaville network takes place any day after the previous sample has been recovered. For multiple day samplers, two sample days may be set-up when 1 in 3 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 pre-weighed to the time it is installed in the monitor. At collocated, sites the second monitor will be set up to run at a sample frequency of 1 in 6 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 Palookaville $PM_{2.5}$ sample methods standard operating procedure.

11.2.2 Sample Recovery

Sample recovery of any individual filter from the FRM or equivalent sampler in the Palookaville network must occur within 96 hours of the end of the sample period for that filter. For 1 in 3 day sampling on single day samplers this will normally be the day after a sample is taken. The next sample would also be set-up at this time. For 1 in 3 day sampling on multiple day samplers, this will normally be on the day after the second sample is taken. The next sample set-up for two samples would also 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 Palookaville $PM_{2.5}$ sampling methods standard operating procedure. Table 11-1 illustrates 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*	

Therefore, sites that utilize multiple day samplers with the 1 in 3 day sampling frequency will require one site visit a week, except for one out of every 6 weeks; where two sites visits will be required. For sites that utilize single day samplers with 1 in 3 day sampling frequency, a recovery and set-up visit will be required for every sample taken.

11.3 Support Facilities for Sampling Methods

Support facilities vary widely in their analysis capabilities, from percentage-level accuracy to ppb-level accuracy. The investigator must ascertain that the capabilities of the support facilities are commensurate with the requirements of the sampling plan established in Step 7 of the DQO Process.

The main support facility for sampling is the sample trailer. At each sample location in the Palookaville network there is a climate controlled sample trailer. The trailer has limited storage space for items used in support of $PM_{2.5}$ sampling. Table 11-2 lists the supplies that are stored at each sample location trailer

Table 11-2 Supplies at Storage Trailers

Item	Minimum Quantity	Notes
Powder Free Gloves	box	*Material must be inert and static resistant*
Fuses	2	*Of the type specified in the sampler manual*
Temperature standard	1	*In the range expected for this site 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	
Data Download Cable	1	*For use with laptop computer*

Since 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 with him/her. Table 11-3 details those items each operator is expected to bring with them.

Table 11-3 Site Dependent Equipment and Consumables

Item	Minimum Quantity	Notes
Tools	1 box	*screw drivers, fitted wrenches, etc...*
Digital Multi meter (DMM)	1	*For troubleshooting electrical components, if trained to do so.*
Lap Top Computer	1	*Set-up to receive data from monitor.*
Floppy Disks	1 box	*3.5", with labels*
WINS Impactor Assembly	1	*Without impactor oil*
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.*

11.4 Sampling/Measurement System Corrective Action

This section should address issues of responsibility for the quality of the data, the methods for making changes and corrections, the criteria for deciding on a new sample location, and how these changes will be documented. This section should describe what will be done if there are serious flaws with the implementation of the sampling methodology and how these flaws will be corrected. For example, if part of the complete set of samples is found to be inadmissable, how replacement samples will be obtained and how these new samples will be integrated into the total set of data should be described.

Corrective action measures in the $PM_{2.5}$ Air Quality Monitoring Network will be taken to ensure the data quality objectives are attained. There is the potential for many types of sampling and measurement system corrective actions. Table 11-4 is an attempt to detail the expected problems and corrective actions needed for a well-run $PM_{2.5}$ 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. 2.) Use new field blank filter as sample filter. 3.) Obtain a new filter from lab.	1.) Document on field data sheet. 2.) Document on field data sheet. 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. 2.) Inspect in-line filter before sample pump and determine if excessive loading has occurred. Replace as necessary.	1.) Document on field data sheet. 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 (<u>+</u> 4% of transfer standard)	1.) Completely remove flow rate device, re-connect and re-perform flow rate check. 2.) Perform leak test. 3.) Check flow rate at 3 points (15.0 LPM, 16.7 LPM, and 18.3 LPM) to determine if flow rate problem is with zero bias or slope. 4.) Re-calibrate flow rate	1.) Document on data sheet. 2.) Document on data sheet. 3.) Document on data sheet. Notify Field Manager 4.) Document on data sheet. Notify Field Manager.
Leak Test	Leak outside acceptable tolerance (80 mL/min)	1.) Completely remove flow rate device, re-connect and re-perform leak test. 2.) Inspect all seals and O-rings, replace as necessary and re-perform leak test. 3.) Check sampler with different leak test device.	1.) Document in log book. 2.) Document in log book, notify Field Manager, and flag data since last successful leak test. 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. 2.) Check flow with a flow rate verification filter and determine if actual flow is low. 3.) Inspect in-line filter downstream of 46.2 mm filter location, replace as necessary.	1.) Document in log book. 2.) Document in log book. 3.) Document in log book.

Item	Problem	Action	Notification
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. 2.) Use ice bath or warm water bath to check a different temperature. If acceptable, re-perform ambient temperature verification. 3.) Connect new thermocouple. 4.) Check ambient temperature with another NIST traceable thermometer.	1.) Document on data sheet. 2.) Document on data sheet. 3.) Document on data sheet. Notify Field Manager. 4.) Document on data sheet. Notify Field Manager.
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. 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 3.) Connect new pressure sensor	1.) Document on data sheet. 2.) Document on data sheet. 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 2.) Try programming sample run to start while operator is at site. Use a flow verification filter.	1.) Document on data sheet. Notify Field Manager 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 not 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

This section includes the requirements needed to prevent sample contamination (disposable samplers or samplers capable of appropriate decontamination), the physical volume of the material to be collected (the size of composite samples, core material, or the volume of water needed for analysis), the protection of physical specimens to prevent contamination from outside sources, the temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

This sections details the requirements needed to prevent 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 $PM_{2.5}$ network has rigid requirements for preventing sample contamination. Powder free gloves are worn while handling filter cassettes. Once the filter cassette is taken outside of the weigh room it must never be opened as damage may result to the 46.2 mm Teflon filter. Filter cassettes are to be stored in filter cassette storage containers as provided by the sampler manufacturer during transport to and from the laboratory. Once samples have been weighed, they are to be stored with the particulate side up and individually stored in static resistant zip lock bags.

11.5.2 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50. Sample flow rate of air is 16.67 L/min. The total sample of air collected will be 24 cubic meters based upon a 24 hour sample. Samples are expected to be 24 hours; however, in some cases a shorter sample period may be necessary, not to be less than 23 hours. Since capture of the fine particulate is predicated upon a design flowrate of 16.67 L/min, deviations of greater than 10% from the design flowrate 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 of the $PM_{2.5}$ network are explicitly detailed in 40 CFR Part 50, Appendix L[1]. 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 in the transport container. Excessive heat must be avoided (e.g.,. do not leave in direct sunlight or a closed-up car during summer). The filter temperature requirements are detailed 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^{O} 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^{O} 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^{O} C or less	40 CFR Part 50, Appendix L, Section 8.3.6

11.5.4 Permissible Holding Times

The permissible holding times for the $PM_{2.5}$ sample are clearly detailed in both 40 CFR Part 50, Appendix L, and Section 2.12 of the U.S. 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	$\leq$30 days	Date of Pre-weigh	Date of Sample	40 CFR Part 50, Appendix L, Section 8.3.5
Recovery of Filter	$\leq$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^{o} C.	$\leq$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^{o} C.	$\leq$10 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Section 8.3.6

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 (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.

3. U.S. EPA Quality Assurance Guidance Document 2.12: Monitoring $PM_{2.5}$ in Ambient Air Using Designated Reference or Class I Equivalent Methods. March, 1998

4. XYZ Company Incorporated. *XYZ Sampler Model 1000 Operating Manual*. April 1998.

5. XYZ Company Incorporated. *XYZ Sampler Model 2000 Operating Manual*.

6. April 1998.Palookaville Standard Operating Procedures for $PM_{2.5}$ Sampling Methods. 1998

12.0 Sampling Custody

This element of the QAPP should clearly describe all procedures that are necessary for ensuring that:

1.) samples are collected, transferred, stored, and analyzed by authorized personnel;
2.) sample integrity is maintained during all phases of sample handling and analyses; and
3.) an accurate written record is maintained of sample handling and treatment from the time of its collection through laboratory procedures to disposal.

Proper sample custody minimizes accidents by assigning responsibility for all stages of sample handling and ensures that problems will be detected and documented if they occur. A sample is in custody if it is in actual physical possession or it is in a secured area that is restricted to authorized personnel. The level of custody necessary is dependent upon the project's DQOs. While enforcement actions necessitate stringent custody procedures, custody in other types of situations (i.e., academic research) may be primarily concerned only with the tracking of sample collection, handling, and analysis.

Sample custody procedures are necessary to prove that the sample data correspond to the sample collected, if data are intended to be legally defensible in court as evidence. In a number of situations, a complete, detailed, unbroken chain of custody will allow the documentation and data to substitute for the physical evidence of the samples (which are often hazardous waste) in a civil courtroom.

An outline of the scope of sample custody--starting from the planning of sample collection, field sampling, sample analysis to sample disposal--should also be included. This discussion should further stress the completion of sample custody procedures, which include the transfer of sample custody from field personnel to lab, sample custody within the analytical lab during sample preparation and analysis, and data storage.

Due to the potential use of the $PM_{2.5}$ data for comparison to the NAAQS and the requirement for extreme care in handling the sample collection filters, sample custody procedures will be followed. Figures 12.1 and 12.2 represent chain of custody forms that will be used to track the stages of filter handling throughout the data collection operation. Definitions of each parameter on the forms are explained in Table 12-1. Although entries on this form will be made by hand, the information will be entered into the a sampling tracking system, where an electronic record will be kept (see Section 19). This section will address sample custody procedures at the following stages:

- Pre-sampling
- Post-sampling
- Filter receipt
- Filter archive

Filter Chain of Custody Record

Pre-Sampling Filter Selection

Site Operator Initial	Filter ID	Cont. ID	Receipt Date	Monitor ID	Sampler ID	Installation Date	Comments
BLM	RF990001	MC001	99/01/01	060021125811041	AD001	99/01/01	
BLM	FB990001	MC002	99/01/01	060021125811041	AD001	99/01/01	

Post-Sampling Filter Recovery

Site Operator Final	Filter ID	Cont. ID	Monitor ID	Sampler ID	Removal Date	Removal Time	Ambient Storage	°C.	Filter Integrity Flags	Field Qualifiers
BLM	RF990001	MC001	060021125811041	AD001	99/01/03	0900		X	GFI	
BLM	FB990001	MC002	060021125811041	AD001	99/01/03	0900		X	GFI	

Free Form Notes -____
____

Shipping Info: Delivered by Operatorr: _____ Delivered by 2nd Party: _X_

Date Shipped: 99/01/03 Shipping Vendor: _FEDEX_ # Boxes: _1_ # Filters: _2_

Airbill Number: 4909283326

Filter Receipt Box 1 Max Temp _____ Min Temp _____ Box 2 Max Temp _____ Min Temp _____

Receiver ID	Filter ID	Cont. ID	Date Received	Receipt time	Shipping Integrity Flags	Archived	Sent to Lab
SBM	RF990001	MC001	99/01/04	1030	GSI		X
SBM	FB990001	MC002	99/01/04	1030	GSI		X

Free Form Notes -____
____

Filter Transfer

Relinquished by: _SBM_ **Date/Time:** 99/01/04 / 1130 **Received by:** _FIN_ **Date/Time:** 99/01/04 / 1130

Figure 12.1 Example filter chain of custody record

Filter Archiving Tracking Form

Filter ID	Analysis Date	Archive Date	Box ID/Box #	Archived By:	Comments
RF990001	99/01/05	99/01/06	060021125811041/1	FIN	
FB990001	99/01/05	99/01/06	060021125811041/1	FIN	

Figure 12.2 Filter archive form

Table 12-1 Parameter List

Parameter	**Parameter Code**	**Frequency**	**Units**	**Comment**
Pre-Sampling				
Site Operator Initial	SOI	Every sample	AAA	Initials of the site operator setting up the sampling run
Filter ID	FID	Every sample	AAYYXXXX	Unique filter ID of filter given by the weighing laboratory.
Container ID	CONTID	Every Sample	AAXXX	Unique ID for the protective containers used to transport the filters. These are reusable.
Receipt Date	SORDATE	Every sample	YY/MM/DD	Date filter taken by the site operator from storage to the field
Monitor Id	MONID	Every sample	see AIRS	Unique AIRS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields.

Parameter	Parameter Code	Frequency	Units	Comment
Sampler ID	SAMPID	Every sample	AAXXX	Sampler model number or unique bar code number associated with the model number.
Installation Date	SORDATE	Every sample	YY/MM/DD	Date filter was placed into sampler by the site operator.
Pre-Sampling Comments	PRESCOM	When required	AAA....	Free form comments from site operator during pre-sampling filter selection
Post-Sampling				
Site Operator Final	SOF	Every sample	AAA	Initials of the site operator completing the sampling run
Removal Date	REMDATE	Every sample	YY/MM/DD	Date filter taken by the site operator from the monitor for transport from the field
Removal Time	REMTIME	Every sample	XXXX	Time in military units that filter was removed from monitor for transport from the field
Ambient Temp.	AMSTOR	See Comment	Y/N	Field to determine whether the sample was maintained at ambient temperature from removal through transport. If this field is not entered, the next ($4^{O}C$) must be
$4^{O}C$	COSTOR	See Comment	Y/N	Field to determine whether the sample was maintained at the $4^{O}C$ temperature from removal through transport. If this field is not entered, the previous (Ambient Temp.) must be. Also if shipped next day air this field must be checked.
Filter Integrity flag	FFIF	Every sample	QFI/ VFI/GFI	QFI -Questionable filter integrity VFI- Void Filter Integrity GFI-Good Filter Integrity
Field Qualifiers	FQUAL	Every sample	AAA	Other field qualifier flags
Free Form Notes	PSTFFM	As needed	AAA....	Free form notes about sample recovery activity.
Shipping Information				
Delivered by Operator:	DELOP	See Comment	Y/N	Field to determine whether the samples on the C-O-C sheet was delivered to the receiving facility by the site operator . If this field is not entered, the following field (2nd party) must be.

Parameter	Parameter Code	Frequency	Units	Comment
Delivered by 2nd Party:	SECDEL	See Comment	Y/N	Field to determine whether the samples on the C-O-C sheet were delivered to the receiving facility by a next day carrier. If this field is not entered, the previous (Delivered by Operator) must be.
Date Shipped	DASHP	If shipped by Vendor	YY/MM/DD	Date filters shipped to the receiving facility .
Shipping Vendor	SHPVEN	If shipped by Vendor	AAAA.....	Vendor used for shipment
# Boxes	NUMBOX	If shipped by Vendor	XX	Total number of boxes sent under one airbill number
# Filters	NUMFIL	If shipped by Vendor	XX	Total number of filters in the representative boxes sent under one airbill number
Airbill number	AIRBIL	If shipped by Vendor	XXXX.....	Airbill number for shipment
Filter Receipt				
Box 1 Min. Temp.	B1MIN	Box 1	XX	Temp. in celsius of min. temperature from max/min thermometer
Box 1 Max. Temp.	MIMAX	Box 1	XX	Temp. in celsius of max. temperature from max/min thermometer
Date received	RECDATE	Every sample	YY/MM/DD	Date filter received at the receiving facility .
Time	RECTIME	Every sample	XXXX	Time in military units that filter was received at the receiving facility.
Container ID	CONTID	every filter	AAAXXX	Identification of the filter transport container .
Shipping Integrity flags	RECFLAG	as needed	AAA	Flags associated with the integrity of the filter shipment upon receipt at the receiving facility.
Archived	ARCH	See Comment	Y/N	Field to determine whether the filters were placed into cold storage at the receiving facility prior to transport to weighing lab (weekend delivery). If this field is not entered, the next (Sent to lab) must be
Sent to Lab	SENLAB	See Comment	Y/N	Field to determine whether the sample was delivered to the weighing laboratory the day it was received. If this field is not entered, the previous (Archived) must be.
Free Form Notes	RECFFM	As needed	AAA....	Free form notes about sample receipt activity.

Parameter	Parameter Code	Frequency	Units	Comment
Filter Transfer				
Relinquished by	RELBY	Every C-O-C Sheet	AAA	Initials of the receiving person relinquishing filters.
Date	RELDATE	Every C-O-C Sheet	YY/MM/DD	Date filter was relinquished by the receiving facility .
Time	RELTIME	Every C-O-C Sheet	XXXX	Time in military units that filter was relinquished by the receiving facility.
Received by:	RECDBY	Every C-O-C Sheet	AAA	Initials of the laboratory technician receiving filters
Date	RECDATE	Every C-O-C Sheet	YY/MM/DD	Date filter received by the weighing laboratory.
Time	RECTIME	Every C-O-C Sheet	XXXX	Time in military units that filter was received by the weighing laboratory.

12.1 Sample Custody Procedure

The QAPP should discuss the sample custody procedure at a level commensurate with the intended use of the data. This discussion should include the following:

1. List the names and responsibilities of all sample custodians in the field and laboratories.
2. Give a description and example of the sample numbering system.
3. Define acceptable conditions and plans for maintaining sample integrity in the field prior to and during shipment to the laboratory (e.g., proper temperature and preservatives).
4. Give examples of forms and labels used to maintain sample custody and document sample handling in the field and during shipping.
5. Describe the method of sealing shipping containers with chain-of-custody seals.
6. Describe procedures that will be used to maintain the chain of custody and document sample handling during transfer from the field to the laboratory, within the laboratory, and among contractors.
7. Provide for the archiving of all shipping documents and associated paperwork.
8. Discuss procedures that will ensure sample security at all times.
9. Describe procedures for within-laboratory chain-of-custody together with verification of the printed name, signature, and initials of the personnel responsible for custody of samples, extracts, or digests during analysis at the laboratory. Finally, document disposal or consumption of samples should also be described.

The discussion should be as specific as possible about the details of sample storage, transportation, and delivery to the receiving analytical facility.

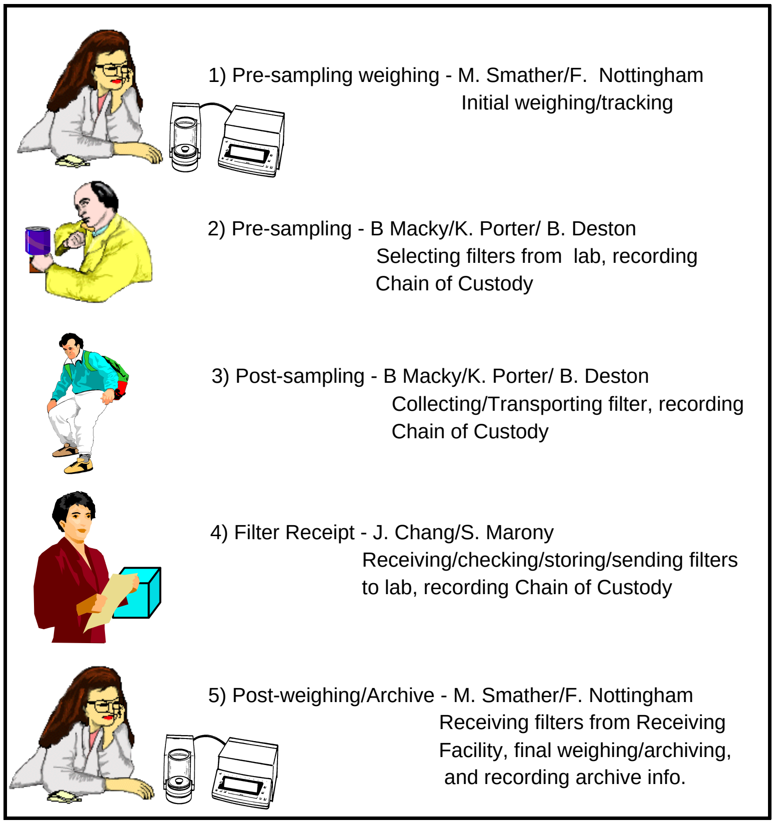

Figure 12.3 Chain of custody phases

Figure 12.3 represents the stages of sample custody for the $PM_{2.5}$ samples and Table 12-2 lists the personnel that will be responsible for sample custody at the various data operation stages. Initials will be used on the chain of custody forms (Figs 12.1, 12.2)

One of the most important values in the sample custody procedure is the unique filter ID number, illustrated in Figure 12.4 The filter ID is an alpha-numeric value. The initial two alpha values identify the type of filter as being either a routine filter (RF), a field blank (FB), a lab blank (LB) or a flow check filter (FC) used for the flow rate check. The next two values (YY) represent the last two digits of the calendar year and the next 4 digits represent a unique number. Each combination of filter type and year will start with the value 0001. Therefore, for 1998 the first routine filter will be numbered RF980001 and the field blank will be FB980001. The filter ID will be generated by the laboratory analyst at the time of preweighing.

Table 12-2 Sample Custodians

Data Operation	Sample Custodians	Branch	Initials
Pre-Sampling	Bill Macky Karin Porter Beverly Deston	Air Monitoring Air Monitoring Air Monitoring	BLM KDP BVD
Post Sampling	Bill Macky Karin Porter Beverly Deston	Air Monitoring Air Monitoring Air Monitoring	BLM KDP BVD
Filter Receipt	Jason Chang Sonny Marony	Shipping/Receiving Shipping/Receiving	JGC SBM
Filter Archive	Mike Smather Fred Nottingham	Laboratory Laboratory	MSS FIN

Filter ID

_A_ _A_ _Y_ _Y_ _X_ _X_ _X_ _X_
Filter Type ---Year--- ----Unique number-----

Figure 12.4 Filter ID

12.1.1 Pre-Sampling Custody

The Department's pre-sampling weighing SOPs define how the filters will be enumerated, conditioned, weighed, placed into the protective shipping container, sealed with tape, and stored on the field filter shelf for selection by the site operators. Filters must be used within 30 days of pre-sampling weighing. A *Filter Inventory Sheet* containing the Filter ID, Filter Type, Container ID, and the Pre-Sampling Weighing Date will be attached to the field filter shelf for use by the site operator. Each sampling period, the site operators will select filters that they will use for the field. The number of filters selected will depend on the time in the field prior to returning to the laboratory and the number of samplers to be serviced. The site operator will perform the following Pre-sampling activities:

1. Contact M. Smather or F. Nottingham for access to laboratory
2. Put on appropriate laboratory attire.
3. Enter the filter storage area.
4. Review the *Filter Inventory Sheet* and select the next set of filters on the sheet. Ensure the seals are intact. Since the site operator can not check the Filter ID he/she will have to use the container ID value.
5. Take a *Filter Chain of Custody Record* for each site visited. Fill out the first 4 columns of the "Pre-Sampling Filter Selection" portion of the *Filter Chain of Custody Record* (Fig 12.1) for each filter.
6. Initial the column "Site Operator" on the *Filter Inventory Sheet* to signify selection of the filters.
7. Pack filters in sample coolers for travel to the field.

Upon arrival at a site:

8. Select the appropriate filters for a sampler.
9. Once the filters are installed at the site, complete the remainder of the columns (5-8) of the "Pre-Sampling Filter Selection" portion of the *Filter Chain of Custody Record* (Fig 12.1)

12.1.2 Post Sampling Custody

The field sampling SOPs specify the techniques for properly collecting and handling the sample filters. Upon visiting the site:

1. Select the appropriate *Filter Chain of Custody Record*. Ensure that the Site ID and the protective Container ID(s) are correct.
2. Remove filter cassette from the sampler. Briefly examine it to determine appropriate filter integrity flag and place it into the protective container per SOPs and seal with tape.
3. Place the protective container(s) into the shipping/transport container with the appropriate temperature control devices.
4. Record "Post Sampling Filter Recovery Information" on the *Filter Chain of Custody Record*.

Shipping Information --

Depending on the number of sites to be serviced, the location of the sites, and the time period from the end of sample collection, the site operator will either deliver the sample to the laboratory or send it next day air to the laboratory. The first line of the "Shipping Info" area on the *Filter Chain of Custody Record* indicates the mode of transportation. If the mode of transportation is next day air, record the appropriate information. The Department has a contract with Federal Express@. The Federal Express location for each site is listed in Table 12-3. Pre- addressed mailing slips will be made available for site operators. Shipping requirements include:

1. Bring the shipping/transport containers to the next day air vendor.
2. Fill out the remainder of the pre-addressed airbills.
3. Fill out the "Shipping Info" on the *Filter Chain of Custody Record(s)*.
4. Photocopy the *Filter Chain of Custody Record*s that pertain to the shipment.
5. Place the photocopied records in a plastic zip lock bag and include it in one of the shipping/transport containers.
6. Seal all shipping/transport containers per SOPs.
7. The site operator will take the original *Filter Chain of Custody Record*s(s) and attach the airbill to the records.
8. The site operator will contact the receiving laboratory of a shipment the day of the shipment.

NOTE: If a site operator needs to send or deliver a shipment on Saturday, the site operator must provide the shipping/receiving office 3-days notice in order ensure shipping/receiving personnel will be available.

Table 12-3 Federal Express Locations

Monitor ID	Site Code	Site Name	Federal Express Location
060021125811041 060021125811049	A1 A1	Darby Road	1615 Faming Blvd Scarborough, CA 12679
060021245811041	A2	Jefferson School	1615 Faming Blvd Scarborough, CA 12679
060030125811041	A3	Bay Bridge Street	1615 Faming Blvd Scarborough, CA 12679
060051625811041	A4	Ridge Road	72 Ridge Road Bakersville, CA 12677
060041125811041 060041125811049	B1 B1	Donner Road	44 Fossberg Road Dunston, CA 121634

12.1.3 Filter Reciept

The samples, whether transported by the site operator or next day air, will be received by either Jason Chang or Sonny Marony at the Shipping/Receiving Office. The Shipping/Receiving Office will:

1. Receive shipping/transport container(s)
2. Upon receipt, open the container(s) to find *Filter Chain of Custody Record*(s) or collect the originals from the site operator (if delivered by operator).
3. Fill out the "Filter Receipt" area of the *Filter Chain of Custody Record*s(s). Check sample container seals.
4. If the samples are delivered on a weekday, follow sequence 5; if the sample (s) are delivered on a weekend, follow sequence 6
5. Check the "Sent to Laboratory" column of the *Filter Chain of Custody Record*s(s) and transport the filters to the $PM_{2.5}$ weighing laboratory. Upon delivery to the $PM_{2.5}$ weighing laboratory, complete the "Filter Transfer" area of the *Filter Chain of Custody Record*s(s)
6. Store the samples in the refrigerator and check the "archived" column of the *Filter Chain of Custody Record*s(s). On the Monday of the following week, deliver the archived filters to the $PM_{2.5}$ weighing laboratory and complete the "Filter Transfer" area of the *Filter Chain of Custody Record*s(s)

12.1.4 Filter Archive

Once the $PM_{2.5}$ weighing laboratory receives the filter, they will use their raw data entry sheets to log the samples back in from receiving and prepare them for post-sampling weighing activities. These activities are included in the analytical SOPs (Section 13). The laboratory technicians will take the filters out of the protective containers and the cassettes and examine them for integrity, which will be marked on the data entry sheets. During all post-sampling activities, filter custody will be the responsibility of Mike Smather and Fred Nottingham. The samples will be stored within the $PM_{2.5}$ weighing laboratory. This laboratory has restricted access to Mr. Smather and Mr. Nottingham.

Upon completion of post-sampling weighing activities, the *Filter Archiving Form* (Figure 12.2) will be used by the laboratory technicians to archive the filter. Each filter will be packaged according to the SOPs and stored in a box uniquely identified by Site ID and box number. Samples will be archived in the filter storage facility for one year past the date of collection. Prior to disposal, EPA Region Y will be notified of the Department's intent to dispose of the filters.

13.0 Analytical Methods Requirements

The choice of analytical methods will be influenced by the performance criteria, Data Quality Objectives, and possible regulatory criteria. Qualification requirements may range from functional group contaminant identification only to complete individual contaminant specification. Quantification needs may range from order-of-magnitude quantities only to parts-per-trillion (ppt) concentrations. If appropriate, a citation of analytical procedures may be sufficient if the analytical method is a complete SOP, such as one of the Contract Lab Program Statements of Work. For other methods, it may suffice to reference a procedure (i.e., from *Test Methods for Evaluating Solid Waste*, SW-846) and further supplement it with the particular options/variations being used by the lab, the detection limits actually achieved, the calibration standards and concentrations used, and so on. In other situations, complete step-wise analytical and/or sample preparation procedures will need to be attached to the QAPP if the procedure is unique or an adaption of a “standard” method.

Specific monitoring methods and requirements to demonstrate compliance traditionally were specified in the applicable regulations and/or permits. However, this approach is being replaced by the Performance-Based Measurement System (PBMS). PBMS is a process in which data quality needs, mandates, or limitations of a program or project are specified and serve as a criterion for selecting appropriate methods. The regulated body selects the most cost-effective methods that meet the criteria specified in the PBMS. Under the PBMS framework, the performance of the method employed is emphasized rather than the specific technique or procedure used in the analysis. Equally stressed in this system is the requirement that the performance of the method be documented and certified by the laboratory that appropriate QA/QC procedures have been conducted to verify the performance. PBMS applies to physical, chemical, and biological techniques of analysis performed in the field as well as in the laboratory. PBMS does not apply to the method-defined parameters.

The QAPP should also address the issue of the quality of analytical data as indicated by the data’s ability to meet the QC acceptance criteria. This section should describe what should be done if the calibration check samples exceed the control limits due to mechanical failure of the instrumentation, a drift in the calibration curve occurs, or if a reagent blank indicates contamination. This section should also indicate the authorities responsible for the quality of the data, the protocols for making changes and implementing corrective actions, and the methods for reporting the data and its limitations.

