UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4

Laboratory Services & Applied Science Division
980 College Station Road
Athens, Georgia 30605-2720

Mr. Patrick Butler, Chief
Ambient Monitoring Section
Division of Air Quality (NC DAQ)
North Carolina Department of Environmental Quality
217 West Jones Street
Raleigh, North Carolina 27603

LSASD Project Number: 23-0076

Mr. Butler:

We have reviewed the following document that you submitted for approval:

Quality Assurance Project Plan (QAPP) for the North Carolina Division of Air Quality Background Monitoring Program, Revision No. 1.0, December 21, 2022.

The quality assurance and technical elements within this QAPP were compared to EPA regulations and current guidance. The stated procedures appear to be clear, sound, and appropriate as written, to the extent they can be evaluated. EPA approval of this document is granted. Please be aware that approval of this QAPP does not constitute a waiver from any regulatory requirements. Your agency remains accountable for ensuring the background ambient air monitoring project adheres to all the applicable requirements detailed in 40 CFR Part 58, and that the data generated is of sufficient quality to be used for its intended purposes. This QAPP should be reviewed internally by NC DAQ on an annual basis and revised when procedures change; at a minimum, the QAPP must be revised within five years.

If you have any questions, please contact Tony Bedel at 706-355-8552 or via email at bedel.anthony@epa.gov.

Sincerely,

KEITH HARRIS

Digitally signed by KEITH HARRIS
Date: 2023.01.04 17:27:20 -05'00'

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NORTH CAROLINA
Environmental Quality

DAQ-01-003

Quality Assurance Project Plan

for the North Carolina Division of Air Quality

Background Monitoring Program

Prepared for:

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NORTH CAROLINA
Department of Environmental Quality

DISCLAIMER

This Quality Assurance Project Plan (QAPP) covers the background monitoring network for the North Carolina Department of Environmental Quality (DEQ) Division of Air Quality (DAQ).

Quality Assurance Project Plan Acronym Glossary

ABS - acrylonitrile-butadiene-styrene
ADQ - Audit of data quality
AMS – Ambient Monitoring Section
AMTIC – Ambient Monitoring Technology Information Center
AQS - Air Quality System (EPA's Air database)
ARD – United States Environmental Protection Agency's Air and Radiation Division
ARM – Air Resources Manager
ASC – Aerosol sample conditioner
AT – Ambient temperature
BAM – Beta attenuation monitor
CAA – Clean Air Act
CAPA – Corrective Action Preventative Action
CFR – Code of Federal Regulations
Chief – Ambient Monitoring Section Chief
CO – carbon monoxide
Coordinator – Regional Office Monitoring Coordinator
CV – Coefficient of variation
DAQ - North Carolina Division of Air Quality
DAS – Data acquisition system
DASC – Data Assessment Statistical Calculator
° C – degrees Celsius
DEQ – North Carolina Department of Environmental Quality
Director – Division of Air Quality Director
DIT – North Carolina Department of Information Technology
DQA - Data quality assessment
DQI - Data quality indicators
DQO - Data quality objectives
ECB – Electronics and Calibration Branch
e-log – electronic logbook
EPA – United States Environmental Protection Agency
FEM – Federal equivalent method
FEP – Fluorinated ethylene propylene
FRM – Federal reference method
FTS – flow transfer standard
GPS – global positioning system
IBEAM – Internet-Based Enterprise Application Management
IDL- Instrument detection limit
LED – light emitting diode
LMS – North Carolina Learning Management System
LPM - Liters per minute
LSASD – Laboratory Services and Applied Science Division
MDL- Method detection limit
MQO – Measurement quality objective
NAAQS - National ambient air quality standards
NIST - National Institute of Standards and Technology
NO – nitric oxide (nitrogen oxide)
NO_2 – nitrogen dioxide
NPAP – National Performance Audit Program
OAQPS – Office of Air Quality Planning and Standards
pdf – portable document format
PEP – Performance Evaluation Program
PFA - Perfluoroalkoxy
± - plus or minus
PM – Particulate matter
$PM_{2.5}$ – Particles with an average aerodynamic diameter of 2.5 micrometers or less, also known as fine particles
PM_{10} – Particles with an average aerodynamic diameter of 10 micrometers or less
$PM_{10-2.5}$ – Coarse particles with an average aerodynamic diameter between 2.5 and 10 microns
ppb – Parts per billion
PPB – Projects and Procedures Branch
ppm – Parts per million
PQAO – Primary Quality Assurance Organization
PSD – Prevention of significant deterioration
psig – pounds per square inch, gauge
PZS - precision/zero/span