Laboratory contamination from the processing of hazardous materials such as toxic or radioactive samples for analysis and their ultimate disposal should be a considered during the planning stages for selection of analysis methods. Safe handling requirements for project samples in the laboratory with appropriate decontamination and waste disposal procedures should also be described.

13.1 Purpose/Background

This method provides for gravimetric analyses of filters used in the Palookaville $PM_{2.5}$ network. The net weight gain of a sample calculated by subtracting the initial weight from the final weigh. Once calculated, the net weight gain can be used with the total flow passed through a filter to calculate the concentration for comparison to the daily and annual NAAQS. Since the method is non-destructive, and due to possible interest in sample composition, the filters will be archived after final gravimetric analyses has occurred.

13.2 Preparation of Samples

Preparation procedures should be described and standard methods cited and used where possible. Step-by-step operating procedures for the preparation of the project samples should be listed in an appendix. The sampling containers, methods of preservation, holding times, holding conditions, number and types of all QA/QC samples to be collected, percent recovery, and names of the laboratories that will perform the analyses need to be specifically referenced.

The Palookaville network will consist of 5 sites, 1 with a collocated sequential sampler and 1 with a collocated single channel sampler. The 4 primary sequential and one single channel samplers are on a 1 in 3 day schedule. The collocated sequential and single channel samplers are on a 1 in 6 day schedule. Therefore, the approximate number of routine filters that have to be prepared, used, transported, conditioned and weighed is 12 per week. In addition, field blanks, lab blanks, and flow check filters must also be prepared. See Appendix C for activities associated with preparing pre-sample batches.

Upon delivery of approved 46.2 mm Teflon filters for use in the Palookaville network, the receipt is documented and the filters stored in the conditioning/weighing room/laboratory. Storing filters in the laboratory makes it easier to maximize the amount of time available for conditioning. Upon receipt, cases of filters will be labeled with the date of receipt, opened one at a time and used completely before opening another case. All filters in a 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. This means that the first case of filters received is the first case that will 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 visually inspected according to the FRM criteria to determine compliance. See App.C, A-FIC for inspection procedure for new shipments of filters. Filters will then be stored in the filter conditioning compartment in unmarked petri dishes. The minimum conditioning period is 24 hours. Filters will not be left out for excessive periods of conditioning since some settling of dust is possible on the filters’ top sides.

13.3 Analysis Method

The citation of an analytical method may not always be sufficient to fully characterize a method because the analysis of a sample may require deviation from a standard method and selection from the range of options in the method. The SOP for each analytical method should be cited or attached to the QAPP, and all deviations or alternative selections should be detailed in the QAPP.

Often the selected analytical methods may be presented conveniently in one or several tables describing the matrix, the analytes to be measured, the analysis methods, the type, the precision/accuracy data, the performance acceptance criteria, the calibration criteria, and etc. Appendix C contains a checklist of many important components to consider when selecting analytical methods.

13.3.1 Analytical Equipment and Method

The analytical instrument used for gravimetric analysis in the FRM or equivalent $PM_{2.5}$ sampler method (gravimetric analysis) is the microbalance. The *Palookaville* microbalance is a *Libra Model 101*, which has a readability* of 1 μg and a repeatability* of 1μg (* equipment performance terms used by balance vendors to characterize their equipment for purchase comparison purposes; see also Appendix C, A-MRS.)

The Libra Model 101 microbalance was initially set-up and run by the Libra Company. It is calibrated yearly by a Libra Balance Technician under the service agreement between the Palookaville Department of Health and the Libra Balance Company.

The gravimetric analysis method (Appendix C) consists of 3 main subparts (App.C, A-1, 2, and 3) following five preliminary sections. The information in the preliminary sections may be needed to establish and verify the continued acceptability of the set of primary and secondary mass reference standards (App.C, A-MRS) and a new lot of filters (App.C, A-FIC; App.C, A-FH) and to establish stable conditions in the weighing room (Filter Conditioning; Electrostatic Charge Neutralization). The three main subparts are entitled Pre-sampling Filter Weighing (Tare Weight); Post-sampling Documentation and Inspection; and Post-sampling Filter Weighing (Gross Weight). A detailed listing of the gravimetric analysis method can be found in the Palookaville microbalance standard operating procedure (App.C).

13.3.2 Conditioning and Weighing Room

The primary support facility for the $PM_{2.5}$ network is the filter conditioning and weighing room/laboratory. Additional facility space is dedicated for long term archiving of the filter. This weigh room laboratory is used to both pre-sampling weighing and post-sampling weighing of each $PM_{2.5}$ filter sample. Specific requirements for environmental control of the conditioning/weighing room laboratory are detailed in 40 CFR Part 50 Appendix L[1]

13.3.3 Environmental Control

The Palookaville weigh room facility is an environmentally controlled room with temperature and humidity control. Temperature is controlled at a minimum from 20 - 23^{O} C. Humidity is controlled from 30 - 40% relative humidity. Temperature and relative humidity are measured and recorded continuously during equilibration. The balance is located on a vibration free table and is protected from or located out of the path of any sources of drafts. Filters are conditioned before both the pre- and post-sampling weighings. Filters must be conditioned for at least 24 hours to allow their weights to stabilize before being weighed.

13.4 Internal QC and Corrective Action for Measurement System

A QC notebook or database (with disk backups)will be mantained which will contain QC data, including the microbalance calibration and maintenance information, routine internal QC checks of mass reference standards and laboratory and field filter blanks, and external QA audits. These data will duplicate data recorded on laboratory data forms but will consolidate them so that long-term trends can be identified. It is recommended that QC charts be maintained on each microbalance and included in this notebook. These charts may allow the discovery of excess drift that could signal an instrument malfunction.

At the beginning of each weighing day, after the analyst has completed zeroing and calibrating the microbalance and measuring the working standard, weigh the three laboratory filter blanks established for the current filter lot and three field filter blanks from the most recently completed field blank study. After approximately every tenth filter weighing, the analyst will reweigh the one working standard and rezero the microbalance. Record the zero, working standard, and blank measurements in the laboratory data form and the laboratory QC notebook or database. If the working standard measurements differ from the certified values or the pre-sampling values by more than 3 µg, repeat the working standard measurements. If the blank measurements differ from the pre-sampling values by more than 15 µg, repeat the blank measurements. If the two measurements still disagree, contact the Laboratory Manager, who may direct the analyst to (1) reweigh some or all of the previously weighed filters, (2) recertify the working standard against the laboratory primary standard, (3)conduct minor, non-invasive diagnostic and troubleshooting, and/or (4) arrange to have the original vendor or an independent, authorized service technician troubleshoot or repair the microbalance.

Corrective action measures in the $PM_{2.5}$ FRM system will be taken to ensure good quality data. There is the potential for many types of sampling and measurement system corrective actions. Tables 13-1 (organized by laboratory support equipment) and 13-2 (organized by laboratory support activity) list potential problems and corrective actions needed to support for a well run $PM_{2.5}$ network. Filter weighing will be delayed until corrective actions are satisfactorily implemented.

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 Manager
Weigh Room	Temperature	Out of Specification	Check HVAC system	Lab Manager
Balance	Internal Calibration	Unstable	Redue and check working standards	Lab Manager
Balance	zero	Unstable	Redue and check for drafts, sealed draft guard	Lab Manager
Balance	Working Standards	Out of Specification	Check balance with Primary standards	Lab Manager
Balance	Filter Weighing	Unstable	Check Lab Blank Filters	Document in Log Book

TABLE 13-2. FILTER PREPARATION AND ANALYSIS CHECKS

Activity	Method and frequency	Requirements	Action if the requirements are not met
Microbalance Use		Resolution of 1 µg, repeatability of 1 µg	Obtain proper microbalance
Control of bal. 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

Activity	Method and frequency	Requirements	Action if the requirements are not met
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
Internal QC	After approximately every tenth filter, rezero 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 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 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.	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, Preservation, and Holding Time Requirements

This section details the requirements needed to prevent and protect the filter sample from contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

13.5.1 Sample Contamination Prevention

The analytical support component of the $PM_{2.5}$ network has rigid requirements for preventing sample contamination. Filters are equilibrated/conditioned and stored in the same room where they are weighed. Powder free gloves are worn while handling filters and filters are only contacted with the use of smooth nonserrated forceps. Upon determination of its pre-sampling weight, the filter is placed in its cassette and then placed in a protective petri dish. The petri dish is labeled with a uniquely identifying number that is a sequential number that includes all filters originating from the *Palookaville* weigh room laboratory. Once the filter cassette is taken outside of the weigh room it will never be opened as damage may result to the 46.2 mm teflon filter.

13.5.2 Sample Volume

The volume of air to be sampled is specified in 40 CFR Part 50. Sample flow rate of air is 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 $PM_{2.5}$ 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^{O} C, with no more than a +/- 2^{O} C change over the 24 period prior to weighing 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 excessive heat 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 state 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 shall not exceed that of the ambient temperature by more than 5^{O} 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 sample media before collection and both the sample media and sample after a sample has been collected. Additionally, during the sample collection there are requirements for temperature control. The temperature requirements are detailed in Table 13-3.

Table 13-3 Temperature Requirements

Item	Temperature Requirement	Reference
Weigh Room	20 - 23^{O} C	40 CFR Part 50, Appendix L, Section 8.3.1
Pre-weighed Filter	+/- 2^{O} 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^{O} 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^{O} 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 $PM_{2.5}$ sample are clearly detailed in both 40 CFR Part 50[1] and Section 2.12 of the U.S. EPA QA Handbook[2]. A summary of these holding times are provided in Table11-6 in subsection 11.5.4.

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 $PM_{2.5}$ in Ambient Air Using Designated Reference or Class I Equivalent Methods. March, 1998

14.0 Quality Control Requirements

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 customer." QC is both corrective and proactive in establishing techniques to prevent the generation of unacceptable data, and so the policy for corrective action should be outlined. This element will rely on information developed in section 7, "Quality Objectives and Criteria for Measurement Data," which establishes measurement performance criteria.

To assure the quality of data from air monitoring measurements, two distinct and important interrelated functions must be performed. One function is the control of 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 the control of the measurement process through the implementation of specific quality control procedures, such as audits, calibrations, checks, replicates, routine self-assessments, etc. In general, the greater the control of a given monitoring system, the better will be the resulting quality of the monitoring data.

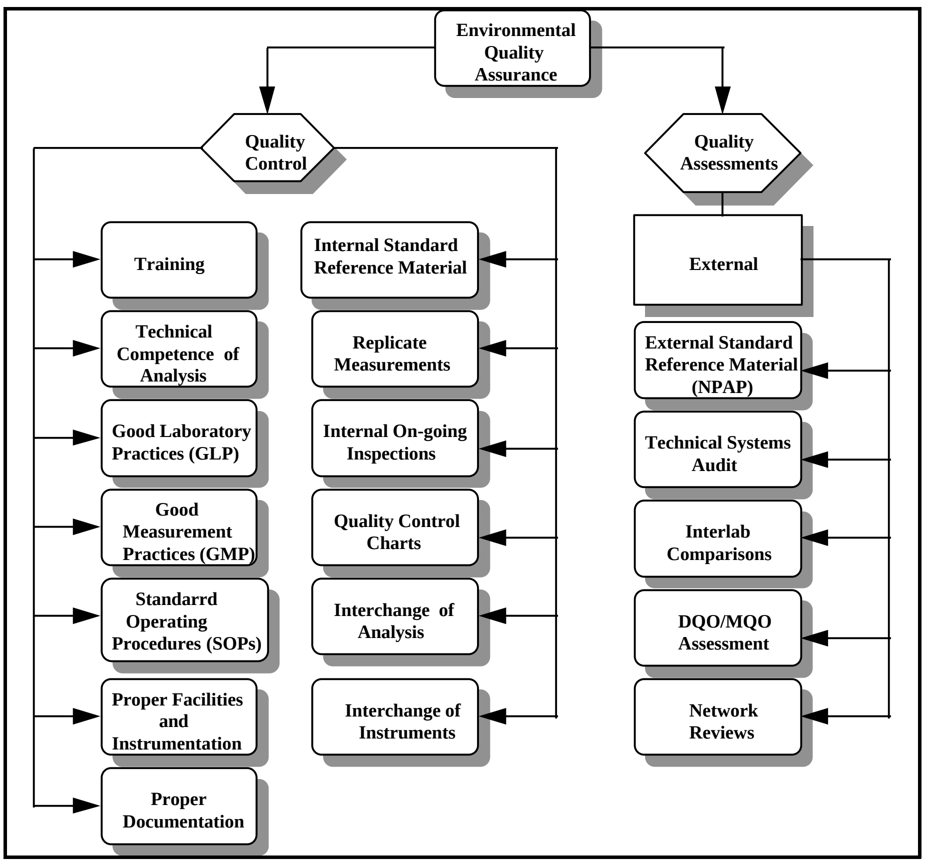

Figure 14.1 Quality control and quality assessment activities

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 customer. In the case of the Ambient Air Quality Monitoring Network, QC activities are used to ensure that measurement uncertainty, as discussed in Section 7, is maintained within acceptance criteria for the attainment of the DQO. Figure 14.1 represents a number of QC activities that help to evaluate and control data quality for the $PM_{2.5}$ program. Many of the activities in this figure are implemented by the Department and are discussed in the appropriate sections of this QAPP.

14.1 QC Procedures

This element will need to furnish information on any QC checks not defined in other QAPP elements and should reference other elements that contain this information where possible.

Many of these QC checks result in measurement data that are used to compute statistical indicators of data quality. For example, a series of dilute solutions may be measured repeatedly to produce an estimate of the instrument detection limit. The formulas for calculating such Data Quality Indicators (DQIs) should be provided or referenced in the text. This element should also prescribe any limits that define acceptable data quality for these indicators (see also Appendix D, "Data Quality Indicators"). A QC checklist should be used to discuss the relation of QC to the overall project objectives with respect to:

- the frequency of the check and the point in the measurement process in which the check sample is introduced,
- the traceability of the standards,
- the matrix of the check sample,
- the level or concentration of the analyte of interest,
- the actions to be taken in the event that a QC check identifies a failed or changed measurement system,
- the formulas for estimating DQIs, and
- the procedures for documenting QC results, including control charts.

Finally, this element should describe how the QC check data will be used to determine that measurement performance is acceptable. This step can be accomplished by establishing QC "warning" and "control" limits for the statistical data generated by the QC checks (see standard QC textbooks or refer to EPA QA/G-5T for operational details).

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 $PM_{2.5}$ Program. The procedures for implementing the QC samples are included in the field and analytical methods section (Sections 11 and 13 respectively). As Figure 14.2 illustrates, 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 contains a summary of all the field and laboratory QC samples. The following information provides some 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.	1/yr	±2% of NIST-traceable Std.	Part 50, App.L Sec 9.1, 9.2	Sec. 6.3	Certification of Traceability
Field Thermometer	1/yr	± 0.1° C resolution	not described	Sec 4.2 and 8.3	Certification of Traceability
		± 0.5° C accuracy	not described	“	
Field Barometer	1/yr	± 1 mm Hg resolution	not described	“	Certification of Traceability
		± 5 mm Hg accuracy	not described	“	
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 verfification	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2.5	Sec 8.3	Calibration drift and memory effects
One point FR verification	1/4 weeks	± 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 1/yr	± 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	1/4 weeks	± 4°C of standard	"	Sec. 6.4 and 8.2	Calibration drift and memory effects
Pressure Calibration	on installation, then 1/yr	±10 mm Hg	“	Sec. 6.5	Calibration drift and memory effects
Pressure Verification	1/4 weeks	±10 mm Hg	"	Sec. 8.2	Calibration drift and memory effects
Clock/timer Verification	1/ 4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	not described	Verification of to assure proper function
Blanks					
Field Blanks	See 2.12 reference	±30 μg	Part 50, App.L Sec 8.2	Sec. 7.10	Measurement system contamination
Precision Checks					
Collocated samples	every 6 days	CV ≤ 10%	Part 58, App.A, Sec 3.5, 5.5	Sec. 10.3	Measurement system precision
Accuracy					
Flow rate audit	1/3mo (manual)	± 4% of transfer standard	Part 58, App A, Sec 3.5.1	Sec. 8.1	Instrument bias/accuracy
External Leak Check	4/yr	< 80 mL/min	not described	"	Sampler function
Internal Leak Check	4/yr	< 80 mL/min	not described	"	Sampler function
Temperature Check	4/yr	± 2°C	not described	"	Calibration drift and memory effects
Pressure Check	4/yr (?)	±10 mm Hg		"	Calibration drift and memory effects
Audits (*external assessments*)					
FRM Performance evaluation	25% of sites 4/yr	± 10%	Part 58, App A, Sec 3.5.3	Sec 10.3	Measurement system bias
Flow rate audit	1/yr	± 4% of audit standard	not described	Sec 10.2	External verification bias/accuracy
External Leak Check	1/yr	< 80 mL/min	not described		Sampler function
Internal Leak Check	1/yr	< 80 mL/min	not described		Sampler function
Temperature Audit	1/yr	± 2°C	not described		Calibration drift and memory effects
Pressure Audit	1/yr	±10 mm Hg	not described		Calibration drift and memory effects

Table 14-2 Laboratory QC

Requirement	Frequency	Acceptance Criteria	QA Guidance Document 2.12 Reference	Information Provided
Blanks				
Lot Blanks	3-lot	$\pm$15 μg difference	2.12 Sec. 7	Filter stabilization/equilibrium
Lab Blanks	3 per batch	$\pm$15 μg difference	Part 50, App.L Sec 8.2 2.12 Sec. 7.10	Laboratory contamination
Calibration/Verification				
Balance Calibration	1/yr	Manufacturers spec.	2.12 sec 7.2	Verification of equipment operation
Lab Temp. Calibration	3 mo	$\pm$ 2°C	QAPP Sec. 13/16	Verification of equipment operation
Lab Humidity Calibration	3 mo	±2%	QAPP Sec. 13/16	Verification of equipment operation
Accuracy				
Balance Audit	1/year	$\pm$15 μg for unexposed filters	2.12 Sec 10.2	Laboratory technician operation
Balance Check	beginning, every 10th samples, end	$\leq$3 μg	2.12 Sec. 7.8	Balance accuracy/stability
Calibration standards				
Working Mass Stds.	3-6 mo.	25 μg	2.12 Sec 4.3 and 7.3	Standards verification
Primary Mass Stds.	1/yr	25 μg	"	Primary standards verification
Precision				
Duplicate filter weighings	1 per weighing session	$\pm$15 μg difference	2.12 Tab 7-1 QAPP Sec. 13/16	Weighing repeatability/filter stability

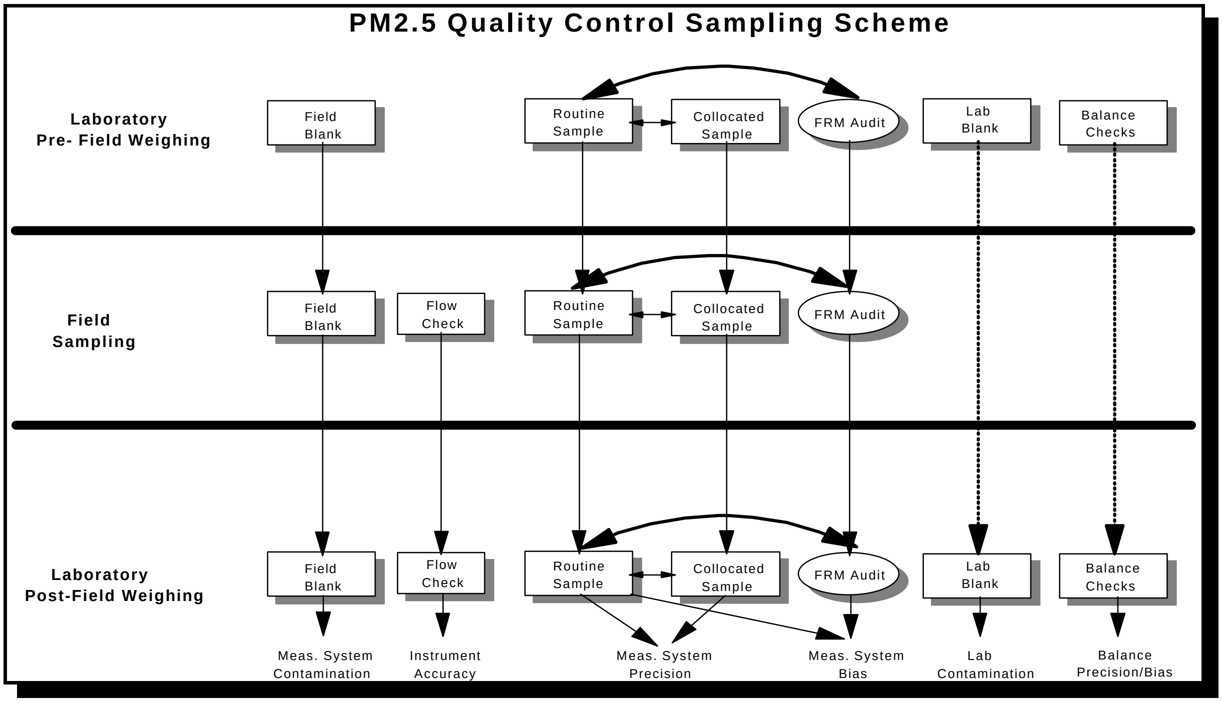

Figure 14.2 PM2.5 Quality control scheme

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 $PM_{2.5}$, calibration activities follow a two step process:

1. Certifying the calibration standard and/or transfer standard against an authoritative standard, and
2. 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 four sources: the environment from which the sample was collected/analyzed, the reagents used in the analysis, the apparatus used, and the operator/analyst performing the data operation. Three types of blanks will be implemented in the $PM_{2.5}$ Program:

Lot blanks - a shipment of 46.2mm filters will be periodically sent from EPA to Palookaville. Each shipment must be tested to determine the length of time it takes the filters to stabilize. Upon arrival of each shipment, 3 lot blanks will be randomly selected for the shipment and be subjected to the conditioning/pre-sampling weighing procedures. The blanks will be measured every 24 hours for a minimum of one week to determine the length of time it take to maintain a stable weight reading.

Field blanks - provides an estimate of total measurement system contamination. By comparing information from laboratory blanks against the field blanks, one can assess contamination from field activities. Details of the use of the field blanks can be found in field SOPs (Appendix E)

Lab blanks -provides an estimate of contamination occurring at the weighing facility. Details of the use of the lab blanks can be found in can be found in field SOPs (Appendix E)

Blank Evaluation --

The Department will include 3 field and 3 lab blanks into 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)* - 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

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

Percent Difference for a Single Check (d_i). 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.

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

Mean difference for batch (d_z) - 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.

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

Corrective action- The acceptance criteria for filed blanks is 30 μg difference, while lot and lab blanks is 15 μg difference and is determined by equation 1. However 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 15μg, all the samples in the weighing session will be re-weighed. Prior to re-weighing, the laboratory balance will 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 with the appropriate flag (FFK or FLB), and efforts will be made to determine the source of contamination. In theory, field blanks should contain more contamination than laboratory 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 20μg and 2 or more of the blanks were greater than 15μg, the laboratory weighing will stop until the issue is satisfactorily resolved. The laboratory technician will alert the Laboratory Branch Manager and QA Officer of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports (PROG/082 OVER/658, see Section 9)

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 Department must ensure the entire measurement process is within statistical control. Two types of precision measurements will be made in the $PM_{2.5}$ Program.

- Collocated monitoring
- Filter duplicates

Collocated Monitoring - -

In order to evaluate total measurement precision, collocated monitoring will be implemented, as referenced in CFR. Therefore, every method designation ***will***:

a. have 25% of the monitors collocated (values of .5 and greater round up).
b. have at least 1 collocated monitor (if total number less than 4). The first collocated monitor must be the FRM.
c. have 50% of the collocated monitors be FRM monitors and 50% must be the same method designation. If there is an odd number of collocated monitors required, bias in favor of the FRM.

Palookaville will be implementing 5 FRM monitors, 4 being sequential types of the same method designation, and 1 being a single channel monitor. Therefore, the Department is required to have 2 collocated monitors. The location of these monitors is described in Section 10, but it is anticipated that these sites will collect concentrations around the NAAQS, or will be sites where higher concentrations are expected.

Evaluation of Collocated Data- Collocated measurement pairs are selected for use in the precision calculations only when both measurements are above 6 µg/m^3. However, all collocated data will be reported to AIRS.

The following algorithms will be used to evaluate collocated data. These algorithms are included in *40 CFR Part 58 Appendix A*. The equation numbers in 40 CFR will also be utilized in this QAPP.

Percent Difference for a Single Check (d_i). The percentage difference, d_i, for each check is calculated by using Equation 19, where X_i represents the concentration produced from the primary sampler and Y_i represents the concentration reported for the duplicate sampler.

$$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} \times 100 \qquad \text{Equation 19}$$

Coefficient of Variation (CV) for a Single Check (CV_i). The coefficient of variation, CV_i, for each check is calculated by dividing the absolute value of the percentage difference, d_i, by the square root of two as shown in Equation 20.

$$CV_i = \frac{|d_i|}{\sqrt{2}} \qquad \text{Equation 20}$$

Precision of a Single Sampler - Quarterly Basis ($CV_{j,q}$). For particulate sampler j, the individual coefficients of variation ($CV_{j,q}$) during the quarter are pooled using Equation 21, where $n_{j,q}$ is the number of pairs of measurements from collocated samplers during the quarter.

$$CV_{j,q} = \sqrt{\frac{\sum_{i=1}^{n_j} CV_i^2}{n_{j,q}}} \qquad \text{Equation 21}$$

The 90 percent confidence limits for the single sampler's CV are calculated using Equations 22 and 23, where $\chi^2_{0.05,df}$ and $\chi^2_{0.95,df}$ are the 0.05 and 0.95 quantiles of the chi-square (χ^2)

distribution with $n_{j,q}$ degrees of freedom.

$$Lower\ Confidence\ Limit = CV_{j,q}\sqrt{\frac{n_{j,q}}{\chi^2_{0.95,\ n_{j,q}}}} \qquad \text{Equation 22}$$

$$Upper\ Confidence\ Limit = CV_{j,q}\sqrt{\frac{n_{j,q}}{\chi^2_{0.05,\ n_{j,q}}}} \qquad \text{Equation 23}$$

Precision of a Single Sampler - Annual Basis. For particulate sampler j, the individual coefficients of variation, CV_i, produced during the calendar year are pooled using Equation 21, where n_j is the number of checks made during the calendar year. The 90 percent confidence limits for the single sampler's CV are calculated using Equations 22 and 23, where $\chi^2_{0.05,df}$ and $\chi^2_{0.95,df}$ are the 0.05 and 0.95 quantiles of the chi-square (χ^2) distribution with n_j degrees of freedom.

Corrective Action: Single Monitor - The precision data quality objective of 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. Therefore, 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 FCS 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%CV for both the initial and reweigh, all the primary sampler data will be flagged FCS from the last precision check and corrective action will be initiated. Paired CVs and percent differences will be control charted to determine trends (section 14.2). The laboratory technician will alert the Laboratory Branch Manager and QA Officer of the problem. The problem and solution will be reported and appropriately filed under response and corrective action reports (PROG/082 OVER/658, see Section 9).

Corrective Action: Quarter - Usually, corrective action will be initiated and imprecision rectified before a quarters worth of data fail to meet 10% CV. However in the case were the quarters CV is greater than 20% the routine data for that monitor for that quarter will be flagged (FPC). The QA Office, the Lab and the Air Monitoring Branch Managers will work together to identify the problem and a solution. The EPA Regional Office will be alerted of the issue and may be asked to help find a common solution. The problem and solution will be reported and appropriately filed under response and corrective action reports (PROG/082 OVER/658, see Section 9)

Duplicate Laboratory Measurements --

During laboratory preweighing and post 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 information. The difference among the weights of these two filters must be less than 15μg. If this criteria is not it met, the pair of values will be flagged FLD. Failure may be due to transcription errors, microbalance malfunction, or that the routine samples have not reached equilibrium. Other QC checks (balance standards and lab blanks) will eliminate microbalance malfunction. If the duplicate does not meet the criteria, a second 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, all samples in the batch will be equilibrated 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 degree of agreement between an observed value and an accepted reference value and includes a combination of random error (precision) and systematic error (bias). Two accuracy checks are implemented in the $PM_{2.5}$ program:

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

Collocated Monitors --

Although the collocated monitors are primarily used for evaluating and controlling precision, they can be used to determine accuracy or bias. By using equation 19 to determine percent difference, one can track trends or bias between the two instruments without knowing which instrument is producing the "true" value. Use of the FRM performance evaluation information (discussed below) in conjunction with collocation data should help improve the quality of data.

Corrective Action - The percent difference of the paired values will be control charted to determine trends. If it appears that there is a statistically significant bias (> 10% at the 90% confidence level) between the pairs, corrective action will be initiated. The process will include eliminating uncertainties that may be occurring at filter handling, transport and laboratory stages, in order to determine that the bias is truly at the instrument. Corrective actions at the instrument will include multi-point temperature, pressure, and flow rate checks as well as complete maintenance activities. Additional corrective action could include a request for vendor servicing or a request for Region Y to implement an FRM performance evaluation.

Flow Rate Audits--

Since the Department will be implementing manual, in lieu of continuous sampling devices, we will implement a flow rate audit every quarter. Details of the implementation aspects 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 for auditing will not be the same flow rate standard used to calibrate the analyzer. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. Report the audit (actual) flow rate and the corresponding flow rate indicated or assumed by the sampler. The procedures used to calculate measurement uncertainty are described below.

Accuracy of a Single Sampler - Single Check (Quarterly) Basis (d_i). The percentage difference (d_i) for a single flow rate audit i is calculated using Equation 13, where X_i represents the audit standard flow rate (known) and Y_i represents the indicated flow rate.

$$d_i = \frac{Y_i - X_i}{X_i} \times 100 \qquad \text{Equation 13}$$

Bias of a Single Sampler - Annual Basis (D_j). For an individual particulate sampler j, the average (D_j) of the individual percentage differences (d_i) during the calendar year is calculated using Equation 14, where n_j is the number of individual percentage differences produced for sampler j during the calendar year.

$$D_j = \frac{1}{n_j} \times \sum_{i=1}^{n_j} d_i \qquad \text{Equation 14}$$

Bias for Each EPA Federal Reference and Equivalent Method Designation Employed by the Department - Quarterly Basis ($D_{k,q}$). For method designation k used by the reporting organization, quarter q's single sampler percentage differences (d_i) are averaged using Equation 16, where $n_{k,q}$ is the number of individual percentage differences produced for method designation k in quarter q.

$$D_{k,q} = \frac{1}{n_{k,q}} \times \sum_{i=1}^{n_{k,q}} d_i \qquad \text{Equation 16}$$

Corrective Action - The single sampler accuracy requirement is $\pm$ 4% . If the audit violates the acceptance criteria, the sampling instrument will be checked for internal and external leaks, ensure that temperature and pressure are within acceptable ranges, and the audit run a second time. If the audit is still unacceptable, a multi-point calibration followed by a one-point verification is required. Routine data, back to an acceptable audit, will be flagged and reviewed to determine validity (see Section 23). In addition, one would expect that the flow rate calibration verification checks that will be implemented every 5 sampling events (see section 16) would indicate a drift towards unacceptable accuracy. If a review of the flow rate calibration verification check data does not show a problem, there is a potential that one or both of the flow rate standards need to be recertified.

Balance Checks -

Balance checks are frequent checks of the balance working standards (100 and 200 mg standards) against the balance to ensure that the balance is within acceptance criteria throughout the pre- and post-sampling weighing sessions. Palookaville will use ASTM class 1 weights for its primary and secondary (working) standards. Both working standards will be used measured at the beginning and end of the sample batch and 1 will be selected for a measure after every 10 filters. Balance check samples will be controlled charted (see Table 14-5).

Balance Check Evaluation- The following algorithm will be used to evaluate the balance checks

Difference for a single check *(d_y)* - The difference, d_y, for each check is calculated using Equation 3, where X represents the certified mass weight and Y represents the reported weight .

$$d_y = Y - X \qquad \text{Equation 3}$$

Corrective Action - The difference among the reported weight and the certified weight must be $\leq$ 3μg. Since this is the first check before any 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 a number of times. If the acceptance criteria is still 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 primary standards, and other trouble shooting techniques fail, the *Libra Balance Company* service technician (see Section 15) 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, trouble shooting, as discussed above, will be initiated. The samples values of the 10 samples weighed prior to the failure will be recorded and flagged, but will be remain with the unweighed samples in the batch to be reweighed when the balance meets the acceptance criteria. The data acquisition system will flag any balance check outside the acceptance criteria as FIS.

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 pertinent regulations for this performance evaluation are found in 40 CFR Part 58, Appendix A, section 3.5.3[2]. The strategy is to collocate a portable FRM $PM_{2.5}$ air sampling instrument with an established routine air monitoring site, operate both monitors in exactly the same manner, and then compare the results of this instrument against the routine sampler at the site. The EPA will be implementing this program and will inform the Department 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 Region 10 for measurement. The comparison of data will be accomplished by EPA personnel using the Aerometric Information Retrieval System (AIRS) data base. It must be noted that the performance evaluation is a estimate of the uncertainty of the measurement system and not the instrument. Therefore, biases may be attributed to sample handling, transportation and laboratory activities as well as to the instrument. The statistics used in the assessment are included in CFR part 58[2]

Corrective Action - The U.S. EPA will notify the Department of the evaluation results within 10 days of sampling. The bias acceptance criteria for the data comparison is $\pm$ 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 majority of the measurement errors are occurring. This may require that Region Y conduct additional FRM performance evaluations to trouble shoot the process.

14.2 Sample Batching - QC Sample Distribution

In order to ensure that the Department can review all types of QC samples within a weighing session, the Department will use the concept of sample batches. A batch of sample will consist of all routine and QC samples collected in a two week sample period. And will consist of the following samples indicated in Table 14-3

Table 14-3 Sample Batch

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 interspersed within the batch in order to provide data quality information throughout the batch weighing session. Table 14-4 represents the sample batch arrangement the laboratory will use during post-sampling weighing activities.

Table 14-4 Batch Sample Distribution

1) Balance Check1	9) Site A3 wk 1 sam 1	17)Coll Sam. Site B1 wk 1	25) Lab Blank	33) Balance Check
2) Balance Check 2	10) Site A3 wk 1 sam 2	18)Site A1 wk 2 sam. 1	26) Field Blank	34) L Dup Site A1 wk 1 s1
3) Lab Blank	11) Site A4 wk 1 sam 1	19)Site A1 wk 2 sam. 2	27) Site A4 wk 2 sam 1	35) Lab Blank
4) Field Blank	12) Site A4 wk 1 sam 2	20) SiteA2 wk 2 sam 1	28) Site A4 wk 2 sam 2	36) Field Blank
5) Site A1 wk 1 sam. 1	13) Balance Check	21) Site A2 wk 2 sam.2	29) Site B1 wk 2 sam 1	37) Balance check 1
6) Site A1 wk 1 sam. 2	14) Site B1 wk 1 sam 1	22) Site A3 wk 2 sam 1	30) Site B1 wk 2 sam 2	38) Balance check 2
7) SiteA2 wk 1 sam 1	15) Site B1 wk 1 sam 2	23) Site A3 wk 2 sam 2	31) Coll Sam Site A1 wk 2	
8) Site A2 wk 1 sam.2	16)Coll Sam Site A1 wk 1	24) Balance Check	32) Coll Sam. Site B1 wk 2	

14.3 Control Charts

Control charts will be used extensively by the Department. They provide a graphical means of determining whether various phases of the measurement process are in statistical control. The Department will utilize property charts which graph single measurements of a standard or a mean of several measurements. The department will also develop precision charts which utilize the standard deviation of the measurement process. Table 14-5 indicates which QC samples will be control charted. The control charts will be utilized as an “early warning system” to evaluate trends in precision and bias. They will be discussed in the *QA Annual QA Report* (Section 21). They will be appropriately filed (SAMP/223) and archived.

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 of 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

The purpose of this element of the QAPP is to discuss the procedures used to verify that all instruments and equipment are maintained in sound operating condition and are capable of operating at acceptable performance levels. This section describes how inspections and acceptance testing of environmental sampling and measurement systems and their components will be performed and documented.

15.1 Purpose/Background

The purpose of this element in the Palookaville QAPP is to discuss the procedures used to verify that all instruments and equipment are maintained in sound operating condition and are capable of operating at acceptable performance levels. All instrument inspection and maintenance activities are documented and filed under AIRP/486. See Section 9 for document and record details.

15.2 Testing

The procedures described should (1) reflect consideration of the possible effect of equipment failure on overall data quality, including timely delivery of project results; (2) address any relevant site-specific effects (e.g., environmental conditions); and (3) include procedures for assessing the equipment status. This element should address the scheduling of routine calibration and maintenance activities, the steps that will be taken to minimize instrument downtime, and the prescribed corrective action procedures for addressing unacceptable inspection or assessment results. This element should also include periodic maintenance procedures and describe the availability of spare parts and how an inventory of these parts is monitored and maintained. The reader should be supplied with sufficient information to review the adequacy of the instrument/equipment management program. Appending SOPs containing this information to the QAPP and referencing the SOPs in the text are acceptable.

Inspection and testing procedures may employ reference materials, such as the National Institute of Standards and Technology's (NIST's) Standard Reference Materials (SRMs), as well as QC standards or an equipment certification program. The accuracy of calibration standards is important because all data will be measured in reference to the standard used. The types of standards or special programs should be noted in this element, including the inspection and acceptance testing criteria for all components. The acceptance limits for verifying the accuracy of all working standards against primary grade standards should also be provided.

All $PM_{2.5}$ samplers used in the Palookaville $PM_{2.5}$ Ambient Air Quality Monitoring Network will be designated federal reference methods (FRM) that have been certified as such by EPA. Therefore, they are assumed to be of sufficient quality for the data collection operation. Testing of such equipment is accomplished by EPA through the procedures described in 40 CFR Part 50[1]. Prior to field installation, Palookaville will assemble and run the samplers at the laboratory. The field operators will perform external and internal leak checks and temperature, pressure and flow rate multi-point verification checks. If any of these checks are out of specification (see Table 14-

1), the Department will contact the vendor for initial corrective action. Once installed at the site, the field operators will run the tests mentioned above. If the sampling instrument meets the acceptance criteria, it will be assumed to be operating properly. These tests will be properly documented and filed (AIRP/486) as indicated in Section 9.

15.3 Inspection

Inspection of various equipment and components are provided here. Inspections are subdivided into two sections: one pertaining to weigh room laboratory issues and one associated with field activities.

15.3.1 Inspection in Weigh Room Laboratory

There are several items that need routine inspection in the weigh room laboratory. Table 15-1 details the items to inspect and how to appropriately document the inspection.

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^{O} C	1.) Check HVAC System 2.) Call service provider that holds maintenance agreement	1.) Document in weigh room log book 2.) Notify Lab Manager
Weigh Room Humidity	Daily	30 - 40^{O} RH	1.) Check HVAC System 2.) Call service provider that holds maintenance agreement	1.) Document in weigh room log book 2.) Notify Lab 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 before and after a $PM_{2.5}$ sample has been taken. Table 15-2 details the inspections performed in the field before and after samples are taken.

Table 15-2 Inspection of Field Items

Item	Inspection Frequency	Inspection Parameter	Action if Item Fails Inspection	Documentation Requirement
Sample downtube	Every site visit	Visible particulate	Clean with a clean dry cloth	Document in log book
WINS Impactor well	Every site visit	"Cone" shape of particulate on impactor well	Replace impactor well (including new impactor oil)	Document in log book
Rain collector	Every site visit	>1/3 full	Empty	Document in log book
O-rings	Every site visit	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

There are many items that need maintenance attention in the $PM_{2.5}$ network. This section describes those items according to whether they are weigh room items or field items.

15.4.1 Weigh Room Maintenance Items

The successful execution of a preventive maintenance program for the weigh room laboratory will go a long way towards the success of the entire $PM_{2.5}$ program. In the Palookaville $PM_{2.5}$ network, weigh room laboratory preventive maintenance is handled through the use of two contractors. The *Bert and Ernie HVAC Company* has a contract to take care of all preventive maintenance associated with the heating, ventilation, and air conditioning system (HVAC). Additionally, the *Bert and Ernie HVAC Company* can be paged for all emergencies pertaining to the weigh room laboratory HVAC system. Preventive maintenance for the micro-balance is performed by the *Libra Balance Company* service technician. Preventive maintenance for the micro-balance is scheduled to occur at initial set-up and every 6-months thereafter. In the event that there is a problem with the micro-balance that cannot be resolved within the Palookaville organization, the *Libra Balance Company* service technician can be paged. The Department's service agreement with *Libra Balance Company* calls for service within 24 hours. The service technician will also have a working micro-balance in his/her possession that will be loaned to

Palookaville in the case that the Department's micro-balance can not be repaired on-site.

Service agreements with both the *Bert and Ernie HVAC Company* and the *Libra Balance Company* are expected to be renewed each year. In the event either companies service agreement is not renewed, a new service provider will be selected and contract put in place.

The following table details the weigh room maintenance items, how frequently they will be replaced, and who will be responsible for performing the maintenance.

Table 15-3 Preventive Maintenance in Weigh Room Laboratories

Item	Maintenance Frequency	Responsible Party
Multi-point Micro-balance maintenance calibration	 6 Months Yearly	*Libra Balance Company*
Polonium strip replacement	6 Months	*Libra Balance Company*
Comparison of NIST Standards to laboratory working and primary standards	6 Months	*Libra Balance Company*
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	*Bert and Ernie HVAC Company*
Computer Back-up	Weekly	Balance Analyst
Computer Virus Check	Weekly	Balance Analyst
Computer system preventive maintenance (clean out old files, compress hardrive, inspect)	Yearly	PC support personnel

15.4.2 Field Maintenance Items

There are many items associated with appropriate preventive maintenance of a successful field program. Table 15-4 details the appropriate maintenance checks of the $PM_{2.5}$ samplers and their frequency.

Table 15-4 Preventive Maintenance of Field Items

Item	Maintenance Frequency	Location Maintenance Performed
Clean WINS $PM_{2.5}$ Impactor	Every 5 sample episodes	At Lab
PM 10 Inlet	Monthly	At Site
Filter Cassettes	Each run	At Lab
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 Lab

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.

16.0 Instrument Calibration and Frequency

This element of the QAPP concerns the calibration procedures that will be used for instrumental analytical methods and other measurement methods that are used in environmental measurements. It is necessary to distinguish between defining calibration as the checking of physical measurements against accepted standards and as determining the relationship (function) of the response versus the concentration. The American Chemical Society (ACS) limits the definition of the term *calibration* to the checking of physical measurements against accepted standards, and uses the term *standardization* to describe the determination of the response function.

16.1 Instrumentation Requiring Calibration

The QAPP should identify any equipment or instrumentation that requires calibration to maintain acceptable performance. While the primary focus of this element is on instruments of the measurement system (sampling and measurement equipment), all methods require standardization to determine the relationship between response and concentration

16.1.1 Mass Analysis by Gravimetry-Laboratory Microbalance

The laboratory support for Palookaville includes calibration of the *Libra Model 101* microbalance. As indicated in Section 13, the balance is calibrated (and mass standard check weights recertified) once a year under a service agreement. The service technician performs routine maintenance and makes any balance response adjustments that the calibration shows to be necessary. During the visit by the service technician, both the in-house primary and secondary (working) standards are checked against the service technicians standards to ensure acceptability. All of these actions are documented in the service technician's report, a copy of which is provided to the laboratory manager, which after review, is appropriately filed (see Section 9).

16.1.2 Flow Rate -Laboratory

Laboratory support performs the comparison of the flow rate transfer standard to a NIST-traceable primary flow rate standard and once every three years sends the primary standard to NIST for recertification. The laboratory and field personnel chose an automatic dry-piston flow meter for field calibrations and flow rate verifications of the flow rates of the network samplers. This type of device has the advantage of providing volumetric flow rate values directly, without requiring conversion from mass flow measurements, temperature, pressure, or water vapor corrections. In addition, the manual bubble flowmeter will be used in the lab as a primary standard and as a backup to the dry-piston flowmeter, where the absence of wind and relatively low humidity will have less negative effect on flowmeter performance.

Upon initial receipt of any new, repaired, or replaced $PM_{2.5}$ sampler, lab support will perform a multipoint flow rate calibration verification on the sampler flow rate to determine if initial performance is acceptable. Once sampler flow rates are accepted, the lab performs the calibration and verifications at the frequency specified in Section 14, as well as directly performing or arranging to have another party perform the tests needed to recertify the organizations standards.

16.1.3 Sampler Temperature, Pressure, Time Sensors- Laboratory

The lab arranges support for the field calibration of temperature and pressure sensors by acquiring the necessary equipment and consumables, preparing and lab testing the temperature comparison apparatus.

A stationary mercury manometer in the laboratory is used as a primary standard to calibrate the two electronic aneroid barometers that go out in the field as transfer standards.

The lab has also arranged with the NIST@ Time calibration service in Boulder, Colorado, to verify the time on a central lab time device (a specified computer), to which other lab and field devices, including the volumetric flow meter and FRM samplers, are compared.

16.1.4 Field

As indicated in 16.1.3, the following calibrations are performed in the field:

- calibration of volumetric flow rate meter in FRM samplers against the working standard
- calibration of sampler temperature and pressure sensors against the working temperature standard
- calibration of the 5 nonmercury min/max thermometers, normally located in the coolers in which filters are transported to and from the sampler in the field, against the laboratory-checked working standard thermometer

16.2 Calibration Method that Will Be Used for Each Instrument

The QAPP must describe the calibration method for each instrument in enough detail for another researcher to duplicate the calibration method. It may reference external documents such as EPA-designated calibration procedures or SOPs providing that these documents can be easily obtained. Nonstandard calibration methods or modified standard calibration methods should be fully documented and justified.

Some instrumentation may be calibrated against other instrumentation or apparatus (e.g., NIST thermometer), while other instruments are calibrated using standard materials traceable to national reference standards.

Calibrations normally involve challenging the measurement system or a component of the measurement system at a number of different levels over its operating range. The calibration may cover a narrower range if accuracy in that range is critical, given the end use of the data. Single-point calibrations are of limited use, and two-point calibrations do not provide information on nonlinearity. If single- or two-point calibrations are used for critical measurements, the potential shortcomings should be carefully considered and discussed in the QAPP. Most EPA-approved analytical methods require multipoint (three or more) calibrations that include zeros, or blanks, and higher levels so that unknowns fall within the calibration range and are bracketed by calibration points. The number of calibration points, the calibration range, and any replication (repeated measures at each level) should be given in the QAPP.

The QAPP should describe how calibration data will be analyzed. The use of statistical QC techniques to process data across multiple calibrations to detect gradual degradations in the measurement system should be described. The QAPP should describe any corrective action that will be taken if calibration (or calibration check) data fail to meet the acceptance criteria, including recalibration. References to appended SOPs containing the calibration procedures are an acceptable alternative to describing the calibration procedures within the text of the QAPP.

16.2.1 Laboratory- Gravimetric (Mass) Calibration

The calibration and QC (verification) checks of the microbalance are addressed in Sections 16.1.1 and 13.3 and Appendix C of this QAPP. For the following 3 reasons, the multipoint calibration for this method will be zero, 100 and 200μg: 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 μgs; and 3) the lowest, commercially available check weights that are certified according to nationally accepted standards are only in the single milligram range. Since 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 (see SOP in the Appendix C).

16.2.2 Laboratory (and Field) -Flow Calibration.

The Air Monitoring and Laboratory Branch Managers conduct spot checks of lab and field notebooks to ensure that the lab and field personnel are following the SOPs, including the QA/QC checks, acceptance criteria and frequencies listed in Tables 6-4 and 7-4 in Sections 6 and 7.

Method Summary: After equilibrating the calibration device to the ambient conditions of the sampler, install a filter cassette containing an unused 46.2 mm filter in the sampler. After removing the inlet from the sampler, connect the flow calibration device on the sampler down tube. If the sampler has not been calibrated before, or if the previous calibration was not acceptable, perform a leak check according to the manufacturer's operational instruction manual, which is incorporated into Palookaville SOPA-4 in Appendix C.

Otherwise, place the sampler in calibration mode (SOPA-4 in Appendix C) and perform a three-point calibration/verification or a one-point flow rate verification. The field staff will only perform a leak check after calibration or verification of are outside of the acceptance criteria.

Following the calibration or verification, turn off the sampler pump, remove the filter cassette from the filter cassette holder, remove the flow calibration device, (and flow adaptor device if applicable), and replace the sampler inlet. If the flow rate is determined to be outside of the required target flow rate, attempt to determine possible causes by minor diagnostic and trouble shooting techniques (e.g., leak checks), including those listed in the manufacturer's operating instruction manual. Do **not** attempt field repairs or flow rate adjustments.

16.2.3 Sampler (and Laboratory-Weighing Room- Environmental Control)Temperature Calibration Procedure.

Both the ambient air and filter temperature sensors will be calibrated once per year.

The ambient air sensor is located inside the shielded fixture on the outside of the $PM_{2.5}$ sampler and is easy to unfasten and remove for comparison to a transfer standard for temperature. The three-point verification/calibration will be conducted at the field site.

The filter temperature sensor is located in the (open) space just below the filter cassette. It is threaded through the walls of the filter cassette holding assembly section of the sampler and removal of plastic or metal fittings is required to remove the sensor and its associated wiring. It may be difficult to calibrate this sensor in the field. Be careful when removing the filter temperature sensor- do not gall the fittings since this could start an internal leak after the installation. A sampler leak check must be performed after reinstallation of the filter temperature sensor.

Several steps to follow in calibrating ambient air temperature are given in SOPA-5 in Appendix C and in the following summary. Refer to the operator's instruction manual for sampler-specific procedures and instructions.

Remove the ambient temperature sensor from the radiation shield. Prepare a convenient container (an insulated vacuum/wide mouth thermos bottle) for the ambient temperature water bath and the ice slurry bath. Wrap the sensor(s) and a thermometer together with rubber band, ensure that all the probes are at the same level. Prepare the ambient or ice slurry solution according to the SOP A-3 in Appendix C. Immerse the sensor(s) and the attached thermometer in the ambient temperature bath. Wait at least 5 minutes for the ambient thermal mass and the sensor/thermometer to equilibrate. Wait at least 15 minutes for equilibration with the ice slurry before taking comparative readings.

For each thermal mass, in the order: Ambient, Cold, Ambient, Hot, Ambient, make a series of 5 measurements, taken about 1 minute apart. If the measurements indicate equilibrium, average the 5 readings and record the result as the sensor temperature relative to the thermometer.

A similar process will be used to verify the calibration of continuously-reading temperature sensors used in the laboratory weighing room.

16.2.4 Sampler Pressure Calibration Procedure. Summarized here and detailed version attached as SOP A-6 in Appendix C.

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 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 Fortin mercury type of barometer is used in the laboratory to calibrate and verify the aneroid barometer used in the field to verify the barometric sensors of $PM_{2.5}$ samplers. Details are provided in 16.4.1, below and SOP A-6.

16.2.5 Sampler and Standard Volumetric Flow Rate Sensors with Built-in Clocks

Time can be verified over phone lines from NIST (in Boulder, Colorado, directly or through the NIST calibration service in Gaithersberg, MD). See SOP A-7 in Appendix C for details (or in NIST standardization handbooks and catalogues cited in A-7).

Procedure for Verifying Relative Humidity Control/Monitoring data for the Filter Conditioning / Weighing Room - Laboratory Only

A sling psychrometer is used by laboratory personnel to verify the humidity generated and controlled by the environmental control system. For details, see SOP A-8 in Appendix C.

16.3 Calibration Standard Materials and Apparatus

Some instruments are calibrated using calibration apparatus rather than calibration standards. For example, an ozone generator is part of a system used to calibrate continuous ozone monitors. Commercially available calibration apparatus should be listed together with the make (the manufacturer's name), the model number, and the specific variable control settings that will be used during the calibrations. A calibration apparatus that is not commercially available should be described in enough detail for another researcher to duplicate the apparatus and follow the calibration procedure.

Table 16-1 presents a summary of the specific standard materials and apparatus used in calibrating measurement systems for parameters necessary to generate the $PM_{2.5}$ data required in 40 CFR parts 50, Appendix L, and part 58.

Table 16-1 Standard Materials and/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	*Best Bet*	111	NA
Temperature M+A M+ A M+A	 Hg H20 NA	 Thermometer Thermal mass (Thermos) Thermistor	 *Lotsa Choices* *Cup a Joe* *Best Bet*	 5500 Big Mouth 8910	 * NA *
Pressure M+A A	 Hg NA	 Fortin Aneroid	 *You Better...* *Aviators Choice*	 22 7-11	 * *
Flow Rate A A A	 NA	 Piston Meter Bubble Meter Adapter	 *Jensen* *Hasty* *Sampler Mfr.*	 F199 LG88 F100	 * NA NA
Relative Humidity A	 NA	 Sling Psychrometer	 *Whosits*	 99	

*- See manufacturer's operating manual an/or instruction sheet

16.4 Calibration Standards

Most measurement systems are calibrated by processing materials that are of known and stable composition. References describing these calibration standards should be included in the QAPP. Calibration standards are normally traceable to national reference standards, and the traceability protocol should be discussed. If the standards are not traceable, the QAPP must include a detailed description of how the standards will be prepared. Any method used to verify the certified value of the standard independently should be described.

Flow Rate --

The flow rate standard apparatus used for flow-rate calibration (field- NIST-traceable, piston-type volumetric flow rate meter; laboratory -NIST-traceable manual soap bubble flow meter and time monitor) has its own certification and is traceable to other standards for volume or flow rate which are themselves NIST-traceable. A calibration relationship for the flow-rate standard, such as an equation, curve, or family of curves, is established by the manufacturer (and verified if needed) 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 actual frequency with which this recertification process must be completed depends on the type of flow rate standard- some are much more likely to be stable than others. The Department will maintain a control chart (a running plot of the difference or % difference between the flow-rate standard and the NIST-traceable 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 gives a good indication of the stability of the standard. If the two standard-deviation control limits are close together, the chart indicates that the standard is very stable and could be certified less frequently. The minimum recertification frequency is 1 year. On the other hand, if the limits are wide, the chart would indicate a less stable standard that will be recertified more often.

Temperature --

The operations manuals associated with the 2 single and 5 sequential Palookaville samplers identify types of temperature standards recommended for calibration and provide a detailed calibration procedure for each type 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 temperature standard used for temperature calibration will have its own certification and 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 depends on the type of temperature standard; some are much more stable than others. The best way to determine recertification requirements is to keep a control chart. The Department will use an ASTM- or NIST-traceable mercury in glass thermometer, for laboratory calibration.

Palookaville Standards

The temperature sensor standards chosen by the lab and field staff and managers are both based on standard materials contained in standardized apparatus; each has been standardized (compared in a strictly controlled procedure) against temperature standards the manufacturers obtained from NIST.

The Palookaville laboratory standards are 2 NIST-traceable glass mercury thermometers from the *Lotsa Choices Distributor Company*@, each with its own certificate summarizing the company's NIST traceability protocol and documenting the technicians signature, comparison date, identification of the NIST standard used, and the mean and standard deviation of the comparison results. There are 2 thermometers with overlapping ranges that span the complete range of typically measured summer to winter lab and field temperature values.

The Palookaville field temperature standards are two *Best Bet Model 8910* @ thermistor probes and one digital readout module with RS232C jack and cable connector available for linkage to a data logger or portable computer. The two probes have different optimum ranges, one including the full range of temperatures ever recorded in the summer and the other including the full range of temperatures ever recorded in the winter by the National Weather Service at the Palookaville sites. Each probe came with a certificate of NIST-traceability with the same kind of information as the thermometer certificates contained.

Pressure

The Fortin mercurial type of barometer works on fundamental principles of length and mass and is therefore 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. It is potentially less accurate than the Fortin type but can be transported with less risk to the reliability of its measurements and presents no damage from mercury spills. The Fortin type of barometer is best employed as a higher quality laboratory standard which is used to adjust and certify an aneroid barometer in the laboratory.

16.4.1 Lab

The Palookaville pressure standard is a *You Better Believe It*@ Model 22 Fortin-type mercury barometer.

16.4.2 Field

The field working standard is an *Aviator's Choice*@ 7-11 aneroid barometer with digital readout.

16.5 Document Calibration Frequency

The QAPP must describe how often each measurement method will be calibrated. It is desirable that the calibration frequency be related to any known temporal variability (i.e., drift) of the measurement system. The calibration procedure may involve less-frequent comprehensive calibrations and more-frequent simple drift checks. The location of the record of calibration frequency and maintenance should be referenced.

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 rate, 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 1-point checks at least monthly and multipoint checks (calibration without adjustment unless needed as determined independently and then performed by the vendor's authorized service representative) at least annually, as proven by tracking on control charts.

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 in Appendix L of 40 CFR Part 50, the manufacturer's operating instruction manual and any others indicated in section 22.7.2 of this document. Laboratory and field activities associated with equipment used by the respective technical staff will be kept in record notebooks as well. The records will normally be controlled by the Branch Managers, and located in the labs or field sites when in use or at the manager's offices when being reviewed or used for data validation.

References

ASTM. 1977. Standard test methods for measuring surface atmospheric pressure. American Society for Testing and Materials. Philadelphia, PA. Standard D 3631-84.

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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.

EPA. 1997b. Ambient air monitoring reference and equivalent methods. U.S. Environmental Protection Agency. 40 CFR Part 53, as amended July 18, 1997.

EPA. 1997. Reference method for the determination of fine particulate matter as $PM_{2.5}$ in the atmosphere. U.S. Environmental Protection Agency. 40 CFR Part 58, Appendix L, as amended July 18, 1997.

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.

NIST. 1976. Liquid-in-glass thermometry. National Institute of Standards and Technology. NBS Monograph 150. January.

NIST. 1986. Thermometer calibration: a model for state calibration laboratories. National Institute of Standards and Technology. NBS Monograph 174. January.

NIST. 1988. Liquid-in-glass thermometer calibration service. National Institute of Standards and Technology. Special publication 250-23. September.

NIST. 1989. The calibration of thermocouples and thermocouple materials. National Institute of Standards and Technology. Special publication 250-35. April.

17.0 Inspection/Acceptance for Supplies and Consumables

Describe how and by whom supplies and consumables shall be inspected and accepted for use in the project. State acceptance criteria for such supplies and consumables.

17.1 Purpose

The purpose of this element is to establish and document a system for inspecting and accepting all supplies and consumables that may directly or indirectly affect the quality of the $PM_{2.5}$ Program. The Palookaville $PM_{2.5}$ monitoring network relies on various supplies and consumables that are critical to its operation. By having documented inspection and acceptance criteria, consistency of the supplies can be assured. This section details the supplies/consumables, their acceptance criteria, and the required documentation for tracking this process.

17.2 Critical Supplies and Consumables

Clearly identify and document all supplies and consumables that may directly or indirectly affect the quality of the project or task. See Figures 10 and 11 for example documentation of inspection/acceptance testing requirements. Typical examples include sample bottles, calibration gases, reagents, hoses, materials for decontamination activities, deionized water, and potable water.

For each item identified, document the inspection or acceptance testing requirements or specifications (e.g., concentration, purity, cell viability, activity, or source of procurement) in addition to any requirements for certificates of purity or analysis.

There are many components to the $PM_{2.5}$ monitoring network. This section attempts to describe the needed supplies for this $PM_{2.5}$ monitoring network and includes items for the weigh room laboratory and the field. Table 17-1 details the various components:

Table 17-1 Critical Supplies and Consumables

Area	Item	Description	Vendor	Model Number
Sampler	Impactor Oil	Tetramethyltetraphenyl-trisiloxane (30ml)	Dow Corning@	704 Oil
Sampler	37 mm Glass Fiber Filter	For use in impactor well	*XYZ Company*	*xxxx*
Sampler	Rain Collector	Glass	*XYZ Company*	*xxxx*
Sampler	O-Rings	The O-rings that seal in the filter cassette when it is placed in the sampler.	*XYZ Company*	*xxxx*

Area	Item	Description	Vendor	Model Number
Sampler	In-line Filter	Downstream of sample collection and upstream of sample pump.	*XYZ Company*	*xxxx*
Sampler	Battery	Internal Sampler Battery.	*XYZ Company*	*xxxx*
Sampler	Fuses	In sampler	*XYZ Company*	*xxxx*
Sampler	Floppy Disks	3.5" Pre-formatted	Purchase local	
Filter	Filters	46.2 mm teflon	Whatman@	
Filter	Petri-dish	47 mm with securing ring.	Gelman@	7231
Filter	Filter Cassettes (single)	As per CFR design	*XYZ Company*	*xxxx*
Filter	Filter Cassette Holder, Protective Containers	For securing cassette	*XYZ Company*	*xxxx*
Filter	Sequential Sampler Cassette Holder	For use with *XYZ Model 2000*	*XYZ Company*	*xxxx*
Filter	Filter Handling Containers	For transport to and from the field	*XYZ Company*	*xxxx*
Weigh Room	Staticide	Anti-static solution	Cole-Parmer@	E-33672-00
Weigh Room	Static Control Strips	Polonium 500μC_i	Mettler-Toledo@	110653
Weigh Room	Air Filters	High Efficiency	Purchase Local	
All	Powder Free Antistatic Gloves	Vinyl, Class M4.5	Fisher Scientific@	Small 11-393-85A Medium 11-393-85A Large 11-393-85A X-Large 11-393-85A
All	Low-lint wipes	4.5" x 8.5" Cleaning Wipes	Kimwipes@	34155

17.3 Acceptance Criteria

Acceptance criteria must be consistent with overall project technical and quality criteria (e.g., concentration must be within ± 2.5%, cell viability must be >90%). If special requirements are needed for particular supplies or consumables, a clear agreement should be established with the supplier, including the methods used for evaluation and the provisions for settling disparities.

Acceptance criteria must be consistent with overall project technical and quality criteria. Some of the acceptance criteria is specifically detailed in 40 CFR Parts 50. Other acceptance criteria such as observation of damage due to shipping can only be performed once the equipment has arrived on site.

Table 17-2 details the acceptance test and limits for procurement of supplies and consumables to be utilized in the $PM_{2.5}$ Palookaville 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 (110-160mg) 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 500μC_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

Procedures should be established to ensure that inspections or acceptance testing of supplies and consumables are adequately documented by permanent, dated, and signed records or logs that uniquely identify the critical supplies or consumables, the date received, the date tested, the date to be retested (if applicable), and the expiration date. These records should be kept by the responsible individual(s) (see Figure 13 for an example log)

Tracking and quality verification of supplies and consumables have two main components. The first is the need of the end user of the supply or consumable to have an item of the required quality. The second need is for the purchasing department to accurately track 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:

1. Receiving personnel will perform a rudimentary inspection of the packages as they are received from the courier or shipping company. Note any obvious problems with a receiving shipment such as crushed box or wet cardboard.

2. The package will be opened, inspected and contents compared against the packing slip.

3. Supply/consumable will be compared to the acceptance criteria in Table 17-2.

4. If there is a problem with the equipment/supply, note it on the packing list, notify the supervisor of the receiving area and immediately call the vendor.

5. If the equipment/supplies appear to be complete and in good condition, sign and date the packing list and send to accounts payable 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 for de-gassing of the filters can be allowed.

7. Stock equipment/supplies in appropriate pre-determined area.

8. For supplies, consumables, and equipment used throughout the $PM_{2.5}$ program, document when these items are changed out. If available, include all relevant information such as: model number, lot number, and serial number.

18.0 Data Acquisition Requirements

This element of the QAPP should clearly identify the intended sources of previously collected data and other information that will be used in this project. Information that is non-representative and possibly biased and is used uncritically may lead to decision errors. The care and skepticism applied to the generation of new data are also appropriate to the use of previously compiled data (for example, data sources such as handbooks and computerized databases).

This section addresses data not obtained by direct measurement from the PM_{25} Ambient Air Quality Monitoring Program. This includes both outside data and historical monitoring data. Non-monitoring data and historical monitoring data are used by the Program in a variety of ways. Use of information that fails to meet the necessary Data Quality Objectives (DQOs) for the PM_{25} Ambient Air Quality Monitoring Program can lead to erroneous trend reports and regulatory decision errors. The policies and procedures described in this section apply both to data acquired through the Palookaville Department of Health monitoring program and to information previously acquired and/or acquired from outside sources.

18.1 Acquisition of Non-Direct Measurement Data

This element's criteria should be developed to support the objectives of element A7. Acceptance criteria for each collection of data being considered for use in this project should be explicitly stated, especially with respect to:

Representativeness. Were the data collected from a population that is sufficiently similar to the population of interest and the population boundaries? How will potentially confounding effects (for example, season, time of day, and cell type) be addressed so that these effects do not unduly alter the summary information?

Bias. Are there characteristics of the data set that would shift the conclusions. For example, has bias in analysis results been documented? Is there sufficient information to estimate and correct bias?

Precision. How is the spread in the results estimated? Does the estimate of variability indicate that it is sufficiently small to meet the objectives of this project as stated in element A7? See also Appendix D.

Qualifiers. Are the data evaluated in a manner that permits logical decisions on whether or not the data are applicable to the current project? Is the system of qualifying or flagging data adequately documented to allow the combination of data sets?

Summarization. Is the data summarization process clear and sufficiently consistent with the goals of this project? (See element D2 for further discussion.) Ideally, observations and transformation equations are available so that their assumptions can be evaluated against the objectives of the current project.

This element should also include a discussion on limitations on the use of the data and the nature of the uncertainty of the data.

The PM_{25} 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 Palookaville Department of Health or from historical records. This section lists this data and addresses quality issues related to the PM_{25} Ambient Air Quality Monitoring Program.

Chemical and Physical Properties Data

Physical and chemical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information that 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 Air Division QA Officer. The following sources may be used in the PM_{25} 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 may be used without prior approval of the Palookaville Air Division QA Officer. Two that are relevant to the fine particulate monitoring program are CRC Press' *Handbook of Chemistry and Physics*, and *Lange's Handbook.*

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. Palookaville Department of Health personnel are cautioned that such information is sometimes in error, and appropriate cross-checks will be made to verify the reasonableness of information contained in manuals. Whenever possible, the field operators will compare physical and chemical constants in the operators manuals to those given in the sources listed above. If discrepancies are found, 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 Department will also contact the Region Y Office to inform them of these errors The following types 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

Geographic Location

Another type of data that will commonly be used in conjunction with the PM_{25} Ambient Air Quality Monitoring Program is geographic information. For the current sites, the Department will locate these 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. Geographic locations of Palookaville monitoring sites that are no longer in operation will not be re-determined.

Historical Monitoring Information of the Palookaville Department of Health

The Palookaville Department of Health has operated a network of ambient air monitoring stations since the 1970's. Historical monitoring data and summary information derived from that 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 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 $PM_{2.5}$ with historical TSP or PM_{10} data will not be reported or used to estimate trends. Dichot sampler data (fine portion) may be used to establish trends in $PM_{2.5}$ concentration; however, evidence must be presented to demonstrate that results of the two methods are comparable. Trends reports comparing $PM_{2.5}$ data with historical particulate data must be approved by the Air Division QA Officer prior to release.

External Monitoring Data Bases

It is the policy of the Palookaville Department of Health that no data obtained from the Internet, computer bulletin boards, or data bases from outside organizations shall be used in creating reportable data or published reports without approval of the Air Division QA Officer. This policy is intended to ensure the use of high quality data in Palookaville 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 shall not be utilized 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 Palookaville 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 Palookaville measurements and that the original data generator had an acceptable QA program in place.

Lead and Speciated Particulate Data

The Palookaville Department of Health has been routinely monitoring airborne lead since the 1980's. Early data is likely to be problematic because of different particle size cutpoints and because of significantly higher detection limits. Lead data (PM_{10}) acquired since 1992, and continuing in parallel with the current program, has improved analytical sensitivity due to a change in the analytical method. However, caution is needed in directly comparing this data with the $PM_{2.5}$ data because of the difference in size fractions.

Existing chemical speciation data for elements other than lead are very limited. Some speciation data from dichot samples were obtained by the Palookaville Institute of Technology in cooperation with the Department of Health during a 1986 research study sponsored by the U.S.EPA. These results may be used to provide a historical baseline for the speciation results to be obtained by the PM_{25} Ambient Air Quality Monitoring Program; however, it is unclear whether the quality of these data is sufficient to allow direct comparison with new data.

U.S. Weather Service Data

Meteorological information is gathered from the U.S. Weather Service station at the Palookaville International Airport. Parameters include: temperature, relative humidity, barometric pressure, rainfall, wind speed, wind direction, cloud type/layers, percentage cloud cover and visibility range. Historically, these data have not been used to calculate pollutant concentration values for any of the Palookaville monitoring sites, which each have the required meteorological sensors. However, NWS data are often included in summary reports. No changes to the way in which these data are collected are anticipated due to the addition of the Fine Particulate data to the Palookaville Department of Health ambient air monitoring program.

19.0 Data Management

19.1 Background and Overview

This element should present an overview of all mathematical operations and analyses performed on raw ("as-collected") data to change their form of expression, location, quantity, or dimensionality. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval. A diagram that illustrates the source(s) of the data, the processing steps, the intermediate and final data files, and the reports produced may be helpful, particularly when there are multiple data sources and data files. When appropriate, the data values should be subjected to the same chain-of-custody requirements as outlined in element B3. Appendix G has further details.

This section describes the data management operations pertaining to $PM_{2.5}$ measurements for the SLAMS/NAMS stations operated by The Palookaville Department of Health. This includes an overview of the mathematical operations and analyses performed on raw ("as-collected") $PM_{2.5}$ data. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval.

Data processing for $PM_{2.5}$ data are summarized in Figure 19-1. Data processing steps are integrated, to the extent possible, into the existing data processing system used for The Palookaville Department of Health's SLAMS network. Originally, all data were entered manually and were processed using a set of programs written in Cobol and Fortran on the Department's central mainframe computer. In the mid-1980s, real-time data acquisition was added and the air pollution data base was moved to a VAX computer run by the Air Quality Division within The Palookaville Department of Health. Data were collected via dedicated and dial-up phone lines. More recently, the system was transferred to a network of PC-compatible computers. The $PM_{2.5}$ data base resides on a machine running the Windows NT Server operating system, which is also the main file server for the Air Quality Division. This machine is shown in the upper left of Figure 19-1.

Each Ambient Air Monitoring Station operated by The Polokaville Department of Health has an Acme Mark IV[@] data logger. These data loggers provide data collection for continuous analyzers at each station. There are currently no facilities to remotely acquire the $PM_{2.5}$ sampler data. However, The Polokaville Department of Health is examining the possibility of upgrading these stations in the future so that sampler status, flow rate, temperatures, etc. can be monitored remotely.

Filter tracking and chain of custody information are entered into the $PM_{2.5}$ Data Acquisition System (DAS) at four main stages as shown in Figure 19-1. Managers are able to obtain reports on status of samples, location of specific filters, etc. using the DAS. All users must be authorized by the Manager, Air Quality Division, and receive a password necessary to log on to the DAS. Different privileges are given each authorized user depending on that person's need. The following privilege levels are defined:

- Data Entry Privilege - The individual may see and modify only data within The $PM_{2.5}$ DAS that he or she has personally entered. After a data set has been "committed" to the system by the data entry operator, all further changes will generate entries in the system audit trail.
- Reporting Privilege - This privilege permits generation of data summary reports available under The $PM_{2.5}$ DAS. No data changes are allowed without additional privileges.
- Data Administration Privilege - Data Administrators for The $PM_{2.5}$ DAS are allowed to change data as a result of QA screening and related reasons. All operations resulting in changes to data values are logged to the audit trail. The Data Administrator is responsible for performing the following tasks on a regular basis
  - merging/correcting the duplicate data entry files
  - running verification and validation routines and correcting data as necessary
  - generating summary data reports for management
  - uploading verified/validated data to EPA AIRS

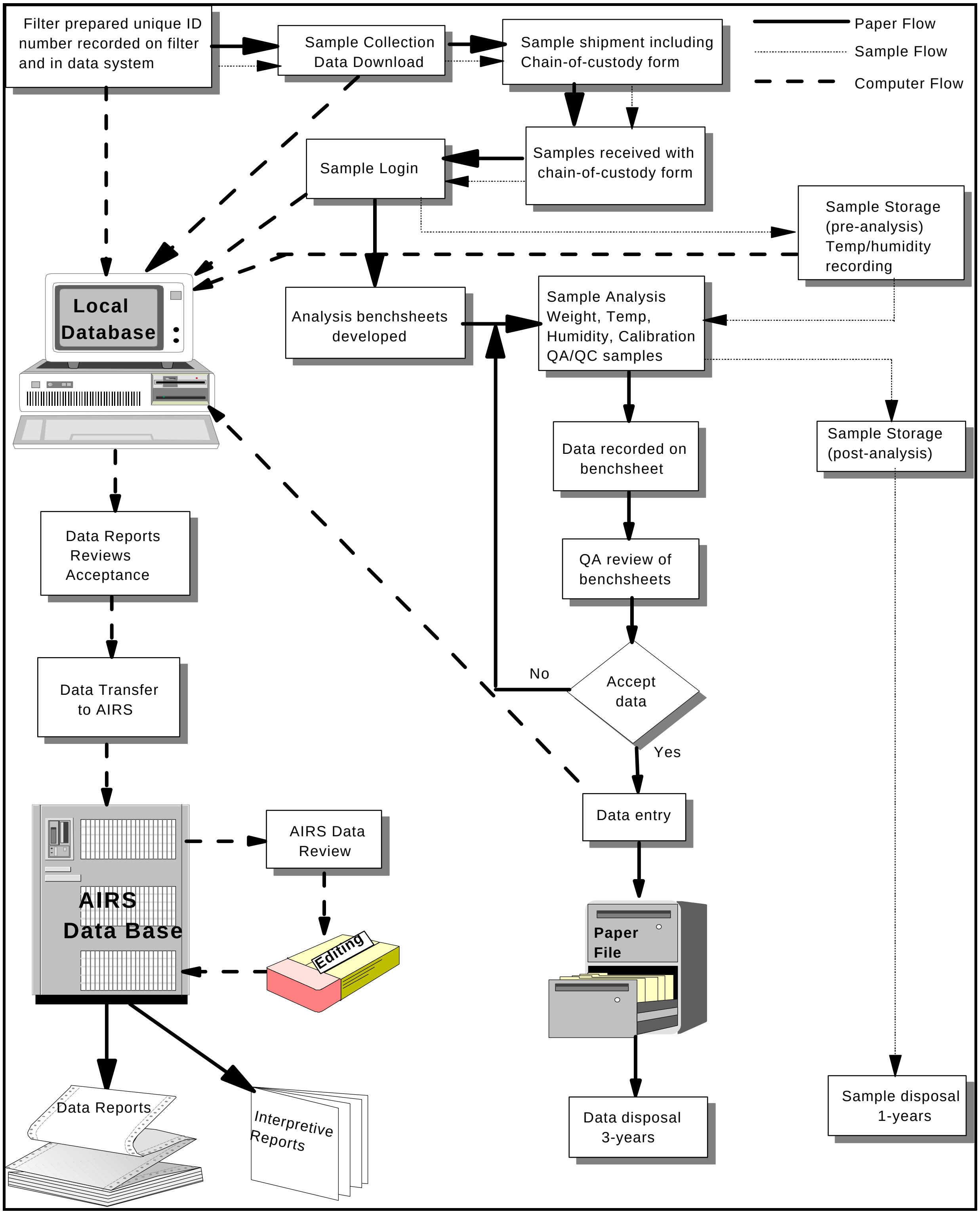

Figure 19-1. PM$_{2.5}$ data flow diagram

19.2 Data Recording

Any internal checks (including verification and validation checks) that will be used to ensure data quality during data encoding in the data entry process should be identified together with the mechanism for detailing and correcting recording errors. Examples of data entry forms and checklists should be included.

Data entry, validation, and verification functions are all integrated in the $PM_{2.5}$ DAS. Bench sheets shown in Figure 19-1 are entered by laboratory personnel. Procedures for filling out the laboratory sheets and subsequent data entry are provided in SOPs listed in Table 19-1 and included in Appendix E.

Table 19-1 List of The Polokaville Department of Health SOPS for $PM_{2.5}$ Data Processing Operations

SOP Number	Title	Description
AIR-IS-FP1	*Data acquisition procedures for the $PM_{2.5}$ monitoring program*	Describes the electronic data processing operations applicable to $PM_{2.5}$ data.
AIR-FLD- FP1	*Standard procedures for operation of field monitoring sites for the $PM_{2.5}$ monitoring program*	Describes all field operations to implement $PM_{2.5}$ monitoring. Includes manual and electronic data acquisition procedures.
AIR-LAB-FP1	*Standard operating procedures for preparation, weighing, and data recording for the $PM_{2.5}$ monitoring program*	Describes all laboratory operations for $PM_{2.5}$ filter handling, weighing, and the associated data recording
AIR-IS-FP2	*Data processing procedures for the $PM_{2.5}$ monitoring program*	Describes the procedures for data entry, processing, merging, validation, reporting, and reduction.
AIR-IS-FP3	*AIRS data transmittal procedures system for the $PM_{2.5}$ monitoring program*	Describes the procedures used to format and transmit $PM_{2.5}$ data to AIRS. (Will be used in conjunction with SOP AIR-IS-SLAMS7, which describes transmittal of other ambient monitoring data to AIRS.)

19.3 Data Validation

The details of the process of data validation and pre-specified criteria should be documented in this element of the QAPP. This element should address how the method, instrument, or system performs the function it is intended to consistently, reliably, and accurately in generating the data. Part D of this document addresses the overall project data validation, which is performed after the project has been completed.

Data validation is a combination of checking that data processing operations have been carried out correctly and of monitoring the quality of the field operations. Data validation can identify problems in either of these areas. 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 $PM_{2.5}$ DAS are <u>never</u> 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 $PM_{2.5}$ DAS to ensure quality of data entry and data processing operations:

- **Duplicate Key Entry** - the following data are subjected to duplicate entry by different operators: filter weight reports, field data sheets, chain of custody sheets. The results of duplicate key entry are compared and errors are corrected at biweekly intervals. The method for entering the data are given in SOP AIR-LAB-FP1, *Standard operating procedures for preparation, weighing, and data recording for the $PM_{2.5}$ monitoring program*. Procedures for reconciling the duplicate entries are given in SOP AIR-IS-FP2, *Data processing procedures for the $PM_{2.5}$ monitoring program*.
- **Range Checks** - almost all monitored parameters have simple range checks programmed in. For example, valid times must be between 00:00 and 23:59, summer temperatures must be between 10 and 50 degrees Celsius, etc. The data entry operator is notified immediately when an entry is out of range. The operator has the option of correcting the entry or overriding the range limit. The specific values used for range checks may vary depending on season and other factors. The currently used range values for data entry acceptance are provided in SOP AIR-IS-FP2. Since these range limits for data input are not regulatory requirements, the Air Division QA Officer may adjust them from time to time to better meet quality goals.
- **Completeness Checks** - When the data are processed certain completeness criteria must be met. For example, each filter must have a start time, an end time, an average flow rate, dates weighed, and operator and technician names. The data entry operator will be notified if an incomplete record has been entered before the record can be closed.
- **Internal Consistency and Other Reasonableness Checks -** Several other internal consistency checks are built into the $PM_{2.5}$ DAS. For example, the end time of a filter must be greater than the start time. Computed filter volume (integrated flow) must be approximately equal to the exposure time multiplied by the nominal flow. Additional consistency and other checks will be implemented as the result of problems encountered during data screening. See the most recent version of SOP AIR-IS-FP2 for the currently implemented consistency checks.
- **Data Retention** - Raw data sheets are retained on file in the Air Quality Division office 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 are cataloged and boxed for storage at the Palookaville Services Warehouse. Physical samples such as filters shall be discarded with appropriate attention to proper disposal of potentially hazardous materials.
- **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 shall be run on a monthly schedule and prior to any data submission to AIRS. Data validation is the process by which raw data are screened and assessed before it can be included in the main data base (i.e., the $PM_{2.5}$ DAS).
- **Sample Batch Data Validation**- which is discussed in Section 23, associates flags, that are

generated by QC values outside of acceptance criteria, with a sample batch. Batches containing too many flags would be rerun and or invalidated.

Table 19-2 summarizes the validation checks applicable to the $PM_{2.5}$ data.

Table 19-2 Validation Check Summaries

Type of Data Check	Electronic Transmission and Storage	Manual Checks	Automated Checks
Data Parity and Transmission Protocol Checks	✔		
Duplicate Key Entry		✔	
Date and Time Consistency		✔	✔
Completeness of Required Fields		✔	✔
Range Checking			✔
Statistical Outlier Checking			✔
Manual Inspection of Charts and Reports		✔	
Sample Batch Data Validation			✔

Two key operational criteria for $PM_{2.5}$ sampling are bias and precision. As defined in 40CFR Part 58, Appendix A, these are based on differences between collocated sampler results and FRM performance evaluations. The Palookaville Department of Health Air Quality Division will inspect the results of collocated sampling during each batch validation activity. This data will be evaluated as early in the process as possible, so that potential operational problems can be addressed. The objective of the Palookaville Department of Health will be to optimize the performance of its $PM_{2.5}$ monitoring equipment. Initially, the results of collocated operations will be control charted (see Section 14). From these charts, control limits will be established to flag potential problems. Multiple collocation results must be accumulated to assess data quality with confidence. However, even limited data can be used for system maintenance and corrective action.

19.4 Data Transformation

Data transformation is the conversion of individual data point values into related values or possibly symbols using conversion formulas (e.g., units conversion or logarithmic conversion) or a system for replacement. The transformations can be reversible (e.g., as in the conversion of data points using a formulas) or irreversible (e.g., when a symbol replaces actual values and the value is lost). The procedures for all data transformations should be described and recorded in this element. The procedure for converting calibration readings into an equation that will be applied to measurement readings should be documented in the QAPP. Transformation and aberration of data for statistical analysis should be outlined in element D3, “Reconciliation with Data Quality Objectives.”

Calculations for transforming raw data from measured units to final concentrations are relatively straightforward, and many are carried out in the sampler data processing unit before being recorded. The following relations in Table 19-3 pertain to $PM_{2.5}$ monitoring:

Table 19-3 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 ($C_{PM2.5}$)	μg/ 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

Data transmittal occurs when data are transferred from one person or location to another or when data are copied from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file and electronic transfer of data over a telephone or computer network. The QAPP should describe each data transfer step and the procedures that will be used to characterize data transmittal error rates and to minimize information loss in the transmittal.

Data transmittal occurs when data are transferred from one person or location to another or when data are copied from one form to another. Some examples of data transmittal are copying raw data from a notebook onto a data entry form for keying into a computer file and electronic transfer of data over a telephone or computer network. Table 19-4 summarizes data transfer operations.

Table 19-4 Data Transfer Operations

Description of Data Transfer	Originator	Recipient	QA Measures Applied
Keying Weighing Data into The $PM_{2.5}$ DAS	Laboratory Technician (hand-written data form)	Data Processing Personnel	Double Key Entry
Electronic data transfer	(between computers or over network)	--	Parity Checking; transmission protocols

Description of Data Transfer	Originator	Recipient	QA Measures Applied
Filter Receiving and Chain-of-Custody	Shipping and Receiving Clerk	The $PM_{2.5}$ DAS Computer (shipping clerk enters data at a local terminal)	Filter numbers are verified automatically; reports indicate missing filters and/or incorrect data entries
Calibration, FRM/FEM, and Audit Data	Auditor or field supervisor	$PM_{2.5}$ Data base Computer	Entries are checked by Air Quality Supervisor and QA Officer
AIRS data summaries	Air Quality Supervisor	AIRS (U.S. EPA)	Entries are checked by Air Quality Supervisor and QA Officer

The Palookaville Department of Health will report all $PM_{2.5}$ ambient air quality data and information specified by the AIRS Users Guide (Volume II, Air Quality Data Coding, and Volume III, 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 the AIRS-AQS via electronic transmission, in the format of the AIRS-AQS, and in accordance with the quarterly schedule. The specific quarterly reporting periods and due dates are shown in the Table 19-5.

Table 19-5 Data Reporting Schedule

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

19.6 Data Reduction

Data reduction includes all processes that change the number of data items. This process is distinct from data transformation in that it entails an irreversible reduction in the size of the data set and an associated loss of detail. For manual calculations, the QAPP should include an example in which typical raw data are reduced. For automated data processing, the QAPP should clearly indicate how the raw data are to be reduced with a well-defined audit trail, and reference to the specific software documentation should be provided.

Data reduction processes involve aggregating and summarizing results so that they can be understood and interpreted in different ways. The $PM_{2.5}$ monitoring regulations require certain summary data to be computed and reported regularly to U.S. EPA. Other data are reduced and reported for other purposes such as station maintenance. Examples of data summaries include:

- average $PM_{2.5}$ concentration for a station or set of stations for a specific time period
- accuracy, bias, and precision statistics based on accumulated FRM/FEM data
- data completeness reports based on numbers of valid samples collected during a specified period

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. Typical reasons for data changes that would be recorded include the following:

- corrections of data input due to human error
- application of revised calibration factors
- addition of new or supplementary data
- flagging of data as invalid or suspect
- logging of the date and times when automated data validation programs are run

The $PM_{2.5}$ DAS audit trail is implemented as a separate table in the Microsoft Access@ data base. Audit trail records will include the following fields:

- operator's identity (ID code)
- date and time of the change
- table and field names for the changed data item
- reason for the change
- full identifying information for the item changed (date, time, site location, parameter, etc.)
- value of the item before and after the change

When routine data screening programs are run, the following additional data are recorded in the audit trail:

- version number of the screening program
- values of screening limits (e.g., upper and lower acceptance limits for each parameter)
- numerical value of each data item flagged and the flag applied

The audit trail is produced automatically and can only document changes; there is no "undo" capability for reversing changes after they have been made. Available reports based on the audit trail include:

- log of routine data validation, screening, and reporting program runs
- report of data changes by station for a specified time period
- report of data changes for a specified purpose
- report of data changes made by a specified person

Because of storage requirements, the System Administrator must periodically move old audit trail records to backup media. Audit trail information will not be moved to backup media until after the data are reported to AIRS. All backups will be retained so that any audit trail information can be retrieved for at least three years.

19.7 Data Analysis

Data analysis sometimes involves comparing suitably reduced data with a conceptual model (e.g., a dispersion model or an infectivity model). It frequently includes computation of summary statistics, standard errors, confidence intervals, tests of hypotheses relative to model parameters, and goodness-of-fit tests. This element should briefly outline the proposed methodology for data analysis and a more detailed discussion should be included in the final report.

The Palookaville Department of Health is currently implementing the data summary and analysis requirements contained in 40CFR Part 58, Appendix A. It is anticipated that as the $PM_{2.5}$ Monitoring Program develops, additional data analysis procedures will be developed. The following specific summary statistics will be tracked and reported for the $PM_{2.5}$ 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 for these reports are given in the Table 19-6.

Table 19-6 Report Equations

Criterion	Equation	Reference
Accuracy of Single Sampler Flow - Single Check (d_i) X_i is reference flow; Y_i is measured flow	$d_i = \frac{Y_i - X_i}{X_i} \times 100$	40 CFR 58 Appendix A, Section 5.5.1.1
Bias of a Single Sampler - Annual Basis (D_j)- average of individual percent differences between sampler and reference value; n_j is the number of measurements over the period	$D_j = \frac{1}{n_i} \times \sum_{i=1}^{n_j} d_i$	5.5.1.2

Percent Difference for a Single Check (d_i) - X_i and Y_i are concentrations from the primary and duplicate samplers, respectively.	$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} \times 100$	5.5.2.1
Coefficient of Variation (CV_i) for a single Check	$CV_i = \frac{\lvert d_i \rvert}{\sqrt{2}}$	5.5.2.2
Pooled Coefficient of Variation, Quarterly Basis ($CV_{j,q}$). The CV_i will only be used when the two measurements are both greater than 6 µg/m3.	$CV_{j,q} = \sqrt{\sum_{i=1}^{n_j} \frac{CV_i^2}{n_{j,q}}}$	5.5.2.3 (a)
Completeness	$Completeness = \frac{N_{valid}}{N_{theoretical}} * 100$	--

19.8 Data Flagging -Sample Qualifiers

A sample qualifier or a result qualifier consists of 3 alphanumeric characters which 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 is not to be reported outside the laboratory. Qualifiers will be used both in the field and in the laboratory to signify data that may be suspect due to contamination, special events, or failure of QC limits. Some flags will be generated by the sampling instrument (see Table 6-2). Appendix D contains a complete list of the data qualifiers for the field and laboratory activities. Qualifiers will be placed on field and bench sheets with additional explanations in free form notes areas. When sample batch information is entered into DAS and the validation process run (see Section 23) flags will be generated. Table 19-7 lists the sample batch flags that will be generated by the DAS.

Table 19-7 Sample Batch Quality Control Flags

Requirement	Acceptance Criteria	Flag
Blanks		
Field Blanks	$\pm$30 μg difference	FFB
Lab Blanks	$\pm$15 μg difference	FLB
Precision Checks		
Collocated samples	CV $\leq$ 10%	FCS
Laboratory Duplicate	$\pm$15 μg	FLD
Accuracy		
Balance Check	$\leq$ 3 μg	FIS

Other data that is entered into the DAS will also generate the following flags:

- Filter holding time exceeded (HTE)
- 24 hour laboratory temperature criteria exceeded (FLT)
- 24 hour relative humidity criteria exceeded (FLH)
- Below quantitation limit (6 $\mu g/m^3$) for collocated pairs (BLQ)

During the sample validation process, the flags will be used to decide on validating or invalidating individual samples or batches of data. Section 23 discusses this process.

19.9 Data Tracking

Data management includes tracking the status of data as they are collected, transmitted, and processed. The QAPP should describe the established procedures for tracking the flow of data through the data processing system.

The $PM_{2.5}$ DAS contains the necessary input functions and reports necessary to track and account for the whereabouts of filters and the status of data processing operations for specific data. Information about filter location is updated at distributed data entry terminals at the points of significant operations. The following input locations are used to track filter location and status:

- Laboratory
  - Filter receipt (by lot)
  - Filter pre-sampling weighing (individual filter number first enters the system)
  - Filter packaged for the laboratory (filter numbers in each package are recorded)
- Shipping (package numbers are entered for both sending and receiving)
- Laboratory
  - Package receipt (package is opened and filter numbers are logged in)
  - Filter post-sampling weighing
  - Filter archival

In most cases the tracking data base and the monitoring data base are updated simultaneously. For example, when the filter is pre-weighed, the weight is entered into the monitoring data base and the filter number and status are entered into the tracking data base. The Palookaville Department of Health has requested permission from the Regional EPA to use this electronic system in lieu of the paper forms previously used for chain-of-custody tracking. Until this request is approved, a parallel paper chain-of-custody system will remain in place.

Tracking reports may be generated by any personnel with report privileges on the DAS. The following tracking reports are available:

- Location of any filter (by filter number)
- List of all filters sent to a specified site that have not been returned
- List of all filters that have not been returned and are more than 30 days past initial weighing date
- List of all filters in the filter archive
- List of all filters that have been received but have not been post-weighed
- Ad hoc reports can also be generated using Microsoft Access® queries

The Air Division QA Officer or designee is responsible for tracking filter status at least twice per week and following up on anomalies such as excessive holding time in the laboratory before reweighing.

19.10 Data Storage and Retrieval

The QAPP should discuss data storage and retrieval including security and time of retention, and it should document the complete control system. The QAPP should also discuss the performance requirements of the data processing system, including provisions for the batch processing schedule and the data storage facilities.

Data archival policies for the $PM_{2.5}$ data are shown in Table 19-8.

Table 19-8 Data Archive Policies

Data Type	Medium	Location	Retention Time	Final Disposition
Weighing records; chain of custody forms	Hardcopy	Laboratory	3 years	Discarded
Laboratory Notebooks	Hardcopy	Laboratory	3 years	N/A
Field Notebooks	Hardcopy	Air Quality Division	3 years	Discarded
$PM_{2.5}$MP Data Base (excluding Audit Trail records)	Electronic (on-line)	Air Quality Division	indefinite (may be moved to backup media after 5 years)	Backup tapes retained indefinitely
$PM_{2.5}$MP Audit Trail records	Electronic (backup tapes)	Air Quality Division	3 years	Discarded
Filters	Filters	Laboratory	1 year	Discarded

The $PM_{2.5}$ data reside on an IBM-PC compatible computer in the Air Quality Division. This computer has the following specifications:

- Processor: Dual Pentium-Pro 180 MHZ
- Operating System: Windows NT Server
- Memory: 128 MB
- Storage: 18 GB (SCSI RAID 0 array)
- Backup: DAT (3 GB per tape) - incremental backups daily; full backups biweekly
- Network: Windows NT, 100 Mbps Ethernet network (currently 23 Windows 95 and NT workstations on site; additional workstations via 28.8 kbps dial-in modem)
- Data Base Software: Microsoft Access, Visual Basic, Visual C++
- Security: Password protection on all workstations and dial-in lines; Additional password protection applied by application software

Security of data in the $PM_{2.5}$ data base is ensured by the following controls:

- Password protection on the data base that defines three levels of access to the data
- Regular password changes (quarterly for continuing personnel; passwords for personnel leaving the Air Division will be canceled immediately)
- Independent password protection on all dial-in lines
- Logging of all incoming communication sessions, including the originating telephone number, the user's ID, and connect times
- Storage of media including backup tapes in locked, restricted access areas

20.0 Assessments and Response Actions

During the planning process, many options for sampling design (ref. EPA QA/G-5S, *Guidance on Sampling Design to Support QAPPs*), sample handling, sample cleanup and analysis, and data reduction are evaluated and chosen for the project. In order to ensure that the data collection is conducted as planned, a process of evaluation of the collected data is necessary. This element of the QAPP describes the internal and external checks necessary to ensure that:

- all elements of the QAPP are correctly implemented as prescribed,
- the quality of the data generated by implementation of the QAPP is adequate, and
- corrective actions, when needed, are implemented in a timely manner and their effectiveness is confirmed.

Although any external assessments that are planned should be described in the QAPP, the most important part of this element is documenting all planned internal assessments. Generally, internal assessments are initiated or performed by the internal QA Officer so the activities described in this element of the QAPP should be related to the responsibilities of the QA Officer as discussed in Section A4.

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 (see Section 21). 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. On the other hand, 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, pollutant concentration levels, etc.

In order to ensure the adequate performance of the quality system, the Pollokaville Department of Health 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

The following is a description of various types of assessment activities available to managers in evaluating the effectiveness of environmental program implementation.

Assessment of the Subsidiary Organizations

A. *Management Systems Review (MSR).* A specific form of management assessment, this process 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. The MSR is used to ensure that sufficient management controls are in place and carried out by the organization to adequately plan, implement, and assess the results of the project. The MSR also checks the conformance of the organization's quality system with its approved QMP. See also *Guidance for the Management Systems Review Process* (EPA QA/G-3).

B. *Readiness reviews*. A readiness review is a technical check to determine if all components of the project are in place so that work can commence on a specific phase of a project.

Assessment of Project Activities

A. *Surveillance.* Surveillance is the continual or frequent monitoring of the status of a project and the analysis of records to ensure that specified requirements are being fulfilled.

B. *Technical Systems Audit (TSA)*. A TSA is a thorough and systematic onsite qualitative audit, where facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP.

C. *Performance Evaluation (PE)*. A PE is a type of audit in which the quantitative data generated by the measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory. The QAPP should list the PEs that are planned, identifying:

- the constituents to be measured,
- the target concentration ranges,
- the timing/schedule for PE sample analysis, and
- the aspect of measurement quality to be assessed (e.g., bias, precision, and detection limit).

D. *Audit of Data Quality* (ADQ) An ADQ reveals how the data were handled, what judgments were made, and whether uncorrected mistakes were made. Performed prior to producing a project's final report, ADQs can often identify the means to correct systematic data reduction errors.

E. *Peer review*. Peer review is not a TSA, nor strictly an internal QA function, as it may encompass non-QA aspects of a project and is primarily designed for scientific review. Reviewers are chosen who have technical expertise comparable to the project's performers but who are independent of the project. ADQs and peer reviews ensure that the project activities:

- were technically adequate,
- were competently performed,
- were properly documented,
- satisfied established technical requirements, and
- satisfied established QA requirements.

In addition, peer reviews assess the assumptions, calculations, extrapolations, alternative interpretations, methods, acceptance criteria, and conclusions documented in the project's report. .

F. *Data Quality Assessment (DQA)*. DQA involves the application of statistical tools to determine whether the data meet the assumptions that the DQOs and data collection design were developed under and whether the total error in the data is tolerable.

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 office of the Director. 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 $PM_{2.5}$ will be part of the MSR. Divisions to be included in the MSR include the QA, Air, and Program Support Divisions. The Office Director's staff will report its findings to the appropriate Divisions within 30 days of completion of the MSR. The report will be appropriately filed (Section 9). Follow-up and progress on corrective action(s) will be determined during regularly scheduled division directors meetings

20.1.2 Network Reviews

Conformance with network requirements of the Ambient Air Monitoring Network set forth in 40 CFR Part 58 Appendices D and E are determined through annual network reviews of the ambient air quality monitoring system. The network review is used to determine how well a particular air monitoring network is achieving its required air monitoring objective, and how it should be modified to continue to meet its objective. A $PM_{2.5}$ Network review will be accomplished every year. Since the EPA Regions are also required to perform these reviews, the Department will coordinate its activity with the Region in order to perform the activity at the same time (if possible). The Air Monitoring Branch will be responsible for conducting the network review.

The following criteria will be considered during the review:

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

In addition, pollutant-specific priorities may be considered (e.g., newly designated nonattainment areas, "problem areas", etc.).

Prior to the implementation of the network review, significant data and information pertaining to the review will be compiled and evaluated. Such information might include the following:

- network files (including updated site information and site photographs)
- AIRS reports (AMP220, 225, 380, 390, 450)

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

Upon receiving the information it will be checked to ensure it is the most current. Discrepancies will be noted on the checklist and resolved during the review. Files and/or photographs that need to be updated will also be identified. The following categories will emphasized during network reviews:

Number of Monitors-For SLAMS, the number of monitors required for $PM_{2.5}$ depending upon the measurement objectives is discussed in 40 CFR Part 58 with additional details in the *Guidance for Network Design and Optimum Exposure for $PM_{2.5}$ and PM_{10}* . Section 10 of this QAPP discusses the $PM_{2.5}$ Network. Adequacy of the network will be determined by using the following information:

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

For NAMS, areas to be monitored must be selected based on urbanized population and pollutant concentration levels. To determine whether the number of NAMS are adequate, the number of NAMS operating will be compared to the number of NAMS specified in 40 CFR 58 Appendix D. The number of NAMS operating can be determined from the AMP220 report in AIRS. The number of monitors required, based on concentration levels and population, can be determined from the AMP450 report and the latest census population data.

Location of Monitors- For SLAMS, the location of monitors is not specified in the regulations, but is determined by the Regional Office and State agencies on a case-by-case basis to meet 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 visualizing or assessing the adequacy of monitor locations. Plots of potential emissions and/or 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- Applicable siting criteria for SLAMS, and NAMS are specified in 40 CFR 58, Appendix E. The on-site visit will consist of the physical measurements and observations to determine compliance with the Appendix E requirements, such as height above ground level, distance from trees, paved or vegetative ground cover, etc. Since many of the Appendix E requirements will not change within one year, this check at each site will be performed every 3 years.

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

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

A checklist similar to the checklist used by the EPA Regional offices during their scheduled network reviews will be used. This checklist can be found in the *SLAMS/NAMS/PAMS Network Review Guidance* which is intended to assist the reviewers in determining conformance with Appendix E. In addition to the items on the checklist, the reviewer will also perform the following tasks:

- ensure that the inlet is clean
- check equipment for missing parts, frayed cords, damage, etc
- record findings in field notebook and/or checklist
- take photographs/videotape in the 8 directions
- document site conditions, with additional photographs/videotape

Other Discussion Topics- In addition to the items included in the checklists, other subjects for discussion as part of the network review and overall 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
  - -proposed regulations
  - -funding

A report of the network review will be written within two months of the review (Section 21) and appropriately filed (Section 10).

20.1.3 Technical Systems Audits

A TSA is a thorough and systematic onsite qualitative audit, where facilities, equipment, personnel, training, procedures, and record keeping are examined for conformance to the QAPP. TSAs of the $PM_{2.5}$ network will be accomplished every three years and will stagger the required TSA conducted by EPA Regional Office. The QA Office will implement the TSA either as a team or as an individual auditor. The QA Office will perform three TSA activities that can be accomplished separately or combined :

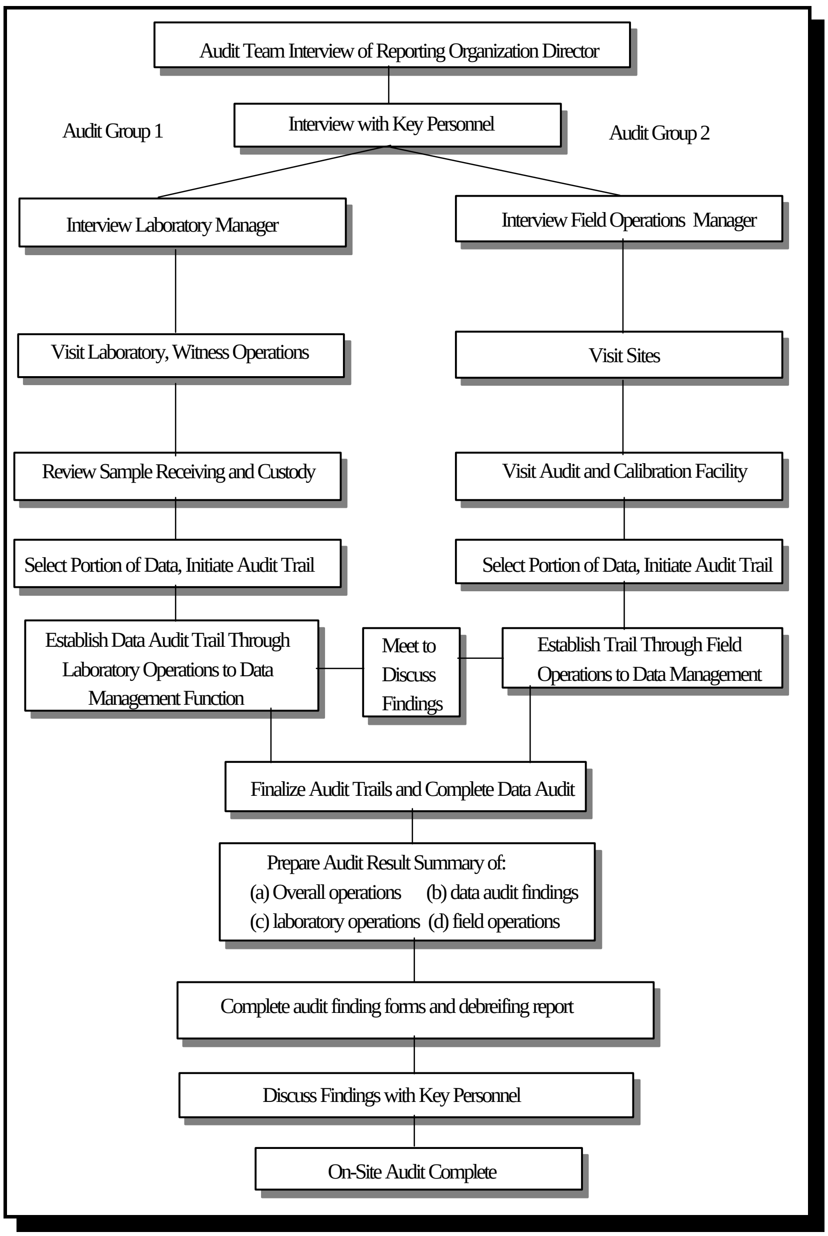

Figure 20.1 Audit Activities

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

Key personnel to be interviewed during the audit are those individuals with responsibilities for: planning, field operations, laboratory operations, QA/QC, data management, and reporting. The audit activities are illustrated in Figure 20.1.

To increase uniformity of the TSA, an audit checklist will be developed and used. It will review activities similar to the training certification forms found in Appendix B, butcontain more detail.

The audit team will prepare a brief written summary of findings, organized into the following areas: planning, field operations, laboratory operations, quality assurance/quality control, data management, and reporting. Problems with specific areas will be discussed and an attempt made to rank them in order of their potential impact on data quality. For the more serious of these problems, audit findings will be drafted (Fig. 20.2) .

The audit finding form has been designed such that one is filled out for each major deficiency that requires formal corrective action. The finding should include items like: pollutant(s) impacted, estimated time period of deficiency, site(s) affected, and reason of action. The finding form will inform the Department about serious problems that may compromise the quality of the data and therefore require specific corrective actions. They are initiated by the Audit Team, and discussed at the debriefing. During the debriefing, if the audited group is in agreement with the finding, the form is signed by the groups branch manager or his designee during the exit interview. If a disagreement occurs, the QA Team will record the opinions of the group audited and set a time at some later date to address the finding at issue.

Audit Finding

Audit Title: ___________________ **Audit #**: _____ **Finding #**:_____

____

Finding:

____

Discussion:

QA Lead Signature: **Date:**

Audited Agencies
Signature: **Date:**

Figure 20.2. Audit Finding Form

Post-Audit Activities- The major post-audit activity is the preparation of the systems audit report. The report will include:

- audit title and number and any other identifying information
- audit team leaders, audit team participants 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 requires
- attachments or appendices that include all audit evaluations and audit finding forms

To prepare the report, the audit team will meet and compare observations with collected documents and results of interviews and discussions 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 audit report will be prepared and submitted. The systems audit report will be submitted to the appropriate branch managers and appropriately filed (Section 10)

If the branch has written comments or questions concerning the audit report, the Audit Team will review and incorporate them as appropriate, and subsequently prepare and resubmit a report in final form within thirty (30) days of receipt of the written comments. The report will include an agreed-upon schedule for corrective action implementation.

Follow-up and Corrective Action Requirements- The QA Office and the audited organization may work together to solve required corrective actions. As part of corrective action and follow-up, an audit finding response form (Fig 20.3) will be generated by the audited organization for each finding form submitted by the QA Team. The audit finding response form is signed by the audited organizations Director and sent to the QA Office who reviews and accepts the corrective action. The audit response form will be completed by the audited organization within 30 days of acceptance of the audit report.

20.1.4 Audit of Data Quality (ADQ)

An ADQ reveals how the data are handled, what judgments were made, and whether uncorrected mistakes were made. ADQs can often 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 has 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/corrective action requirements as the TSA.

Audit Finding Response Form

Audited Division:___________________

Audit Title: ________________________ **Audit #:** ____ **Finding #:**____

Finding:

Cause of the problem:

Actions taken or planned for correction:

Responsibilities and timetable for the above actions:

Prepared by: _______________________ **Date:** ___________

Signed by: _______________________ **Date:** ___________

QA Division

Reviewed by: _______________________ **Date:** ___________

Remarks:

Is this audit finding closed? _______ **When?** _______

File with official audit records. Send copy to auditee

Figure 20.3. Audit Response Form

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 decision which are based on the 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*: review the DQO and develop one, if it has not already been done. Define statistical hypothesis, tolerance limits, and/or 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:* perform test and document inferences. Evaluate the performance for future use

Data quality assessment will be included in the *QA Annual Report.* Details of these reports are discussed in Section 21.

Measurement uncertainty will be estimated for both automated and manual methods. Terminology associated with measurement uncertainty are found within 40 CFR Part 58 Appendix A and includes: (a) 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; (b) 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; (c) 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

The following material describes what should be documented in a QAPP after consideration of the above issues and types of assessments:

Number, Frequency, and Types of Assessments- Depending upon the nature of the project, there may be more than one assessment. A schedule of the number, frequencies, and types of assessments required should be given.

Aassessment Personnel- The QAPP should specify the individuals, or at least the specific organizational units, who will perform the assessments. Internal audits are usually performed by personnel who work for the organization performing the project work but who are organizationally independent of the management of the project. External audits are performed by personnel of organizations not connected with the project but who are technically qualified and who understand the QA requirements of the project.

Sschedule of Assessment Activities-A schedule of audit activities, together with relevant criteria for assessment, should be given to the extent that it is known in advance of project activities.

Reporting and Resolution of Issues-Audits, peer reviews, and other assessments often reveal findings of practice or procedure that do not conform to the written QAPP. Because these issues must be addressed in a timely manner, the protocol for resolving them should be given here together with the proposed actions to ensure that the corrective actions were performed effectively. The person to whom the concerns should be addressed, the decision-making hierarchy, the schedule and format for oral and written reports, and the responsibility for corrective action should all be discussed in this element. It also should explicitly define the unsatisfactory conditions upon which the assessors are authorized to act and list the project personnel who should receive assessment reports.

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

Table 20-1 Assessment Summary

Assessment Activity	Frequency	Personnel Responsible	Schedule	Report Completion	Reporting/Resolution
Management Systems Reviews	1/3 years	Directors Office	1/1/2000	30 days after activity	Directors Office to QA, Air, Program Support Divisions
Network Reviews App D App E	 1/ years 1/3 years	 Air Division Air Division	 1/1/2000 1/1/2000	 30 days after activity	 Air Division to Air Monitoring Branch
Technical Systems Audits	1/3 years	QA Office	5/1/99	30 days after activity	QA Division to Air Monitoring Division
Audits of Data Quality	1/ year	QA Office	5/1/99	30 days after activity	QA Division to Air Monitoring Division
Data Quality Assessment	1/year	QA/Air Monitoring Divisions	1/1/2000	120 days after end of calendar year	Air Monitoring Division to Directors Office/ EPA Region

21.0 Reports to Management

Effective communication between all personnel is an integral part of a quality system. Planned reports provide a structure for apprising management of the project schedule, the deviations from approved QA and test plans, the impact of these deviations on data quality, and the potential uncertainties in decisions based on the data. Verbal communication on deviations from QA plans should be noted in summary form in element D1 of the QAPP.

This section describes the quality-related reports and communications to management necessary to support SLAMS/NAMS $PM_{2.5}$ network operations and the associated data acquisition, validation, assessment, and reporting. Unless otherwise indicated, data pertaining to $PM_{2.5}$ will be included in reports containing monitoring data for other pollutants.

Important benefits of regular QA reports to management include the opportunity to alert the management of 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, is conducted to help insure that measurement results meet program objectives and to insure that necessary corrective actions are taken early, when they will be most effective. This is particularly important in the new $PM_{2.5}$ network, as new equipment and procedures are being implemented.

Effective communication among all personnel is an integral part of a quality system. Regular, planned quality reporting provides 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 quality
- analysis of the potential uncertainties in decisions based on the data

21.1 Frequency, Content, and Distribution of Reports

The QAPP should indicate the frequency, content, and distribution of the reports so that management may anticipate events and move to ameliorate potentially adverse results. An important benefit of the status reports is the opportunity to alert the management of data quality problems, propose viable solutions, and procure additional resources. If program assessment (including the evaluation of the technical systems, the measurement of performance, and the assessment of data) is not conducted on a continual basis, the integrity of the data generated in the program may not meet the quality requirements. These audit reports, submitted in a timely manner, will provide an opportunity to implement corrective actions when most appropriate

Required reports to management for $PM_{2.5}$ 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 QA Annual Report

Periodic assessments of SLAMS data quality are required to be reported to EPA (40 CFR 58 Appendix A, Section 1.4, revised July 18, 1997). The Palookaville Health Department Air Division's *QA Annual Report* is issued to meet this requirement. This document describes the quality objectives for measurement data and how those objectives have been met.

The *QA Annual Report* also provides for the review of the SLAMS air quality surveillance system on an annual basis to determine if the system meets the monitoring objectives defined in 40 CFR Part 58, Appendix D. Such review will identify needed modifications to the network such as termination or relocation of unnecessary stations or establishment of new stations which are necessary.

The *QA Annual Report* will include Quality information for each ambient air pollutant in the Palookaville monitoring network. These sections are organized by ambient air pollutant category (e.g., gaseous criteria pollutants, $PM_{2.5}$). Each section includes the following topics:

- program overview and update
- quality objectives for measurement data
- data quality assessment

For reporting $PM_{2.5}$ measurement uncertainties, the *QA Annual Report* contains the following summary information required by 40 CFR 58 Appendix A (Section 3.5, revised July 18, 1997):

- Flow Rate Audits (Section 3.5.1)
- Collocated Federal Reference Method Samplers (Section 3.5.2)
- Collocated Equivalent Samplers of same designation (Section 3.5.2)
- Assessment of Bias Using the FRM Audit Procedure (Section 3.5.3)

21.1.2 Network Reviews

The EPA Regional office prepares annual network reviews in accord with requirements in 40 CFR Part 58.20(d). The purpose of the annual network reviews is to determine if the system meets the monitoring objectives defined in 40 CFR Part 58 Appendix D. The review identifies needed modifications to the network including termination or relocation of unnecessary stations or establishment of new stations which are necessary. Information gathering for these reviews will be coordinated through the Air Division Director. Supervisors and other personnel will assist as necessary to provide information and support. The Director of the Palookaville Department of Health is responsible for assuring that such changes are included in future planning. The Director of the Air Division and the Air Branch QA Manager are jointly responsible for implementing other review findings impacting data quality.

As required by 40 CFR Part 58 Appendix A, Section 4(a), revised July 18, 1997, the Palookaville Air Division Director has provided a list of all monitoring sites and their AIRS site identification codes and submits the list to the EPA Regional Office, with a copy to AIRS-AQS. The Aerometric Information Retrieval System (AIRS)-Air Quality Subsystem (AQS) is EPA's computerized system for storing and reporting of information relating to ambient air quality data. Whenever there is a change in this list of monitoring sites in a reporting organization, Palookaville Air Division Director will report this change to the EPA Regional Office and to AIRS-AQS.

21.1.3 Quarterly Reports

Each quarter, the Palookaville Department of Health, Air Division 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, consistent 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 are to 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 accord 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 Palookaville Air Monitoring Branch Information Manager will be responsible for preparing the data reports, which will be reviewed by the QAO and Air Branch Manager before they are transmitted to EPA.

21.1.4 Technical System Audit Reports

The Palookaville Department of Health performs Technical System Audits of the monitoring system (section 20) . These reports are issued by the QA Division Director and are reviewed by the Air Division Director and the Director of the Department of Health. These reports will be filed (see table 9-1) and made available to EPA personnel during their technical systems audits.

External systems audits are conducted at least every three years by the EPA Regional Office as required by 40 CFR Part 58, Appendix A, Section 2.5. Further instructions are available from either the EPA 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. A separate form (see fig 20.2) will be used for each problem identified. 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 is 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 the effectiveness of the solution. Copies of the Response/Corrective Action Report will be distributed twice: first when the problem has been identified and the action has been scheduled; and second when the correction has been completed. The originator, the field or laboratory branch manager, and the QA Division Director will be included in both distributions.

21.1.6 Control Charts with Summary

Control charts for laboratory instruments are updated after every new calibration or standardization as defined in the relevant SOP. Analysts are responsible for reviewing each control chart immediately after it is updated and for taking corrective actions whenever an out-of-control condition is observed. Control charts are to be reviewed at least quarterly by the laboratory supervisor. The supervisors will provide summary information to the QA Division Director for the Annual QA Report to Management. Control charts are also subject to inspection during audits, and laboratory personnel are responsible for maintaining a readily-accessible file of control charts for each instrument.

21.2 Responsible Organizations

It is important that the QAPP identify the personnel responsible for preparing the reports, evaluating their impact, and implementing follow-up actions. It is necessary to understand how any changes made in one area or procedure may affect another part of the project. Furthermore, the documentation for all changes should be maintained and included in the reports to management. At the end of a project, a report documenting the Data Quality Assessment findings to management should be prepared.

This section outlines the responsibilities of individuals 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.

Director of the Palookaville Department of Health - The ultimate responsibility for the quality of the data and the technical operation of the fine particle monitoring network rests with the Director of the Palookaville Department of Health. The Director's responsibilities with respect to air quality reporting are delegated to the Director of the Air Division. These responsibilities include defining and implementing the document management and quality assurance systems for the $PM_{2.5}$ monitoring network.

Air Division Director - The Air Division Director is responsible for operation of the air quality network. The Air Division Director is specifically responsible for assuring the timely submittal of quarterly and annual data summary reports. The Air Director works closely with the Air Branch QA Manager in implementation of QA procedures, arranging for audits, and reporting QA data.

QA Division Director - The QA Division Director is responsible for establishing QA policies and systems employed by the Palookaville Health Department. The QA Division Director reviews the *QA Annual Report* and provides general supervision to the QA Directors of the various Branches.

QA Manager and QA Officer - The QA Manager is responsible for management and administrative aspects of the Air QA program including coordinating audits and preparing required reports. The QA Officer is appointed by the Air Branch QA Manager to be responsible for day-to-day conduct of QA activities for the Ambient Air Monitoring Program. The QA Officer's responsibilities for QA reports to management include the following:

- assisting the Air Branch Manager with data quality assessments and other internal audits
- calculating and/or reviewing precision and bias data generated by the collocated $PM_{2.5}$ monitors
- reviewing control charts and other laboratory QC materials
- monitoring Response/Corrective Action Reports

Information Manager - The Information Manager is responsible for coordinating the information management activities for SLAMS/NAMS data. Specific responsibilities related to management reports include:

- ensuring access to data for timely reporting and interpretation
- ensuring timely delivery of all required data to the AIRS system

Air Branch Manager - The Air Branch Manager is responsible for identifying problems and issuing appropriate Response/Corrective Action Reports. He is also responsible for assigning Response/Corrective Action Reports to specific personnel and assuring that the work is completed and that the corrections are effective. The Branch Manager is also responsible for assuring that technicians and site operators under their supervision maintain their documentation files as defined in the network design. Supervisors are responsible for disseminating information appearing in audit reports and other quality-related documents to operations personnel.

Laboratory Branch Manager - The Laboratory Branch Manager is responsible for identifying problems and issuing appropriate Response/Corrective Action Reports related to laboratory activities. He is also responsible for reviewing laboratory QC data such as control charts and for assuring that repairs and preventive maintenance are completed and that the maintenance is effective. The Branch Manager is also responsible for assuring that analysts under their supervision maintain their documentation files as defined in the relevant SOPs. The Laboratory Branch Manager will assist the QA Officer in preparing QA reports and summaries and is responsible for disseminating information appearing in audit reports and other quality-related documents to operations personnel.

Field and Laboratory Technicians - Individual technicians and analysts are not normally responsible for authoring reports to management. However, they 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

The purpose of this element is to state the criteria for deciding the degree to which each data item has met its quality specifications. Investigators should estimate the potential effect that each deviation from a QAPP may have on the usability of the associated data item, its contribution to the quality of the reduced and analyzed data, and its effect on the decision.

The process of data verification requires confirmation by examination or provision of objective evidence that the requirements of these specified QC acceptance criteria are met. In design and development, verification concerns the process of examining the result of a given activity to determine conformance to the stated requirements for that activity. For example, have the data been collected according to a specified method and have the collected data been faithfully recorded and transmitted? Do the data fulfill specified data format and metadata requirements? The process of data verification effectively ensures the accuracy of data using validated methods and protocols and is often based on comparison with reference standards.

The process of data validation requires 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. For example, have the data and assessment methodology passed a peer review to evaluate the adequacy of their accuracy and precision in assessing progress towards meeting the specific commitment articulated in the objective or subobjective. The method validation process effectively develops the QC acceptance criteria or specific performance criteria.

Each of the following areas of discussion should be included in the QAPP elements. The discussion applies to situations in which a sample is separated from its native environment and transported to a laboratory for analysis and data generation. However, these principles can be adapted to other situations (for example, *in-situ* analysis or laboratory research).

This section will describe how the Palookaville Department of Health will verify and validate the data collection operations associated with the $PM_{2.5}$ ambient air monitoring network. **Verification** can be defined as confirmation by examination and provision of objective evidence that *specified requirements* have been fulfilled. **Validation** can 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 of ambient air data, the major objective for the Palookaville $PM_{2.5}$ network is for comparison to the NAAQS standard and therefore, this will be identified as the intended use. This section will describe the verification and validation activities that occur at a number of the important data collection phases. Earlier elements of this QAPP describe in detail how the activities in these data collection phases will be implemented 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 Department will use various qualitative assessments (e.g., technical systems audits, network reviews) 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 described in Section 7.

22.1 Sampling Design

How closely a measurement represents the actual environment at a given time and location is a complex issue that is considered during development of element B1. See *Guidance on Sampling Designs to Support QAPPs (*EPA QA/G-5S). Acceptable tolerances for each critical sample coordinate and the action to be taken if the tolerances are exceeded should be specified in element B1.

Each sample should be checked for conformity to the specifications, including type and location (spatial and temporal). By noting the deviations in sufficient detail, subsequent data users will be able to determine the data's usability under scenarios different from those included in project planning. The strength of conclusions that can be drawn from data (see *Guidance Document for Data Quality Assessment*, EPA QA/G-9) has a direct connection to the sampling design and deviations from that design. Where auxiliary variables are included in the overall data collection effort (for example, microbiological nutrient characteristics or process conditions), they should be included in this evaluation.

Section 10 describes the sampling design for the network established by Palookaville. It covers 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, it is the responsibility of Palookaville to ensure 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:

Network Design Plan Confirmation - The Network Design Plan that discusses the initial deployment of the network must be submitted, reviewed and approved by EPA prior to implementation. This process verifies the initial sampling design.

Internal Network Reviews -Once a year, the Air Division 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 (see Section 20).

External Network Reviews - Every three year the EPA Regional Office will conduct 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.

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, the Department will use saturation monitors as well as special purpose monitors to validate that the monitors are properly sited and that the sampling design will meet the objectives of the network. This information will be included in network review documentation and appropriately communicated the EPA Regional Office. In addition, the processes described in Section 10 will be used to confirm the network design.

22.2 Sample Collection Procedures

Details of how a sample is separated from its native time/space location are important for properly interpreting the measurement results. Element B2 provides these details, which include sampling and ancillary equipment and procedures (including equipment decontamination). Acceptable departures (for example, alternate equipment) from the QAPP, and the action to be taken if the requirements cannot be satisfied, should be specified for each critical aspect. Validation activities should note potentially unacceptable departures from the QAPP. Comments from field surveillance on deviations from written sampling plans also should be noted.

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 processes will be used to verify the sampling collection activities:

Internal Technical Systems Audits - will be required ever three years as described in Section 20

External Technical Systems Audits - will be conducted by the EPA Regional Y Office every three years

Both types 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 audit finding forms and corrected using the procedures described in Section 20.

22.2.2 Sample Collection Validation

The sample collection activity is just 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 QC data such as the collocated sampling data, field blanks, the FRM performance evaluation, and the sampling equipment verification checks that are described in section 14 and 16 can be used to validate the data collection activities. Any data that indicates 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

Details of how a sample is physically treated and handled during relocation from its original site to the actual measurement site are extremely important. Correct interpretation of the subsequent measurement results requires that deviations from element B3 of the QAPP and the actions taken to minimize or control the changes, be detailed. Data collection activities should indicate events that occur during sample handling that may affect the integrity of the samples.

At a minimum, investigators should evaluate the sample containers and the preservation methods used and ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. Checks on the identity of the sample (e.g., proper labeling and chain-of-custody records) as well as proper physical/chemical storage conditions (e.g., chain-of-custody and storage records) should be made to ensure that the sample continues to be representative of its native environment as it moves through the analytical process. .

Sections 11, 12, and 17 detail the requirements for sampling handling, including the types of sample containers and the preservation methods used to ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. Due to the size of the filters and the nature of the collected particles, sample handling is one of the phases where inappropriate techniques can have a significant effect on sample integrity and data quality

22.3.1 Verification of Sample Handling

As mentioned in the above section, both internal and external technical systems audits will be performed to ensure the specifications mentioned in the QAPP are being followed. The audits would include checks on the identity of the sample (e.g., proper labeling and chain-of-custody records), packaging in the field, and proper storage conditions (e.g., chain-of-custody and storage records) to ensure that the sample continues to be representative of its native environment as it moves through the data collection operation.

22.3.2 Validation of Sample Handling

Similar to the validation of sampling activities, the review of data from collocated sampling, field blanks, and the FRM performance evaluations, that are described in section 14 and 16, can be used to validate the sample handling activities. Acceptable precision and bias in these samples would lead one to believe that the sample handling activities are adequate. Any data that indicates 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 handling activities that require corrective action.

22.4 Analytical Procedures

Each sample should be verified to ensure that the procedures used to generate the data (as identified in element B4 of the QAPP) were implemented as specified. Acceptance criteria should be developed for important components of the procedures, along with suitable codes for characterizing each sample's deviation from the procedure. Data validation activities should determine how seriously a sample deviated beyond the acceptable limit so that the potential effects of the deviation can be evaluated during DQA.

Sections 13 details the requirements for the analytical methods, which include the pre-sampling weighing activities that give each sample a unique identification, an initial weight, and prepares 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 (section 13 and 14) for important components of the procedures, along with suitable codes for characterizing each sample's deviation from the procedure

22.4.1 Verification of Analytical Procedures

As mentioned in the above sections, 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 audit finding forms and corrected using the procedures described in Section 20.

22.4.2 Validation of Analytical Procedures

Similar to the validation of sampling activities, the review of data from lab blanks, calibration checks, laboratory duplicates and other laboratory QC that are described in sections 14 and 16 can be used to validate the analytical procedures. Acceptable precision and bias in these samples would lead one to believe that the analytical procedures are adequate. Any data that indicates unacceptable levels of bias or precision or a tendency (trend on a control chart) will be flagged and investigated as described in Section 14. This investigation could lead to a discovery of inappropriate analytical procedures, requiring corrective action.

22.5 Quality Control

Element B5 of the QAPP specifies the QC checks that are to be performed during sample collection, handling, and analysis. These 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, acceptance criteria, and corrective action (and changes) should be specified. Data validation should document the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data.

Sections 14 and 16 of this QAPP specify the QC checks that are to be performed during sample collection, handling, and analysis. These 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, acceptance criteria, and corrective action are specified.

22.5.1 Verification of Quality Control Procedures

As mentioned in the above sections, both internal and external technical systems audits will be performed to ensure the quality control method specifications mentioned in the QAPP are being followed.

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 that 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

Element B7 addresses the calibration of instruments and equipment and the information that should be presented to ensure that the calibrations:

- were performed within an acceptable time prior to generation of measurement data;
- were performed in the proper sequence;
- included the proper number of calibration points;
- were performed using standards that “bracketed” the range of reported measurement results (otherwise, results falling outside the calibration range should be flagged as such); and
- had acceptable linearity checks and other checks to ensure that the measurement system was stable when the calibration was performed.

When calibration problems are identified, any data produced between the suspect calibration event and any subsequent recalibration should be flagged to alert data users.

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 $PM_{2.5}$ network.

22.6.1 Verification of Calibration Procedures

As mentioned in the above sections, both internal and external technical systems audits will be performed to ensure the calibration specifications and corrective actions mentioned in the QAPP are being followed. Deviations from the calibration procedures will be noted in audit finding forms and corrected using the procedures described in Section 20.

22.6.2 Validation of Calibration Procedures

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

22.7 Data Reduction and Processing

Checks on data integrity evaluate the accuracy of "raw" data and include the comparison of important events and the duplicate rekeying of data to identify data entry errors.

Data reduction is an irreversible process that involves a loss of detail in the data and may involve averaging across time (for example, hourly or daily averages) or space (for example, compositing results from samples thought to be physically equivalent). Since this summarizing process produces few values to represent a group of many data points, its validity should be well-documented in the QAPP. Potential data anomalies can be investigated by simple statistical analyses (see *Guidance for Data Quality Assessment*, EPA QA/G-9).

The information generation step involves the synthesis of the results of previous operations and the construction of tables and charts suitable for use in reports. How information generation is checked, the requirements for the outcome, and how deviations from the requirements will be treated, should be addressed in this element.

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, discussed in section 20, 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 information)
- Calibration -the calibration information represented from that sampling period
- Sample handling/custody
- Post-sampling weighing
- Corrective action
- Data reduction

This raw data will be reviewed and final concentrations will be calculated by hand to determine if the final vales submitted to AIRS compare to the hand calculations. The data will also be reviewed to ensure that associated flags or any other data qualifiers have been appropriately associated with the data and that appropriate corrective actions were taken.

23.0 Validation and Verification Methods

The purpose of this element is to describe, in detail, the process for validating (determining if data satisfy QAPP-defined user requirements) and verifying (ensuring that conclusions can be correctly drawn) project data. The amount of data validated is directly related to the DQOs developed for the project. The percentage validated for the specific project together with its rationale should be outlined or referenced. Diagrams should be developed showing the various roles and responsibilities with respect to the flow of data as the project progresses. The QAPP should have a clear definition of what is implied by "verification" and "validation."

READERS NOTE

The material in this section is an example. At the time of the development of this document a $PM_{2.5}$ QA Workgroup was working on devising a consistent method for validating $PM_{2.5}$ data based on the review of various QC information. The following material displays the concepts of the ongoing discussions but not the consensus validation criteria.

Many of the processes for verifying and validating the measurement phases of the $PM_{2.5}$ 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, one would expect to achieve the $PM_{2.5}$ DQOs. However, exceptional field events may occur, and field and laboratory activities may negatively effect the integrity of samples. In addition, it is expected that some of the QC checks will fail to meet the acceptance criteria. Information on problems that effect the integrity of data are identified in the form of flags (Appendix D). It is important to determine how these failures effect the routine data. The review of this routine data and their associated QC data will be verified and validated on a sample batch basis. Section 14.2 discusses the concept and use of sample batching. The sample batch is the most efficient entity for verification/validation activities. It is assumed that if measurement uncertainty can be controlled within acceptance criteria, at a batch level, then the overall measurement uncertainty will be maintained within the precision and bias DQOs.

23.1 Describe the Process for Validating and Verifying Data

Each sample should be verified to ensure that the procedures used to generate the data (as identified in element B4 of the QAPP) were implemented as specified. Acceptance criteria should be developed for important components of the procedures, along with suitable codes for characterizing each sample's deviation from the procedure. Data validation activities should determine how seriously a sample deviated beyond the acceptable limit so that the potential effects of the deviation can be evaluated during DQA.

23.1.1 Verification of Sample Batches

After a sample batch is completed, a thorough review of the data will be conducted for completeness and data entry accuracy. All raw data that is hand entered on data sheets will be double keyed as discussed in Section 19, into the DAS. The entries are compared to reduce the possibility of entry and transcription errors. Once the data is entered into the DAS, 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" that the values are entered correctly. Details of these activities are discussed in Section 19. The data qualifiers or flags can be found in Appendix D.

23.1.2 Validation

Validation of measurement data will require two stages, one at the measurement value level, and the second at the batch level. Records of all invalid samples will be filed. Information will include a brief summary of why the sample was invalidated along with the associated flags. This record will be available on the DAS since all filters that were pre-weighed will be recorded. At least one flag will be associated with an invalid sample, that being the "INV" flag signifying invalid, or the "NAR" flag when no analysis result is reported. Additional flags will usually be associated with the NAR or INV flags that help describe the reason for these flags, as well as free form notes from the field operator or laboratory technician.

If the number of samples being invalidated or relatively small, the department will report them on a monthly basis to Region Y. If however, more than 5 values, in sequential order, from one site appears to require invalidation, Region Y will be notified and the issue described.

Validation of Measurement Values --

Certain criteria based upon CFR and field operator and laboratory technician judgement have been developed that will be used to invalidate a sample or measurement. The flags listed in Appendix D will be used to determine if individuals samples, or samples from a particular instrument will be invalidated. In all cases the sample will be returned to the laboratory for further examination. When the laboratory technician reviews the field sheet and chain-of -custody forms he/she will look for flag values. Filters that have flags related to obvious contamination (CON), filter damage (DAM), field accidents (FAC) will be immediately examined. Upon concurrence of the laboratory technician and laboratory branch manager, these samples will be invalidated. The flag "NAR" for no analysis result will be placed in the flag area associated with this sample, along with the other associated flags.

Other flags listed in Appendix D may be used alone or in combination to invalidate samples. Since the possible flag combinations are overwhelming and can not be anticipated, the Department will review these flags and determine if single values or values from a site for a particular time period will be invalidated. The Department will keep a record of the combination of flags that resulted in invalidating a sample or set of samples. These combinations will be reported to Region Y and will be used to ensure that the Department evaluates and invalidates data consistently from one batch to the next. It is anticipated that the these combinations can be programmed into the DAS system in order to assist the laboratory in evaluating data. As mentioned above, all data invalidation will be documented. Table 23-1 and 23-2 contains criteria that can be used to invalidate single samples based on single flags (Table 23-1) or a combination of flags (Table 23-2)

Table 23-1 Single Flag Invalidation Criteria for Single Samples

Requirement	Flag	Comment
Contamination	CON	Concurrence with lab technician and branch manager
Filter Damage	DAM	Concurrence with lab technician and branch manager
Event	EVT	Exceptional , known field event expected to have effected sample . Concurrence with lab technician and branch manager
Laboratory Accident	LAC	Concurrence with lab technician and branch manager
Field Accident	FAC	Concurrence with lab technician and branch manager
Flow Rate Cutoff	FVL	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]	**Flag**
Flow Rate	≤ ± 5% of 16.67 L/min. for < 5 min	>10%	>5%	FLR
Flow Rate Verification	≤ 4% of transfer standard	> 6%	> 4%	FLV
Filter Temp	.> 5^o C for < 30 min	> 10^oC	.> 5^o C	FLT
Elapsed Sample Time	> 1380* or < 1500 minutes	> 1530	>1500	EST
Holding Times Pre-sampling Sample Recovery Post-sampling 25°C 4°C	 ≤ 30 days ≤ 96 hours ≤ 10 days ≤ 30 days	 >32 days >100 hours >12 days >32 days	 >30 days >96 hours >10 days >30 days	 HTE “ “ “

*- sample will still be used with sample period calculated with a time of 1440 minutes and flagged
1-if 2 majors occur data invalidated
2-if 4 minors occur data invalidated. 2 minors equal 1 major

Validation of Sample Batches --

Due to the nature and holding times of the routine samples, it is critical that the Department minimize the amount of data that is invalidated. Therefore, the Department will validate data on sample batches that are described in Section 14.2. Based on the types of QC samples that are included in the batch and the field and laboratory conditions that are reported along with the batch (field/lab flags), the Department has developed a validation template that will be used to determine when routine data will be invalidated and when major corrective actions need to be instituted. Table 23-3 represents the validation template.

Table 23-3 Validation Template

Requirement	# per batch	Acceptance Criteria	Major[1]	Minor[2]	Flag
Blanks					
Field Blanks	3	$\leq \pm$ 30 μg	both blanks >$\pm$ 30 μg	one blank >$\pm$ 30 μg	FFB
Lab Blanks	3	$\leq \pm$15 μg	both blanks >$\pm$ 15 μg	one blank >$\pm$ 15 μg	FLB
Precision Checks					
Collocated pairs	2	PD $\leq$ 10%	both samples > 15%	one sample > 15%	FCS
Duplicate weight	1	$\leq \pm$15 μg	duplicate >$\pm$ 20 μg	duplicate >$\pm$ 15 μg	FLD
Accuracy					
Balance Checks	7	$\leq \pm$3 μg	4 checks > $\pm$3 μg	2 checks > $\pm$3 μg	FIS
Lab Conditions					
Temperature	1	Mean 20-23ºC $\leq \pm$ 2ºC	Mean >25º or <18º > $\pm$ 4º	Mean 23-25º or 18-20º > $\pm$ 2º < $\pm$ 4º	ISP ISP
Humidity	1	30-40% $\leq \pm$ 5%	Mean > 45% or < 20% >$\pm$ 7%	Mean > 45% or < 20% > $\pm$ 5% < $\pm$ 7%	ISP ISP

1-if 2 majors occur data invalidated
2-if 4 minors occur data invalidated. 2 minors equal 1 major

Based upon the number of major and minor flags associated with the batch, the batch may be invalidated. The DAS system will evaluate the batch and generate a report based upon the results described in the validation template. If the report describes invalidating the batch of data, the batch will be reanalyzed. Prior to reanalysis, all efforts will be made to take corrective actions, depending on the type of QC checks that were outside of acceptance criteria, to correct the problem. If the batch remains outside the criteria, the routine samples will be flagged invalid (INV). Each month a summary report of all data that was invalidated will be submitted to Region Y along with explanations.

24.0 Reconciliation with Data Quality Objectives

24.1 Reconciling Results with DQOs

The DQA process has been developed for cases where formal DQOs have been established. *Guidance for Data Quality Assessment* (EPA QA/G-9) focuses on evaluating data for fitness in decision- making and also provides many graphical and statistical tools.

DQA is a key part of the assessment phase of the data life cycle, as shown in Figure 9. As the part of the assessment phase that follows data validation and verification, DQA determines how well the validated data can support their intended use. If an approach other than DQA has been selected, an outline of the proposed activities should be included

The DQOs for the $PM_{2.5}$ ambient air monitoring network were developed in Section 7. The resulting DQOs are for precision, as measured by a coefficient of variation, to be less than 10% and for relative bias to be between -10% and +10%. This section of the QAPP will outline the procedures that Palookaville 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 an assessment is termed a Data Quality Assessment (DQA) and is thoroughly described in *EPA QA/G-9: Guidance for Data Quality Assessment*[2]. An assessment of the quality of the data will be made at the site level as well as at the Palookaville level.

24.1.1 Five Steps of DQA Process

As described in *EPA QA/G-9*[2], the DQA process is comprised of five steps. The steps are detailed below.

Step 1. Review DQOs and Sampling Design. Section 7 of this QAPP contains the details for the development of the DQOs, including defining the primary objective of the $PM_{2.5}$ ambient air monitoring network ($PM_{2.5}$ NAAQS comparison), translating the objective into a statistical hypothesis (3-year average of annual mean $PM_{2.5}$ concentrations less than or equal to 15 $\mu g/m^3$ and 3-year average of annual 98th percentiles of the $PM_{2.5}$ concentrations less than or equal to 65 $\mu g/m^3$), and developing limits on the decision errors (incorrectly conclude area in non-attainment when it truly is in attainment no more than 5% of the time, and incorrectly conclude area in attainment when it truly is in non-attainment no more than 5% of the time).

Section 10 of this QAPP contains the details for the sampling design, including the rationale for the design, the design assumptions, and the sampling locations and frequency. If any deviations from the sampling design have occurred, these will be indicated and their potential effect carefully considered throughout the entire DQA.

Step 2. Conduct Preliminary Data Review. A preliminary data review will be performed to uncover potential limitations to using the data, to reveal outliers, and generally to explore the basic structure of the data. The first step is to review the quality assurance reports. The second step is to calculate basic summary statistics, generate graphical presentations of the data, and review these summary statistics and graphs.

Review Quality Assurance Reports. Palookaville will review all relevant quality assurance reports that describe the data collection and reporting process. Particular attention will be directed to looking for anomalies in recorded data, missing values, and any deviations from standard operating procedures. This is a qualitative review. However, any concerns will be further investigated in the next two steps.

Calculation of Summary Statistics and Generation of Graphical Presentations. Palookaville will generate some summary statistics for each of its primary and QA samplers. The summary statistics will be calculated at the quarterly, annual, and three-year levels and will include only valid samples. The summary statistics are:

> Number of samples, mean concentration, median concentration, standard deviation, coefficient of variation, maximum concentration, minimum concentration, interquartile range, skewness and kurtosis.

These statistics will also be calculated for the percent differences at the collocated sites. The results will be summarized in a table. Particular attention will be given to the impact on the statistics caused by the observations noted in the quality assurance review. In fact, Palookaville may evaluate the influence of a potential outlier by evaluating the change in the summary statistics resulting from exclusion of the outlier.

Palookaville will generate some graphics to present the results from the summary statistics and to show the spatial continuity over Palookaville. Maps will be created for the annual and three-year means, maxima, and interquartile ranges for a total of 6 maps. The maps will help uncover potential outliers and will help in the network design review. Additionally, basic histograms will be generated for each of the primary and QA samplers and for the percent difference at the collocated sites. The histograms will be useful in identifying anomalies and evaluating the normality assumption in the measurement errors.

Step 3. Select the Statistical Test. The primary objective for the $PM_{2.5}$ mass monitoring is determining compliance with the $PM_{2.5}$ NAAQS. As a result, the null and alternative hypotheses are:

$$H_0\text{: } X \quad 15\ \mu g/m^3 \ \ and \ \ Y \quad 65\ \mu g/m^3$$
$$H_A\text{: } X > 15\ \mu g/m^3 \ \ or \ \ Y > 65\ \mu g/m^3$$

where *X* is the three-year average $PM_{2.5}$ concentration and *Y* is the three-year average of the annual

98th percentiles of the $PM_{2.5}$ concentrations recorded for an individual monitor. The exact calculations for *X* and *Y* are specified in 40 CFR Part 50 Appendix N[4]. The null hypothesis is rejected, that is, it is concluded that the area is not in compliance with the $PM_{2.5}$ NAAQS when the observed three-year average of the annual arithmetic mean concentration exceeds 15.05 µg/m^3 or when the observed three-year average of the annual 98th percentiles exceeds 65.5 µg/m^3. If the bias of the sampler is greater than -10% and less than +10% and the precision is within 10%, then the error rates (Type I and Type II) associated with this statistical test are less than or equal to 5%. The definitions of bias and precision will be outlined in the following step.

Step 4. Verify Assumptions of Statistical Test. The assumptions behind the statistical test include those associated with the development of the DQOs in addition to the bias and precision assumptions. Their method of verification will be addressed in this step. Note that when less than three years of data are available, this verification will be based on as much data as are available.

The DQO is based on the annual arithmetic mean NAAQS. For each primary sampler, Palookaville will determine which, if either, of the $PM_{2.5}$ NAAQS is violated. In the DQO development, it was assumed that the annual standard is more restrictive than the 24-hour one. If there are any samplers that violate ONLY the 24-hour NAAQS, then this assumption is not correct. The seriousness of violating this assumption is not clear. Conceptually, the DQOs can be developed based on the 24-hour NAAQS and the more restrictive bias and precision limits selected. However, Palookaville will assume the annual standard is more restrictive, until proven otherwise.

Normal distribution for measurement error. Assuming that measurement errors are normally distributed is common in environmental monitoring. Palookaville has not investigated the sensitivity of the statistical test to violation of this assumption; although, small departures from normality generally do not create serious problems. Palookaville will evaluate the reasonableness of the normality assumption by reviewing a normal probability plot, calculating the Shapiro-Wilk W test statistic (if sample size less than 50), and calculating the Kolmogorov-Smirnoff test statistic (if sampler size greater than 50). All three techniques are provided by standard statistical packages and by the statistical tools provided in *EPA QA/G-9D: Data Quality Evaluation Statistical Tools*[1] *(DataQUEST)*. If the plot or statistics indicate possible violations of normality, Palookaville may need to determine the sensitivity of the DQOs to departures in normality.

Decision error can occur when the estimated 3-year average differs from the actual, or true, 3-year average. This is not really an assumption as much as a statement that the data collected by an ambient air monitor is stochastic, meaning that there are errors in the measurement process, as mentioned in the previous assumption.

The limits on precision and bias are based on the smallest number of required sample values in a 3-year period. In the development of the DQOs, the smallest number of required samples was used. The reason for this was to ensure that the confidence was sufficient in the minimal case; if more samples are collected, then the confidence in the resulting decision will be even higher. For each of the samplers, Palookaville will determine how many samples were collected in each quarter. If this number meets or exceeds 12, then the data completeness requirements for the DQO are met.

The decision error limits were set at 5%. Again, this is more of a statement. If the other assumptions are met, then the decision error limits are less than or equal to 5%.

Measurement imprecision was established at 10% coefficient of variation (CV). For each sampler, Palookaville will review the coefficient of variation calculated in Step 2. If any exceed 10%, Palookaville may need to determine the sensitivity of the DQOs to larger levels of measurement imprecision.

Table 24-1 will be completed during each DQA. The table summarizes which, if any, assumptions have been violated. A check will be placed in each of the row/column combinations that apply. Ideally, there will be no checks. However, if there are checks in the table, the implication is that the decision error rates are unknown even if the bias and precision limits are achieved. As mentioned above, if any of the DQO assumptions are violated, then Palookaville will need to reevaluate its DQOs.

Table 24-1. Summary of Violations of DQO Assumptions

Site	Violate 24-Hour Standard ONLY?	Measurement Errors Non-Normal?	Data Complete? (12 samples per quarter)	Measurement CV > 10%?
Primary Samplers				
A1				
A2				
A3				
A4				
B1				
QA Samplers				
A1				
B1				

Achievement of bias and precision limits. Lastly, Palookaville will check the assumption that at the three-year level of aggregation the sampler bias is in [-10%,10%] and precision is less than 10%. The data from the collocated samplers will be used to estimate quarterly, annual, and three-year bias and precision estimates even though it is only the three-year estimates that are critical for the statistical test.

Since all the initial samplers being deployed by Palookaville will be FRMs, the samplers at each of the collocated sites will be identical method designations. As such it is difficult to determine which of the collocated samplers is closer to the true $PM_{2.5}$ concentration. Palookaville will calculate an estimate of precision. A bias measure will also be calculated but it can only describe the relative difference of one sampler to the other, not definitively indicate which sampler is more "true." Algorithms for calculating precision and bias are described below. These are similar, but differ slightly, from the equations in 40 CFR Part 58 Appendix A[3]. These have been developed with assistance from OAQPS/EMAD.

Before describing the algorithm, first some ground work. When less than three years of collocated data are available, the three-year bias and precision estimates must be predicted. Palookaville's strategy for accomplishing this will be to use all available quarters of data as the basis for projecting where the bias and precision estimates will be at the end of the three-year monitoring period. Three-year point estimates will be computed by weighting the quarterly components, using the most applicable of the following assumptions:

1. Most recent quarters precision and bias are most representative of what the future quarters will be.
2. All previous quarters precision and bias are equally representative of what the future quarters will be.
3. Something unusual happened in the most recent quarter, so the most representative quarters are all the previous ones, minus the most recent.

Each of these scenarios results in weights that will be used in the following algorithms. The weights are shown in Table 24-2 where the variable Q represents the number of quarters for which observed bias and precision estimates are available. Note that when Q=12, that is, when there are bias and precision values for all of the quarters in the three-year period, then all of the following scenarios result in the same weighting scheme.

Table 24-2. Weights for Estimating Three-Year Bias and Precision

Scenario	Assumption	Weights
1	Latest quarter most representative	w_q = 12-(Q-1) for latest quarter, w_q = 1 otherwise
2	All quarters equally representative	w_q = 12/Q for each quarter
3	Latest quarter unrepresentative	w_q = 1 for latest quarter, w_q = 11/(Q-1) otherwise

In addition to point estimates, Palookaville will develop confidence intervals for the bias and precision estimates. This will be accomplished using a re-sampling technique. The protocol for creating the confidence intervals are outlined in Box 24-1.

Box 24-1. Method for Estimating Confidence in Achieving Bias and Precision DQOs

Let Z be the statistic of interest (bias or precision). For a given weighting scenario, the re-sampling will be implemented as follows:

1. Determine M, the number of collocated pairs per quarter for the remaining 12-Q quarters (default is M=15 or can use M=average number observed for the previous Q quarters.
2. Randomly select with replacement M collocated pairs per quarter for each of the future 12-Q quarters in a manner consistent with the given weighting scenario.
   Scenario 1: Select pairs from latest quarter only.
   Scenario 2: Select pairs from any quarter.
   Scenario 3: Select pairs from any quarter except the latest one.
   Result from this step is “complete” collocated data for a three-year period, from which bias and precision estimates can be determined.
3. Based on the “filled-out” three-year period from step 2, calculate three-year bias and precision estimate, using Equation 1 where w_q = 1 for each quarter.
4. Repeat steps 2 and 3 numerous times, such as 1000 times.
5. Determine P, the fraction of the 1000 simulations for which the three-year bias and precision criteria are met. P is interpreted as the probability that the sampler is generating observations consistent with the three-year bias and precision DQOs.

The algorithms for determining whether the bias and precision DQOs have been achieved for each sampler follow.

Bias Algorithm

1. For each measurement pair, use Equation 19 from Section 14 to estimate the percent relative bias, d_i. To reiterate, this equation is

$$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} x100$$

   where X_i represents the concentration recorded by the primary sampler, and Y_i represents the concentration recorded by the collocated sampler.

2. Summarize the percent relative bias to the quarterly level, $D_{j,q}$, according to

$$D_{j,q} = \frac{1}{n_{j,q}} \sum_{i=1}^{n_{j,q}} d_i$$

where $n_{j,q}$ is the number of collocated pairs in quarter q for site j.

3. Summarize the quarterly bias estimates to the three-year level using

$$\hat{D}_j = \frac{\sum_{q=1}^{n_q} w_q D_{j,q}}{\sum_{q=1}^{n_q} w_q} \qquad \text{Equation 1}$$

where n_q is the number of quarters with actual collocated data and w_q is the weight for quarter q as specified by the scenario in Table 24-2.

4. Examine $D_{j,q}$ to determine whether one sampler is consistently measuring above or below the other. To formally test this, a non-parametric test will be used. The test is called the Wilcoxon Signed Rank Test and is described in *EPA QA/G-9*[2]. If the null hypothesis is rejected, then one of the samplers is consistently measuring above or below the other. This information may be helpful in directing the investigation into the cause of the bias.

Precision Algorithm

1. For each measurement pair, calculate the coefficient of variation according to Equation 20 from Section 14 and repeated below:

$$CV_i = \frac{|d_i|}{\sqrt{2}}$$

2. Summarize the coefficient of variation to the quarterly level, $CV_{j,q}$, according to

$$CV_{j,q} = \sqrt{\frac{\sum_{i=1}^{n_j} CV_i^2}{n_{j,q}}}$$

where $n_{j,q}$ is the number of collocated pairs in quarter q for site j.

3. Summarize the quarterly precision estimates to the three-year level using

$$\hat{CV}_j = \sqrt{\frac{\sum_{q=1}^{n_q} (w_q CV_{j,q}^{\;2})}{\sum_{q=1}^{n_q} w_q}} \qquad \text{Equation 2}$$

where n_q is the number of quarters with actual collocated data and w_q is the weight for quarter q as specified by the scenario is Table 24-2.

4. If the null hypothesis in the Wilcoxon signed rank test was not rejected, then the coefficient of variation can be interpreted as a measure of precision. If the null hypothesis in the Wilcoxon signed rank test was rejected, the coefficient of variation has both a component representing precision and a component representing the (squared) bias.

Confidence in Bias and Precision Estimates

1. Follow the method described in Box 24-1 to estimate the probability that the sampler is generating observations consistent with the three-year bias and precision DQOs. The re-sampling must be done for each collocated site.

Summary of Bias and Precision Estimation

The results from the calculations and re-sampling will be summarized in Table 24-3. There will be one line for each site operating a collocated sampler.

Table 24-3. Summary of Bias and Precision

Collocated Site	Three-year Bias Estimate (Equation. 1)	Three-year Precision Estimate (Equation. 2)	Null Hypothesis of Wilcoxon Test Rejected?	*P* (Box 24-1)
A1				
B1				

Step 5. Draw Conclusions from the Data.

Before determining whether the monitored data indicate compliance with the $PM_{2.5}$ NAAQS, Palookaville must first determine if any of the assumptions upon which the statistical test is based are violated. This can be easily checked in Step 5 because of all the work done in Step 4. In particular, as long as

- in Table 24-1, there are no checks, and
- in Table 24-3,
  - the three year bias estimate is in the interval [-10%,10%], and
  - the three year precision estimate is less than or equal to 10%

then the assumptions underlying the test appear to be valid. As a result, if the observed three-year average $PM_{2.5}$ concentration is less than 15 µg/m^3 and the observed three-year average 98th percentile is less than 65 µg/m^3, the conclusion is that the area seems to be in compliance with the $PM_{2.5}$ NAAQS, with an error rate of 5%.

If any of the assumptions have been violated, then the level of confidence associated with the test is suspect and will have to be further investigate.

24.1.3 Action Plan Based on Conclusions from DQA

A thorough DQA process will be completed during the summer of each year. Thorough means that all five steps of the process will be completed. Additionally, steps 2, Table 24-1, and Step 5 will be completed on a quarterly basis as a check to determine if something is changing with the monitoring or laboratory work that needs addressing before the annual review.

For this section, Palookaville will assume that the assumptions used for developing the DQOs have been met. If this is not the case, Palookaville must first revisit the impact of the violation on the bias and precision limits determined by the DQO process.

DQA indicates every monitor operated by Palookaville is collecting $PM_{2.5}$ mass data that are within the precision and bias goals determined by the $PM_{2.5}$ DQOs.

If the conclusion from the DQA process is that each of the $PM_{2.5}$ mass monitors are operating with less than 10% bias and 10% precision, then Palookaville will pursue action to reduce the QA/QC burden. The basic idea is that once Palookaville has demonstrated that it can operate within the precision and bias limits, it is reasonable to dedicate some of the $PM_{2.5}$ QA/QC resources to other duties/tasks, such as modifying its QA monitoring or reducing some of its QC samplers or monitoring frequecy. Possible courses of action include the following.

- **Modifying the QA Monitoring Network**. 40 CFR Part 58[1] requires that each QA monitor be the same designation as the primary monitor, in the case that the primary monitor is an FRM. Since the initially deployed samplers will all be FRMs, this means that the sites operating sequential samplers will have to collocate a sequential sampler. In particular, the site northwest of Scarborough, A1, will have two $PM_{2.5}$ sequential samplers, the primary one and the collocated one. Once it is demonstrated that the data collected from the network are within tolerable levels of errors, Palookaville may request that it be allowed to collocate with a single-day sampler instead. This will allow Palookaville to establish a new site with the sequential sampler that had been the collocated sampler.

- **Reducing QC Requirements**. QC is integral to any ambient air monitoring network and is particularly important to new networks. However, once it is demonstrated that the data collected from the network are within tolerable levels of errors, then Palookaville may request a reduction in the QC checks such as those specified in Table 23-1. However, if, during any of the annual DQA processes, it is determined that the errors in the data are approaching or exceed either the bias limits or the precision limits, then Palookaville will return to the prescribed levels of QC checks as indicated in Table 23-1.

DQA indicates at least one monitor operated by Palookaville is collecting $PM_{2.5}$ mass data that are not within the precision and bias goals determined by the $PM_{2.5}$ DQOs.

If and when the data from at least one of the collocated sites violates the DQO bias and/or precision limits, then Palookaville will conduct an investigation to uncover the cause of the violation. If all of the collocated sites in Palookaville violate the DQOs (across monitor designations), the cause may be at the Palookaville level (operator training) or higher (laboratory QC, problems with method designation). If only one site violates the DQOs, the cause is more likely specific to the site (particular operator, problem with site). The tools for getting to the root of the problem include: data from the collocated network (Palookaville, nearby reporting organizations, national), data from FRM performance evaluations (Palookaville, nearby reporting organizations, national), QC trails. Some particular courses of action include the following.

- **Determine level of aggregation at which DQOs are violated**. The DQA process can identify which monitors are having problems since the DQOs were developed at a monitor level. To determine the level at which corrective action is to be taken, it must be determined whether the violation of the DQOs is due to problems unique to one or two sites, unique to Palookaville, or caused by a broader problem, like a particular sampler demonstrating poor QA on a national level. Palookaville understands that AIRS will generate QA reports summarizing bias and precision statistics at the national and reporting organization levels, and by method designation. These reports will assist Palookaville in determining the appropriate level at which the DQOs are being violated. The procedure for determining level of violation is:

    * Review national reports for the method designations for which Palookaville's DQA process indicated a violation. If large bias or imprecision is seen at the national level, Palookaville will request assistance from the Regional Office and OAQPS. If no problem seen at national level, Palookaville will proceed looking at the QA reports specific to its neighboring reporting organizations.
    * Review neighboring reporting organizations' precision and bias reports for the method designations for which Palookaville's DQA process indicated a violation. If large bias or imprecision is seen in the neighboring organizations, Palookaville will request assistance from the Regional Office. If no problem seen in the neighboring reporting organizations, Palookaville will proceed looking at the QA reports specific to Palookaville.
    * Within Palookaville, if the violations occur across method designations, then laboratory

QC and training will be reviewed.

* Within Palookaville, if the violations occur for only one method designation, the FRM performance evaluation data will be reviewed for confirmation with the collocated data. The FRM performance evaluation data may show that one of the monitors has a problem and must be repaired or replaced. Palookaville will also use the national FRM performance evaluation summaries to see if Palookaville is unique or like the national network. If Palookaville is similar to the national picture, then assistance will be requested from the Regional Office and OAQPS. The results from the neighboring reporting organizations will also be reviewed. If the violations seem unique to Palookaville, Palookaville will continue investigating all the pieces that comprise the data.

- **Communication with Regional Office**. If a violation of the bias and precision DQOs is found, Palookaville will remain in close contact with the Regional Y Office both for assistance and for communication.

- **Extensive Review of Quarterly Data until DQOs Achieved**. Palookaville will continue to review extensively the quarterly QA reports and the QC summaries until the bias and precision limits are attained.

References

1.Data Quality Evalation Statistical Evaluation Toolbox (DataQUEST) EPA QA/G-9D U.S. Environmental Protection Agency, QAD EPA/600/R-96/085, December 1997

2. Guidance for the Data Quality Assessment Process EPA QA/G-9 U.S. Environmental Protection Agency, QAD EPA/600/R-96/084, July 1996.

3. 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.

4.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.

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

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 *Appendix D, 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 or 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 indicates 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 determine 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 quantitative 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 Quality 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 used 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:

- 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 part 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 determine 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, firm, 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 effort 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 performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring the results are of acceptable quality.

Quality 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 formulation, 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 (QC) 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

The following forms will be used by the Department's QA Division to certify the $PM_{2.5}$ field and laboratory personnel have performed environmental data operations at a satisfactory level. Quantitative scores of 80% are considered satisfactory.

Training Certification Evaluation Form
Field Sampling Procedures

Trainee: ___________________________ Date _________________

Evaluator: ________________________ Score: ________________

Activity	Successful	Comment
Prepare for Site Visit on Scheduled Date/time		
1) Preweighed sampling filter in cassette, packed in a labeled carrier. Also take spares.		
2) Three preweighed field blank filters in cassettes, packed in labeled carriers, if a field blank study is scheduled		
3) $PM_{2.5}$ Sampler Run Data Sheet for each sampler, site notebook; calculator		
4) Transfer standard for ambient temperature measurements		
5) Transfer standard for ambient atmospheric pressure measurements		
6) Transfer standard for volumetric flow-rate measurements		
7) Laptop computer and connecting cables to download sampler data		
8) Spare parts and tools to include O-rings, silicone grease, lab wipes, voltmeter, etc.		
9) Operator's manual for sampler(s) to be serviced		
SCORE	/9	
Fifth Day Maintenance Check		
1) Clean impactor well assembly or filter/lab wipes/diffusion oil to clean and service the one at the site		
2) Sample inlet adapter and flow rate measurement transfer standard		
3) Clean, unused flow check filter in its cassette		
4) Sampler Flow Check Data Sheet		
SCORE	/4	
Install Filter/Cassette and Begin Sampler Operations		
1) Remove the new filter/cassette from its protective case and visually inspect the filter/cassette for flaws. Verify that this is the correct filter for this sampler, site, and run date		
2) Be sure sampler is **not** operating.		
3) Fill in initial information on $PM_{2.5}$ Run Data Sheet.		

Activity	Successful	Comment
4) Remove the sampler's filter holder assembly (if required by the manufacturer's instructions). Inspect the O-rings inside the filter holder.		
5) Install the filter/cassette in the filter holder assembly, and then install the loaded filter holder assembly in the sampler per the manufacturer's instructions. If you touch or scratch the filter, void the filter and get another one from the set of extra filters brought to the site.		
6) Program the sampler to energize at the beginning of a sampling period (consult the instruction manual).		
7) Make independent measurements of ambient temperature (T_a) and ambient pressure (P_a) using transfer standards. Record these values and the T_a and P_a values indicated by the sampler on the data sheet		
8) Ensure that the sampler(s) begins operation at the designated time. Record the start time on the data sheet. 15 minutes after sampling begins, record the sampler's display value for the indicated flow rate, Q, in L/min on the data sheet.		
SCORE	/8	
Remove Filter/Cassette; End Sampling Operations		
1) Determine P_a and T_a using transfer standards. Enter on data sheet.		
2) When sampling ends, record stop time, total elapsed time, final Q, Q_{avg}, Q_{cv}, total volume sampled, T_a, P_a, etc, on data sheet		
3) After each completed run, download data from the sampler data port to a laptop or other computer storage disk.		
4) Open the filter holder assembly (consult the instruction manual); remove the used filter/cassette; visually inspect the filter for tears, oil, insects, moisture, etc; and record observations on the data sheet.		
5) Place the filter/cassette inside a properly labeled protective container. Verify the container's label versus the site name, date, etc.		
6) Place the container inside a cooled storage chest. Do not allow the metal container to come into contact with ice or water. Sealed cooling blocks are recommended. Protect the containers from condensed water.		
7) Inspect the interior of the filter housing. Note any abnormalities.		
8) Inspect the interior of the impactor housing and the exterior of the impactor well. Remove any moisture or dust with a lint-free wipe and make notes on the data sheet.		
9) Without opening the impactor well, inspect the well's interior. Note any abnormalities. Clean or replace the impactor well if necessary or if the recommended 5-day servicing is due. Reinstall the impactor assembly. (If another sampling run is to begin, insert a new filter/cassette in the filter holder assembly and set up the sampler for the next run.)		

Activity	Successful	Comment
10) Review the recorded data for sample elapsed time, flow rate, filter quality, and temperature to start the process of determining if the sample is valid, questionable, or invalid. Scan through the sampling summary on the sampler display and note flags. Record observations and reasoning for questioning or invalidating a run on the data sheet.		
11) Make a final check of the site, and observe and record the presence of any activity that may have affected the particulate loading of the sample.		
12) Keep the container holding the filter/cassette at a temperature of less than 25 °C (preferably cooled to 4 °C), and promptly deliver it and the original of the data sheet to the sample custodian in receiving facility. Keep a copy of the data sheet with the site records.		
SCORE	/12	
FINAL SCORE	/33	
PERCENTAGE	%	

Training Certification Evaluation Form
Laboratory Procedures

Trainee: ________________________ Date ______________

Evaluator: ______________________ Score: ______________

Activity	Sucessful	Comments
Pre-sampling PROCEDURES		
1) Clean the microbalance's weighing chamber with a fine brush, if necessary.		
2) Zero (i.e., tare) and calibrate the microbalance according to the manufacturer's directions. Record the tare weight on the laboratory data form and in the laboratory notebook or database.		
3) Using smooth, nonserrated, nonmetallic forceps, weigh two working mass reference standards as a QC check. Wait until the microbalance's display has remained steady for 30 to 60 seconds or until the microbalance indicates that a stable reading has been obtained. Record the certified and measured values of these standards on the laboratory data form and in the laboratory notebook or database.		
4) Record the relative humidity and temperature of the conditioning chamber on the laboratory data form and in the laboratory QC notebook or database. Verify the filter has been conditioned for at least 24 hours.		
5) Laboratory blank filters and the current sampling interval's field blank filters will be weighed at least once in each weighing session. If many filters are weighed, you may want to weigh the set of laboratory blanks more than once. A new set of three laboratory blanks will be established for each distinct filter lot		
6) Weigh the filters. Operate the balance according to the balance manufacturer's directions. Take the filter from its filter-handling container (petri dish or equivalent) by gently slipping the filter-handling forceps under the outer polyolefin support ring. Hold the filter only by the ring. Place the filter, reinforcing ring side up, next to a ^{210}Po antistatic strip for 30 to 60 seconds. The antistatic strip will be inside the weighing chamber or as close to the chamber door as is practical. Immediately transfer the filter to the microbalance's pan and close the weighing chamber door. After the microbalance's display has remained steady for at least 60 seconds or until the microbalance indicates that a stable reading has been obtained, record the balance number, the sampler number the filter is intended to be used with, the filter number, the filter lot number, and the filter's tare weight (pre-sampling mass) on the laboratory data form.		

Activity	Sucessful	Comments
7) After every tenth filter weighing, the analyst will rezero the microbalance and reweigh one working standard. Record the zero and working standard measurements on the laboratory data form and the laboratory QC notebook or database. If the zero and working standard measurements disagree from the first measurements of the day by more than 3 µg (i.e., three times the microbalance's reproducibility), repeat the zeroing process and reweigh the working standards. If the two measurements still disagree, contact the laboratory's QA Officer, who may direct the analyst to (1) reweigh the previously weighed filters and/or (2) troubleshoot or repair the microbalance, re-zero and reweigh the two working standards and repeat the weighing session.		
8) Any unused filter whose weight is outside the normal range (i.e., 110 to 160 mg) must be investigated. If there is a consistent negative replication (>15 µg) for laboratory blank filters, it is usually a sign that the filters have not equilibrated long enough. In this case, notify the QA Officer.		
9) Return the filter to the filter-handling container, replace the lid, and return it to storage.		
10) Prior to filters beinge taken to the sites, install each filter in a filter cassette, and put the filter/cassette assembly into a protective container for transport to the sampler. Attach a label with the sampler number and the unique filter number to the outside of the protective container. This label will also be used to identify the upcoming sample run date. Record the sampler number, sample date, and filter number on the $PM_{2.5}$ Sampler Run Data Sheet. Double-check the entries in the laboratory data form. Prepare several extra filters in case a filter is invalidated during the installation process.		
SCORE	/10	
Post-sampling DOCUMENTATION/INSPECTION PROCEDURES		
1) Examine the field data sheet. Determine whether all data needed to verify sample validity and to calculate mass concentration (e.g., average flow rate, ambient temperature and barometric pressure, and elapsed time) are provided. If data are missing or unobtainable from a field operator or if a sampler malfunction is evident, flag the filter and record in the laboratory data form that the sample has been flagged and the reason. Notify the QA Officer		

Activity	Sucessful	Comments
2) If the shipment was to be kept cold, verify that the temperature of the cooler's interior was maintained at the desired point, usually less than 4 °C. If the protective container is cold, allow it to warm to the filter conditioning environment's temperature before opening, to preclude water condensation on a cold filter. Remove the filter from its protective container and examine the container. If particulate matter or debris is found in the protective container after the filter has been removed, flag the filter and record notes on the laboratory data form that the sample has been flagged and the reason. Save the filter for inspection by the QA Officer.		
3) Match the sampler number with the correct laboratory data form on which the original microbalance number, filter number, pre-sampling filter weight, and other information were inscribed. Group filters according to the microbalance used to determine their initial tare weights. Initial separation of filters in this way will eliminate the risk of a measurement error that could result from the use of different microbalances for pre- and post-sampling weighings.		
4) Remove the filter from both the protective container and the filter cassette. Be careful not to touch or otherwise disturb the filter and its contents. Transfer the filter to a filter-handling container labeled with the corresponding filter number. Place the used filter in the container "dirty-side" up. Keep the particles from contact with the walls of the container. The filter must be handled with clean, smooth forceps and must not be touched by hands. Inspect the filter for any damage that may have occurred during sampling. If any damage is found, void the sample, and record on the laboratory data form that the sample has been voided and why. Retain the filter for inspection by the QA Officer.		
5) Transfer the filter in its filter-handling container to the conditioning chamber under the same conditions as pre-sampling ($\pm$ 5% RH)		
6) Allow the filter to condition for not less than 24 hours		
SCORE	/6	
POST SAMPLING FILTER WEIGHING		
1) Group filters according to the microbalance used for pre-weighing and by their filter numbers. Reweigh each filter on the same microbalance on which its pre-sampling weight was obtained.		
2) Clean the microbalance's weighing chamber with a fine brush, if necessary.		
3) Zero (i.e., tare) and calibrate the microbalance according to the manufacturer's directions. Record the tare weight on the laboratory data form and in the laboratory notebook or database.		

Activity	Sucessful	Comments
4) Using smooth, nonserrated, nonmetallic forceps, weigh two working mass reference standards as a QC check. Wait until the microbalance's display has remained steady for 30 to 60 seconds or until the microbalance indicates that a stable reading has been obtained. Record the certified and measured values of these standards on the laboratory data form and in the laboratory notebook or database.		
5) Record the relative humidity and temperature of the conditioning chamber on the laboratory data form and in the laboratory QC notebook or database.		
6) Laboratory blank filters and the current sampling interval's field blank filters will be weighed at least once in each weighing session. If many filters are weighed, you may want to weigh the set of laboratory blanks more than once. A new set of three laboratory blanks will be established for each distinct filter lot		
7) Weigh the filters. Operate the balance according to the balance manufacturer's directions. Take the filter from its filter-handling container (petri dish or equivalent) by gently slipping the filter-handling forceps under the outer polyolefin support ring. Hold the filter only by the ring. Place the filter, reinforcing ring side up, on a ^{210}Po antistatic strip for 30 to 60 seconds. The antistatic strip will be inside the weighing chamber or as close to the chamber door as is practical. Immediately transfer the filter to the microbalance's pan and close the weighing chamber door. After the microbalance's display has remained steady for at least 60 seconds or until the microbalance indicates that a stable reading has been obtained, record the balance number, the sampler number the filter is intended to be used with, the filter number, the filter lot number, and the filter's tare weight (pre-sampling mass) on the laboratory data form.		
8) After every tenth filter weighing, the analyst will rezero the microbalance and reweigh the one working standard. Record the zero and working standard measurements on the laboratory data form and the laboratory QC notebook or database. If the zero and working standard measurements disagree from the first measurements of the day by more than 3 µg, repeat the zeroing process and reweigh the working standards. If the two measurements still disagree, contact the laboratory's QA Officer, who may direct the analyst to (1) reweigh the previously weighed filters and/or (2) troubleshoot or repair the microbalance, re-zero and reweigh the two working standards and repeat the weighing session.		
9) Any unused filter whose weight is outside the normal range (i.e., 110 to 160 mg) must be investigated. If there is a consistent negative replication (>15 µg) for laboratory blank filters, it is usually a sign that the filters have not equilibrated long enough. In this case, notify the QA Officer.		
10) Return the filter to the filter-handling container, replace the lid, and return it to storage.		

Activity	**Sucessful**	**Comments**
11) If the pre- and post-sampling weights for the laboratory and field filter blanks disagree by more than 15 µg, repeat the measurements. If the two measurements still disagree, contact the laboratory's QA Officer, who may direct the analyst to (1) reweigh the previously weighed filters and/or (2) troubleshoot or repair the microbalance, then reweigh.		
12) If the filter will receive further analysis, return it to the filter-handling container and note on the container and the laboratory data form that additional analyses are required. Transfer the filter to the laboratory responsible for performing the additional analyses.		
134) A filter's post-sampling mass minus its pre-sampling mass is the net mass loading for that filter. Record this value on the laboratory data form. Refer to Section 11.0 of *Guidance Document 2.12* for the calculations required to compute and report ambient $PM_{2.5}$ concentrations in $\mu g/m^3$.		
SCORE	/13	
FINAL SCORE	/29	
PERCENTAGE	%	

Appendix C
Analytical and Calibration Procedures (SOPs)

The following SOPs will be used to prepare for and weigh QC and sample filters before and after they are used for sampling, and to calibrate the sampling instruments and measuring devices required for $PM_{2.5}$ sampling described in Appendix L of 40 CFR Part 50. Most of the information in these procedures comes from the EPA QA Handbook , Section 2.12.6 (Calibration) and 2.12.7 (Filter Preparation and Weighing).

A-MRS Mass Reference Standards

Mass reference standards will be in the range of 0 to 200 mg, given that the mass range of typical 46.2-mm filter is from 110 to 160 mg. They must be certified as being traceable to NIST mass standards (see ASTM 1993b; Harris 1993; Kupper 1990). Additionally, they must have an individual tolerance of no more than 0.025 mg. Examples of mass reference standards that meet these specifications are ANSI/ASTM Classes 1, 1.1, and 2. The Department will use Class 1 standards. The mass reference standards must be recalibrated on a regular basis (e.g., yearly) at a NIST-accredited State weights and measures laboratory or at a calibration laboratory that is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP), which is administered by NIST (Harris 1994; White 1997). The recalibration frequency will be determined from records of previous recalibrations of these standards.

Note that the microbalance's resolution and repeatability are better than the tolerance of the most accurate classes of mass reference standards. Accordingly, the accuracy of the gravimetric analysis is limited by the tolerance of the standards rather than by the microbalance's characteristics.

Two separate sets of mass reference standards are recommended; working and primary standards. Working calibration standards will be used for routine filter weighing and will be kept next to the microbalance in a protective container. Laboratory primary standards will be handled very carefully and will be kept in a locked compartment. The working standards will be compared to the laboratory primary standards every 3 to 6 months to check for mass shifts associated with handling or contamination. The current masses of the working standards, as compared to the laboratory primary standards, will be recorded in a laboratory notebook and used to check the calibration of the microbalance.

Always use smooth, nonmetallic forceps for handling mass reference standards. The standards are handled only with these forceps, which are not used for any other purpose. Mark these forceps to distinguish them from the forceps used to handle filters. Handle the standards carefully to avoid damage that may alter their masses.

A-FH Filter Handling

Careful handling of the filter during sampling, equilibration, and weighing is necessary to avoid measurement errors due to damaged filters or a gain or loss of collected particles on the filters. Whenever filters are handled, the analyst must wear gloves that are powder-free and antistatic. The filters must be handled carefully with smooth, nonserrated forceps that are used only for that purpose. Mark these forceps to distinguish them from the forceps used to handle mass reference standards. These precautions reduce the potential effect from body moisture or oils contacting the filters and subsequently affecting the measured weights.

In the laboratory, each filter will be transferred from its sealed manufacturer's packaging to a filter-handling container, such as a glass or plastic petri dish, to reduce the risk of contamination. The filter will remain in this container, except for weighing, until it is loaded into a filter cassette prior to sampling. Each filter must have a unique identification number. A label that lists the filter number must be attached to the filter-handling container. It is recommended that each microbalance be assigned a block of filter numbers to be processed and used sequentially. Assign a filter identification number and take extreme care to avoid mistakenly assigning the same number twice or omitting a number.

A-FIC Filter Integrity Check

All filters must be visually inspected for defects before the initial weighing. A filter must be discarded if any defects are found. Any lot of filters containing a high number of defects will be returned to the supplier. Specific defects to look for are the following:

1. **Pinhole—**A small hole appearing (a) as a distinct and obvious bright point of light when examined over a light table or screen or (b) as a dark spot when viewed over a dark surface.

2. **Separation of ring—**Any separation or lack of seal between the filter and the filter border reinforcing the ring.

3. **Chaff or flashing—**Any extra material on the reinforcing, polyolefin ring or on the heat seal area that would prevent an airtight seal during sampling.

4. **Loose material—**Any extra loose material or dirt particles on the filter.

5. **Discoloration—**Any obvious discoloration that might be evidence of contamination.

6. **Filter nonuniformity—**Any obvious visible nonuniformity in the appearance of the filter when viewed over a light table or black surface that might indicate gradations in porosity or density across the face of the filter.

7. **Other—**A filter with any imperfection not described above, such as irregular surfaces or other results of poor workmanship.

A-FC Filter Conditioning

Filters will be conditioned or equilibrated immediately before both the pre- and post-sampling weighings. Filters must be conditioned for at least 24 hours to allow their weights to stabilize before being weighed.

Researchers in the desert western and southeastern portions of the United States have found that some Teflon® filters exhibit a loss of weight for a period of time after they are removed from their original shipping containers. The magnitude of weight loss varies from batch to batch and may be due to loss of volatile components from the polyolefin support ring. In the desert West, weight loss of up to 150 µg has been observed (Desert Research Institute 1994). Some filters require at least 6 weeks to equilibrate.

In the Southeast, filter weight stability experiments were done as part of EPA's research to develop the volatility test now included in 40 CFR Part 53.66 of the revised requirements for designation of reference and equivalent methods for $PM_{2.5}$ (Eisner 1997). Small but still relatively significant (i.e., from 0 to 45 µg) weight losses were observed. These experiments showed that the problem could be addressed by active conditioning (e.g., forced, HEPA-filtered air for 1-hour duration) instead of passive conditioning. The active conditioning was conducted with each filter sitting in the bottom of an open petri dish. Consecutive 4-hour periods of active conditioning of filters did not change the weight by more than ±5 µg.

Mean relative humidity will be held 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. Relative humidity and temperature will be continuously measured and recorded on a daily basis during equilibration. The Department's $PM_{2.5}$ laboratory has demonstrated that it meets this criteria. It should be noted that the relative humidity condtions for post-sampling conditioning should be within $\pm$ 5% of pre-sampling conditions.

Within the conditioning chamber, the filters will be placed on a covered rack that will allow air circulation over the filters while reducing the chance that airborne material inside the chamber will settle onto the filters.

Filters will be conditioned in their filter-handling containers. Label both the container's lid and bottom half. The lid must be removed during conditioning. Place the lid beneath the bottom half of the container to be certain that no filter mix-up occurs. To improve filter inventory control, care will be taken to stack the filters in the chamber in numerical order so that the analyst can more easily weigh the filters in numerical order.

Note: Typically, filters come packed together in large groups or in a container with separators. This package is usually contained inside another clear, reclosable plastic package, which may, in turn, be inside a box used in shipping. The more time that each filter is exposed to the conditioning environment, the more likely that its weight will be stable by the end of a conditioning period.

New filters will be removed individually from their sealed packages, placed in their own filter-handling containers (uncovered petri dish) and conditioned for a sufficient time to allow their weight to stabilize before use. The Department will condition ~100 filters every 15 days. Each set of 100 filters will be considered a "lot" and be conditioned as a lot . 100 filters would support all sites and QC samples for 30 days of sampling. Analysts may need to determine the conditions and time period needed to stabilize the weights for each new lot of filters. To determine this, randomly select three filters for "lot blanks" from each lot and expose each in a separate container, similar to routine filters, in the conditioning chamber. Weigh the filters prior to conditioning, and every 24 hrs. If the weight change exceeds 15 µg, the conditioning period will continue for that lot. Conduct additional tests with the lot blanks until the weight change of each lot blank is less than 15 µg between weighings, signifying that the filters from that lot can be processed for use in the field. Lot blank weighings are recorded in the Filter Conditioning Notebook using the Filter Condition Form (Figure C.1)

A-ESC- Electrostatic Charge Neutralization

Electrostatic charge buildup will prevent a microbalance from operating properly. Static charge is the accumulation of electrical charges on the surface of a nonconductive material. Common symptoms of this problem include noisy readout, drift, and sudden readout shifts. Electrostatic charge buildup becomes greater as the air becomes drier. To reduce static charge within the balance, place a radioactive antistatic strip containing a very small amount (i.e., 500 picocuries) of ^{210}Po in the weighing chamber. ^{210}Po antistatic strips are used to reduce electrostatic buildup in the microbalance's weighing chamber and on individual filters by charge neutralization. They will neutralize electrostatic charges on items brought within an inch of them. These antistatic strips are safe, commonly available, and inexpensive. ^{210}Po has a half-life of 138 days. Change the antistatic strips every 6 months and dispose of the old strips according to the manufacturer's recommendations. The technician will hold each filter about an inch from the antistatic strip for 30 seconds before it is weighed. See Engelbrecht et al. (1980), Hawley and Williams (1974), and Weil (1991) for more information about electrostatic charge and how to minimize its effects.

Filter Conditioning Form			
Filter Lot Number C20102		Analyst F. Nottingham	
Balance Number A44603		QA Officer J. Dinsmore	
Analysis Date-- Time	**Zero (Tare) Check Weight (mg)**	**Working Standard 1 Weight (mg)**	**Working Standard 2 Weight (mg)**
6/28/98--10:54	0.000	100.001	199.999
6/29/98--11:00	0.000	99.999	200.001
6/30/98--11:00	0.000	99.999	200.000
Analysis Date	**Lot Blank 1 Weight (mg)**	**Lot Blank 2 Weight (mg)**	**Lot Blank 3 Weight (mg)**
6/28/98--10:54	136.560	129.999	130.633
6/29/98--11:00	136.540	129.980	130.622
6/29/98--11:00	136.535	129.978	130.620

Figure C.1. Example Filter Conditioning Form.

Do not assume that grounding eliminates all electrostatic buildup because the electrical ground may not be perfect. Even though a filter weight might stabilize within 30 seconds and no weight drift is observed during that period, the microbalance may still be influenced by some electrostatic buildup.

Charge neutralization times may need to be longer than 60 seconds for sampling situations in which (1) a high amount of charge has developed on collected particles due to their origin or (2) the particle loading on a filter is large. Examples of atmospheres that might be expected to contain a higher quantity of charged particles include air containing particles generated by mechanical means and air through which lightning has passed.

A-1 Pre-sampling Filter Weighing (Tare Weight)

The microbalance will be located in the same controlled environment in which the filters are conditioned. The filters must be weighed immediately following the conditioning period. Prior to actually weighing, select a sample batch of filters that can be weighed for the day. Since a sample batch has been developed for post weighing (Section 14 of QAPP), a batch will be developed that contain at a minimum 20 routine filters, 4 collocated filters, 3 field blanks and 3 laboratory blanks. Including 4 spare filters, 34 filters will be included in a pre-sampling filter batch. Start a Filter Pre-sampling Weighing Sheet to record this information (Figure C.2)

These steps will be followed during the pre-sampling filter weighing:

1. Record the relative humidity and temperature of the conditioning chamber on the laboratory data form. Ensure that the filters have been conditioned for at least 24 hours prior to weighing.

2. Clean the microbalance's weighing chamber with a fine brush, if necessary. Avoid using pressurized gas, which may blow damaging debris and oils into the microbalance's mechanism. Clean the surfaces near the microbalance with antistatic solution- or methyl alcohol-moistened disposable laboratory wipes. Clean the standard forceps with a lint-free cloth and the filter forceps with the moistened wipes. Make sure the forceps are thoroughly dry before use. Even a small amount of moisture can cause a significant measurement bias.

3. To ensure maximum stability, the microbalance will be turned on at all times. This procedure enables the microbalance to be operational at any time and eliminates the need for a warmup period before analyses are performed.

4. Allow the microbalance to perform an internal calibration. When this is completed, zero (i.e., tare) the instrument.

5. Using smooth, nonserrated, nonmetallic forceps, weigh two working mass reference standards (a 100 and 200 mg) as a QC check. Handle the working standards carefully to avoid damage that may alter their masses. Recheck the standards annually or after any incident of rough handling against the laboratory's primary standard weights. The 100 or 200 mg standard approximates the mass of a blank or a loaded filter. Wait until the micro-balance's display indicates that a stable reading has been obtained. Record the certified and measured values of these standards on the laboratory data form.

   If the certified and measured values of a working standard disagree by more that 3 µg, reweigh the working standards. If the two values still disagree, follow corrective action procedures (see QAPP section 14).

7. Weigh the filters. Operate the balance according to the balance manufacturer's directions. Take the filter from its filter-handling container (petri dish or equivalent) by gently slipping the filter-handling forceps under the outer polyolefin support ring. Hold the filter only by the ring. Place the filter, reinforcing ring side up, close to the ^{210}Po antistatic strip for 30 seconds. The antistatic strip will be inside the weighing chamber or as close to the chamber door as is practical. Immediately transfer the filter to the microbalance's pan and close the weighing

chamber door. After the microbalance's display indicates that a stable reading has been obtained, record filter's tare weight (pre-sampling mass) on the laboratory data form.

8. After approximately every tenth filter weighing, the analyst will rezero the microbalance and reweigh one working standard. Record the working standard measurements on the laboratory data form. If the zero and working standard measurements disagree from the first measurements of the day by more than 3 µg (i.e., three times the microbalance's reproducibility), repeat the zeroing process and reweigh the working standards. If they are within acceptance reweigh the previous ten routine filters and continue. If the two measurements still disagree, follow corrective action procedures (see QAPP section 14).

9. Any unused filter whose weight is outside the normal range (i.e., 110 to 160 mg) must be investigated. If there is a consistent negative replication (>15 µg) for laboratory blank filters, it is usually a sign that the filters have not equilibrated long enough. In this case, notify the QA Officer.

10. Return the filter to the filter-handling container, replace the lid, and return it to storage.

11. When the time comes for the filters to be taken to the sites (must be within 30 days of the initial weighing), install each filter in a filter cassette, and put the filter/cassette assembly into a protective container for transport to the sampler. Attach a label with the sampler number and the unique filter number to the outside of the protective container. This label will also be used to identify the upcoming sample run date. Record the sampler number, sample date, and filter number and protective container label on the $PM_{2.5}$ Filter Inventory Sheet. Double-check the entries in the laboratory data form. The sample will have to be invalidated if it cannot be reconciled with the correct sampler and filter identification numbers. Prepare several extra filters in case a filter is invalidated during the installation process.

Filter Lot Number 0001	Filter Pre-sampling Batch Number 0001	Analyst F. Nottingham
Balance Number A44603		QAO J. Dinsmore
Pre-sampling Filter Weighing	Date 6/30/95	Temp 21°C

Sampler ID	Site ID	Filter Number[a]	Pre-sampling Mass (mg)	Post-sampling Mass (mg)	Net Mass Filter Loading (mg)
		100mg	99.999		
		200 mg	199.999		
		LB990001	130.633		
AD001	A1	FB990001	130.633		
AD001	A1	RF990001	139.293		
AD006	A1	RF990002	136.020		
AD002	A2	RF990003	135.818		
AD002	A2	FB990002	130.633		
AD003	A3	RF990004	131.456		
AD004	A4	RF990005	137.508		
AD005	B1	RF990006	136.546		
AD007	B1	RF990007	129.999		
		100mg	99.999		
		LB990002	130.896		
AD001	A1	RF990008	130.633		
AD002	A2	RF990009	139.293		
AD003	A3	RF990010	136.020		
AD003	A3	FB990003	135.818		
AD004	A4	RF990011	131.456		
AD005	B1	RF990012	137.508		
		LB990003	136.546		
		FB990004	129.999		

[a]Indicate zero (tare) check or working standard check here.

Figure C.2. Example pre-sampling laboratory data form.

A-2 Post-sampling Documentation and Inspection

Upon receipt of the sample from the field, the Shipping/Receiving Office will:

1. Receive shipping/transport container(s)
2. Upon receipt, open the container(s) to find *Filter Chain of Custody Record*(s) or collect the originals from the site operator (if delivered by operator).
3. Fill out the "Filter Receipt" area of the *Filter Chain of Custody Records*(s). Check sample container seals.
4. If the samples are delivered on a weekday, follow sequence 5; if the sample (s) are delivered on a weekend, follow sequence 6
5. Check the "Sent to Laboratory" column of the *Filter Chain of Custody Records*(s) and transport the filters to the $PM_{2.5}$ weighing laboratory. Upon delivery to the $PM_{2.5}$ weighing laboratory, complete the "Filter Transfer" area of the *Filter Chain of Custody Records*(s)
6. Store the samples in the refrigerator and check the "archived" column of the *Filter Chain of Custody Records*(s). On the Monday of the following week, deliver the archived filters to the $PM_{2.5}$ weighing laboratory and complete the "Filter Transfer" area of the *Filter Chain of Custody Records*(s)

Upon filter transfer, the laboratory personnel will

1 Examine field data sheets and custody sheets. Determine whether all data needed to verify sample validity and to calculate mass concentrations are provided. If data are missing or unobtainable from the field operator or if a sampler malfunction is evident, flag the filter appropriately but continue processing. Notify QAO.

2. If the protective shipping container is cold, allow it to warm to the filter conditioning environment's temperature before opening to preclude water condensation on a cold filter. Remove the filter from its protective container and examine the container. If particulate matter or debris is found in the protective container after the filter has been removed, record notes on the laboratory data form and flag appropriately. Consult the branch manager if it is felt that the sample should be invalidated.

3. Match the sampler number with the correct laboratory data form on which the original microbalance number, filter number, pre-sampling filter weight, and other information were inscribed. Group filters into sample batches (see QAPP Section 14) according to the microbalance used to determine their initial tare weights. Initial separation of filters in this way will eliminate the risk of a measurement error that could result from the use of different microbalances for pre- and post-sampling weighings.

4. Remove the filter from both the protective container and the filter cassette. Some cassettes may require special tools to disassemble them. Be very careful when removing the filter from the cassette. Be careful not to touch or otherwise disturb the filter and its contents. Transfer the filter to a filter-handling container labeled with the corresponding filter number. Place the used filter in the container "dirty-side" up. Keep the particles from contact with the walls of the container. The filter must be handled with clean, smooth forceps and must not be touched by hands. Inspect the filter for any damage that may have occurred during sampling. If any damage is found, flag and record this on the laboratory data form. Retain the filter for inspection by the branch manager. Consult the branch manager if it is felt that the sample will be invalidated.

5. Transfer the filter in its filter-handling container to the conditioning chamber.

6. Allow the filter to condition for not less than 24 hours. It should be noted that the relative humidity condtions for post-sampling conditioning should be within $\pm$5% of pre-sampling.

A-3 Post-sampling Filter Weighing (Gross Weight)

Both the pre- and post-sampling filter weighing must be carried out on the same analytical balance, and preferably by the same analyst. Use an effective technique to neutralize static charges on the filter. The post-sampling conditioning and weighing will be completed within 240 hours (10 days)from the sampling end date, unless the filter is maintained at 4 °C or less during the entire time between retrieval from the sampler and start of the conditioning, in which case the period shall not exceed 30 days.

The following steps will be followed during post-sampling filter weighing.

1. Group filters according to the microbalance used for pre-weighing and by their filter numbers. Reweigh each filter on the same microbalance on which its pre-sampling weight was obtained.

2. Repeat Steps 1 through 10 in Section A.1

3. If the filter will receive further analysis, return it to the filter-handling container and note on the container and the laboratory data form that additional analyses are required. Transfer the filter to the laboratory responsible for performing the additional analyses.

Calculation of Net Mass Filter Loading

A filter's post-sampling mass minus its pre-sampling mass is the net mass loading for that filter. Record this value on the laboratory data form.

The mass of particulate matter collected on the filter during the sampling period is determined by subtracting the initial (tare) mass of each filter from the final mass of the filter, as

$$M_{2.5} = (M_f \quad M_i) \times 10^3 \qquad (11\text{-}2)$$

where

$M_{2.5}$ = total mass of $PM_{2.5}$ collected during the sampling period, µg
M_f = final mass of the equilibrated filter after sample collection, mg
M_i = initial (tare) mass of the equilibrated filter before sample collection, mg
10^3 = units conversion (µg/mg).

For example, a filter that weighed 139.293 mg before sampling (M_i) and 139.727 mg after sampling (M_f) would have a $PM_{2.5}$ mass ($M_{2.5}$) of 434 µg.

See remaining sections below for the calculations required to compute and report ambient $PM_{2.5}$ concentrations in µg/m^3.

Sample Volume Calculations

Both reference and equivalent method samplers are required to provide measurements of the total volume of air sampled (V_a), in m^3 at the actual ambient temperatures and pressures during sampling (40 CFR Part 50, Appendix L, paragraph 7.4.5.2). If the sampler's flow measurement system is properly calibrated, V_a should be accurate, and no further sample volume calculations are required.

Note that in the event the total sample volume measurement from the sampler is not available, the total sample volume may be calculated by multiplying the average flow rate, in actual m^3/min, by the elapsed sample collection time in minutes. Both of these measurements are required to be provided by reference and equivalent method samplers. Use the following formula only if V_a is not available directly from the sampler:

$$V_a = Q_{ave} \times t \times 10^{\;3} \qquad (11\text{-}1)$$

where

V_a = total sample volume, actual m^3
Q_{ave} = average sample flow rate over the sample collection period, L/min
t = total elapsed sample collection time, min
$10^{\;3}$ = units conversion (m^3/L).

For example, a sampler with an average flow rate of 16.7 L/min (Q_{ave}) for a 1,410-min (23.5-hour) sampling period (t) would have a total sample volume (V_a) of 23.5 m^3.

$PM_{2.5}$ Concentration Calculation

Each $PM_{2.5}$ mass concentration measurement is calculated by dividing the total mass of $PM_{2.5}$ (Equation 11-2) collected during the sampling period ($M_{2.5}$) by the total volume of air sampled (V_a) (taken directly from the sampler readout display or calculated from Equation 11-1), as

$$PM_{2.5} = M_{2.5} / V_a \,. \qquad (11\text{-}3)$$

For example, a sample with a mass ($M_{2.5}$) of 434 µg collected from a total sample volume (V_a) of 23.5 m^3 calculates to be a $PM_{2.5}$ concentration ($PM_{2.5}$) of 18.5 µg/m^3.

SOPS CALIBRATION PROCEDURES

A-4 FlowRate Calibration Verification Procedure

The sampler's flow rate measurement system must be verified/recalibrated after electromechanical maintenance or transport of the sampler, and whenever there is any indication that the system is inaccurate or operating abnormally. Be sure to check the temperature and pressure measurement systems also.

For routinely operated samplers that are performing properly, the sampler's flow rate measurement system will be verified/recalibrated at periodic intervals not to exceed 1 year. A good way to determine an appropriate frequency for each sampler is to keep a control chart (a running plot of the difference (or % difference) between the sampler's flow rate measurement system and the flow rate measurement of the NIST-traceable flow rate standard) for all calibrations, audits and flow checks. Such a chart alerts the operator should the performance of the flow rate measurement system degrade to such an extent that repairs are required.

1. Equilibrate the selected flow-rate calibration device to the ambient conditions of the air mass for which flow is to be measured. This equilibration can take up to an hour, depending on the difference from the conditions at which the instrument was stored prior to moving it to the point of use. During this equilibration period, the standard must be exposed to the prevailing air conditions, but it must also be protected from precipitation, wind, dust, solar heating, and other hazards that could affect its accuracy.
2. Install a flow check filter cassette in the sampler. This filter will meet all specifications for $PM_{2.5}$ sampling, but it does not need to be preweighed or postweighed. Discard this filter once calibration is complete.
3. Remove the inlet from the sampler. Place the flow calibration device on the sampler down tube using a flow adaptor device if necessary. Ensure that any valves are open so that flow through the sampler is unrestricted.
4. Place the sampler in calibration mode according to instructions in the manufacturer's operating manual. Calibration of the sampler's flow-rate measurement system must consist of at least three separate flow-rate measurements (a multipoint calibration) approximately evenly spaced within the range of -10% to +10% of the sampler's operational flow rate (40 CFR Part 50, Appendix L, Sec. 9.2.4). The sampler is required to have the capability to adjust the flow rate over the -10% to +10% range (40 CFRPart 50, Appendix L, Sec.7.4.2). The sampler's instruction manual will provide additional guidance on this flow-rate adjustment.

Verification of the sampler's flow rate shall consist of one flow-rate measurement at the sampler's operational flow rate (40 CFR Part 50, Appendix L, Sec. 9.2.4). This one-point verification of the flow-rate measurement system may be substituted for a three-point calibration, provided that a full three-point calibration is carried out upon initial installation of the sampler and at least once per year and that the flow rate measurement system has met the ± 2% accuracy requirement in the previous three-Point calibration verification. A full three-point calibration verification must be done whenever a one-point verification indicates that the sampler's flow-rate measurement system differs by ± 4% or more from the flow rate measured by the flow rate standard, and the one-point verification must be repeated after the three-point calibration(40 CFR Part 50, Appendix L, Sec. 9.2.6).

5. Follow the instructions in the manufacturer's manual for performing the flow calibration.

6. Once calibration is completed successfully, turn off the sampler pump, remove the filter cassette from the filter cassette holder, remove the flow calibration device (and flow adaptor

device, if applicable), and replace the sampler inlet.

7. The sampler flow rate is now verified/calibrated.

A-5 Temperature Calibration

Calibration frequency for the temperature and pressure sensors will also be set based on such control charts or equivalent operational experience.

The ambient air temperature sensor is located inside the shielded fixture on the outside of the $PM_{2.5}$ sampler and is easy to unfasten and remove for comparison to a transfer standard for temperature. The three-point calibration can be conducted at the field site, although it may prove easier to remove the sampler to the laboratory to avoid weather problems and for convenience in preparing the temperature standards.

On the other hand, the filter temperature sensor of Reference or Class I Equivalent $PM_{2.5}$ samplers is located in the (open) space just below the filter cassette. It is threaded through the walls of the filter cassette holding assembly section of the sampler and removal of plastic or metal fittings is required to remove the sensor and its associated wiring. It is recommended that this sensor be calibrated in the laboratory. The temperature sensor housing, the sampler inlet, and the interior of the down tube can also be cleaned in the laboratory. Be careful when removing the filter temperature sensor- do not gall the fittings since this could start an internal leak after the installation. It is suggested that a sampler leak check be performed after reinstallation of the filter temperature sensor.

Several steps to follow in calibrating ambient air temperature are given below. Make frequent reference to the operator's instruction manual for sampler-specific procedures and instructions.

1. Remove the ambient temperature sensor from the radiation shield so that it can be placed in a constant temperature bath while it (the sensor) is still connected to the sampler's signal conditioner.
2. Prepare a convenient container (such as an insulated vacuum bottle) for the ambient temperature water bath and the ice slurry bath. See step 3 below. If complete immersion of the sensor is necessary, wrap it in plastic film so that liquid cannot reach the point where the connecting wire(s) and the sensor interface. Use partial immersion when possible, thus keeping the interface dry. To further insulate the vacuum bottle, it can be positioned inside a larger 2-gallon insulated container that has been modified to allow wires or cables to enter from the top. Refer to Figure 4.3.5.3 of Volume IV of the EPA QA handbook.

Keep the temperature changes relatively small and make comparative measurements in this order: Ambient, Cold, Ambient, Hot, Ambient. The range of temperatures need be only as broad as that expected to contain all the ambient temperatures that will be experienced during the upcoming time period, generally a year.

3. For the ambient bath, use an insulated bottle that was filled with tap or deionized water several hours earlier and allowed to equilibrate to ambient temperature. For the ice slurry, the ice will be made with distilled water and then crushed into pea-sized pieces and mixed with distilled water until an easily penetrable slurry state is reached. As long as ice is present in the slurry and the open end of the bottle is guarded from ambient air temperature fluctuations, the ice slurry temperature will be $0.0 \pm 0.1\,^{\circ}C$.
4. Wrap the sensor(s) and a thermometer together so that the thermometer bulb and the temperature sensor active site will be close together. Immerse the sensor and the attached thermometer in the ambient temperature bath. Use a cork or some other device to cover the

open end of the insulated bottle and thus keep ambient air from circulating over the top surface of the water (or ice slurry mass). Wait at least 5 minutes for the ambient thermal mass and the sensor/thermometer to equilibrate. Wait at least 15 minutes for equilibration with the ice slurry before taking comparative readings.

For each thermal mass, in the order indicated in Step 2 above, make a series of five measurements, taken about a minute apart. Accurately read the meniscus of the thermometer. Use a magnification if necessary to see the meniscus; avoid paralax errors. If the measurements made support the assumption of equilibrium, then average the five readings and record the result as the sensor temperature relative to the thermometer for ambient and for 0.0°C relative to the ice slurry.

A-6 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 explosively 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.

Laboratory: The Fortin type of barometer is best employed as a higher quality laboratory standard which is used to adjust and certify an aneroid type of barometer in the laboratory.

Fortin Type Barometer Readings

1. Read the temperature, to the nearest 0.1°C, from the thermometer attached to the barrel of the barometer
2. Lower the mercury level in the cistern until it clears the index pointer. Raise the level slowly until a barely discernible dimple appears on the surface of the mercury.
3. Tap the barrel near the top of the mercury column.
4. Set the vernier so that the base just cuts off light at the highest point of the meniscus and carefully avoid parallax error.
5. Read the height of the mercury column from the barometer in the manner appropriate to the vernier scale used to the equivalent of the nearest 0.1 mm Hg. Apply appropriate corrections for temperature and gravity as described in the barometer instruction booklet.

Field: Aneroid Type Barometer

1. Always use and read an aneroid type barometer when it is in the same position (vertical or horizontal) as it was when calibrated.
2. Immediately before reading the scale of an aneroid barometer with mechanical linkages, tap its case lightly to overcome bearing drag.
3. Read the aneroid barometer to the nearest 1 mm Hg.

A-7 Sampler and Standard Volumetric Flow Rate Sensors with Built-in Clocks: Time -of -Day

Time, and in time-of-day, is not a standard even though it can be referenced to time-of -day signals maintained at national labs. Any frequency source can be used to derive a time-of-day signal with the same stability as the source, but the accuracy depends upon how well the source can be synchronized to the external reference. Proper synchronization of the signal requires a knowledge of equipment and signal propagation delays. The accuracy of any timekeeping system depends upon how often the signal is synchronized to the reference, the stability of the oscillator, and the distribution delays from the system to the user.

A number of satellite, radio, and telephone systems carry a digital time code. With the right equipment, this code can be read and used to obtain time-of-day. In some cases (WWV and WWVH radio and telephone services) the time is also sent by voice. A list of time-of-day signals is given below. It is the responsibility of the lab acquiring such time signals to properly account for all propagation and equipment delays. National laboratories, such as NIST, can only ensure the time is accurate as it leaves the broadcast source.

A. Radio Sources of time-of-day signals.

a. WWV and WWVH (voice and digital code)
b. WWVB (digital code)
c. GOES Satellite (digital code)
d. Global Positioning Satellite System (digital code)

B. Telephone Sources of time-of-day signals

a. Automated Computer Time Service (digital code for computers by telephone at 303-494-4774)
b. NIST Telephone Service (WWV audio at 303-499-7111)

From section 2.3.0, “Technical Criteria for Calibration Laboratories Engaged in Time and Frequency Calibrations,” starting on page 94 of the NIST Handbook 150-2(Draft; June 1996), “NVLAP Calibration Laboratories Technical Guide,” C. Douglas Faison, Editor.

A-8 Relative Humidity Verification for Environmental Conditioning/Weighing Room

The procedure for calibrating the thermometers in a psychrometer is essentially the same as any thermometer calibration (See App. A-5).

Once a mercury or alcohol liquid-in-glass thermometer is calibrated, there is no need for recalibration, unless it is to be used for reference or as a transfer standard. Errors in wet bulb temperatures are most frequently the result of an improperly installed or dirty muslin wick, the repeated use of tap water instead of distilled water, or human error in reading. Wicking material used on psychrometers must be washed to remove traces of sizing and finger-prints. Once cleaned, the material is tied at the top of the thermometer bulb and a loop of thread placed around the bottom so the thermometer bulb is tightly covered. To prevent solid materials from collecting on the cloth and preventing proper evaporation, the wick will be wet with distilled water. Of course, slinging or motor aspiration will be done in the shade, away from reflected or scattered radiation, at a ventilation rate of about 3 to 5m/s. Many technique-related errors are minimized by using an Assman-type, motor-operated psychrometer, providing that the instrument is allowed to assume near ambient conditions prior to use. (from subsections 4.5.2 and 4.5.3 of Vol. IV , Meteorological Equipment QA, EPA QA Handbook)

For an additional discussion, see section 2.8.0, “Technical Criteria for calibration Laboratories Engaged in Thermodynamic Calibrations,” starting on page 255 of NIST Handbook 150-2 (Draft; June 1996), entitled “ NVLAP Calibration Laboratories Technnical Guide,” edited by C. Doug Faison.

Both the dew cell and the cooled-mirror hygrometer can be checked for approximate calibration accuracy with a motor-operated psychrometer. Their performance will be verified under stable conditions at night or under cloudy conditions during the day. Several readings taken at the intake of the aspirator or shield will be taken. Bench calibrations of these more sophisticated units must be made by the manufacturer.

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Appendix D
Data Qualifiers/ Flags

A sample qualifier or a result qualifier consists of 3 alphanumeric characters which act as an indicator of the fact and the reason that the subject analysis (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 is not to be reported outside the laboratory.

Field 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 effected filter

1/- Flag generated by sampling equipment

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
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
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 list is meant to provide an example of the types of standard operating procedures that would be available for the $PM_{2.5}$ Program; either included in the QAPP or referenced. In either case, they would need to be available for the EPA Regional personnel during the review of the QAPP.

Document Number	Title	Comments
Equipment/Consumables		
AIR-EQ-IN1	*Receipt, Inspection , Acceptance Procedures for Capital Equipment* Section: $PM_{2.5}$ Equipment	
AIR-EQ-CN1	*Receipt, Inspection, Acceptance Procedures for Consumable Supplies* Section 13 $PM_{2.5}$ Consumables: Filter Handling Filter Integrity Check Sample Storage Sample Chain-of- Custody	Receipt/Testing/Inspection procedures of consumables (particularly filters)
Laboratory Activities		
AIR-LAB-FP1	*Standard Operating Procedures for Preparation, Weighing, and Data Recording for the $PM_{2.5}$ Monitoring program* Sections: 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/Archive	
Field Activities		
AIR-FLD- FP1	*Standard Procedures for Operation of Field Monitoring Sites for the $PM_{2.5}$ Monitoring Program* Sections: Monitor set-up/Installation Filter Selection from Laboratory Filter Installation and Recovery Filter Transportation, Packaging and Shipping Sample Chain-of- Custody Flow Rate Calibration/Verification Temperature Calibration/Verification Sampler Pressure Calibration Internal/External Leak Checks Field Maintenance	SOPS for field activities

Document Number	**Title**	**Comments**
	Shipping/ Receiving	
AIR-SHP-FP1	*Standard Operating Procedures for Receiving PM2.5 Filters from the Field* Receiving and Inspection Sample Chain-of- Custody Sample Storage	
	Information Management	
AIR-IS-FP1	*Data Acquisition Procedures for the $PM_{2.5}$ Monitoring Program* Sections: Data Entry Filter Conditioning Filter Pre-weighing Filter Post-weighing Field Data Acquisition Sample Chain-of- Custody	Data entry SOPs for hardcopy information (field, lab forms) and entry into automated systems.
AIR-IS-FP2	*Data processing procedures for the $PM_{2.5}$ monitoring program* Sections Data Review Data editing Data Verification Calculations, Algorithms, and Data Reduction Back-up/security procedures Data Validation	
AIR-IS-FP3	*AIRS data transmittal procedures system for the $PM_{2.5}$ monitoring program* Upload to AIRS AIRS checks/edits Security	

Appendix F
$PM_{2.5}$ Reference Material Guidance Documents

The following documents provide guidance on various aspects of the $PM_{2.5}$ 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
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)

DOCUMENT TITLE	STATUS
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, 1994
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, 1994
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*
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

DOCUMENT TITLE	STATUS
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
Validation of Air Monitoring Data, U.S. Environmental Protection Agency, EPA-600/4-80-030, June 1980.	Partially out of date