QA – Quality assurance
QA Handbook - EPA Quality Assurance Handbook for Air Pollution Measurements Systems, Volume II
QA/QC - Quality assurance/quality control
QAM – Quality Assurance Manager
QAPP - Quality assurance project plan
QC – Quality control
QMP – Quality Management Plan
RCO – Raleigh central office
SLAMS - State and local air monitoring station
SO_2 – Sulfur dioxide
SOP - Standard operating procedure
SQL – Structured Query Language
STP – Standard temperature and pressure
TSA – Technical Systems Audit
$\mu g/m^3$ – micrograms per cubic meter
UV – Ultraviolet
VIP – Valuing individual performance

1.0 Quality Assurance Project Plan Identification and Approval Sheet

Title: *DAQ-01-003 Quality Assurance Project Plan for the North Carolina Division of Air Quality Background Monitoring Program, Revision 1*

The Division of Air Quality hereby recommends the attached *DAQ-01-003 Quality Assurance Project Plan for the North Carolina Division of Air Quality Background Monitoring Program, Revision 1* for approval and commits the State of North Carolina, Department of Environmental Quality, Division of Air Quality to follow the elements described within.

Department of Environmental Quality

1. Signature: DocuSigned by: Michael Abraczinskas D5013FED0218423... _____ Date 12/20/2022
   Air Quality Division Director

2. Signature: DocuSigned by: Patrick Butler 4290A7E2D2A0429... _____ Date 12/20/2022
   Quality Assurance Manager
   (Ambient Monitoring Section Chief)

3. Signature: DocuSigned by: B278F8186CEC4DC... _____ Date 12/20/2022
   Projects and Procedures Branch Supervisor

4. Signature: DocuSigned by: Travis Funderburk BDD86579E9314CD... _____ Date 12/20/2022
   Primary QAPP Author, Environmental Chemist

5. Signature: KEITH HARRIS Digitally signed by KEITH HARRIS Date: 2023.01.04 17:25:08 -05'00' _____ Date _____
   EPA Region 4 Designated Approving Official

2.0 Table of Contents

List of Tables and Figures

3.0 Distribution

Table 3-1 lists the primary recipients of this quality assurance project plan, or QAPP. The people on this distribution list have the responsibility to ensure and document that the regional office monitoring technicians and coordinators, Electronics and Calibration Branch, or ECB, electronics technicians, Raleigh Central Office, or RCO, chemists and statistician and any other personnel involved with this project have read and understood this QAPP. The Ambient Monitoring Section (AMS) chief, or chief, will post the official QAPP after it receives approval from the United States Environmental Protection Agency, or EPA, on the Department of Environmental Quality, or DEQ, website and email a link to it to everyone on this distribution list.

Table 3.1. DAQ Ambient Air Quality Background Monitoring Program QAPP Distribution List

Name/Position	Address	Phone and email
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Table 3.1. DAQ Ambient Air Quality Background Monitoring Program QAPP Distribution List

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Joette Steger, PPB Supervisor	DAQ, Projects and Procedures Branch 1641 Mail Service Center Raleigh, North Carolina 27699-1641	(919) 707-8449 joette.steger@ncdenr.gov
Caroline Freeman, EPA Region 4 Director, Air and Radiation Division (ARD)	EPA Region 4 Director ARD United States Environmental Protection Agency, Region 4 Atlanta Federal Building 61 Forsyth Street Atlanta, GA 30303-8960	(404) 562-8975 Freeman.Caroline@epa.gov
Keith Harris, Manager, Quality Assurance Section	United States Environmental Protection Agency, Region 4 Laboratory Services and Applied Science Division 980 College Station Road Athens, Georgia 30605-2720	(706) 355-8624 Harris.Keith@epa.gov
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4.0 Project/Task Organization

The EPA is responsible for developing the national ambient air quality standards, or NAAQS, defining the quality of data necessary to make comparisons to the NAAQS and identifying a minimum set of quality control or QC, measurements from which to judge the data quality. The state and local air monitoring organizations are responsible for using this information and to develop and implement a quality assurance, or QA, program that will meet the data quality requirements. It is the responsibility of the EPA and the monitoring organizations to assess the quality of the data and take corrective action, when appropriate.

The State of North Carolina Division of Air Quality (DAQ) ambient air monitoring program is an independent primary quality assurance organization (PQAO) as defined in 40 Code of Federal Regulations, or CFR, Part 58, Appendix A, Section 1.2. The DAQ operates the background monitoring program as part of the DAQ prevention of significant deterioration (PSD) PQAO as defined in 40 CFR Part 58, Appendix B, Section 1.2.

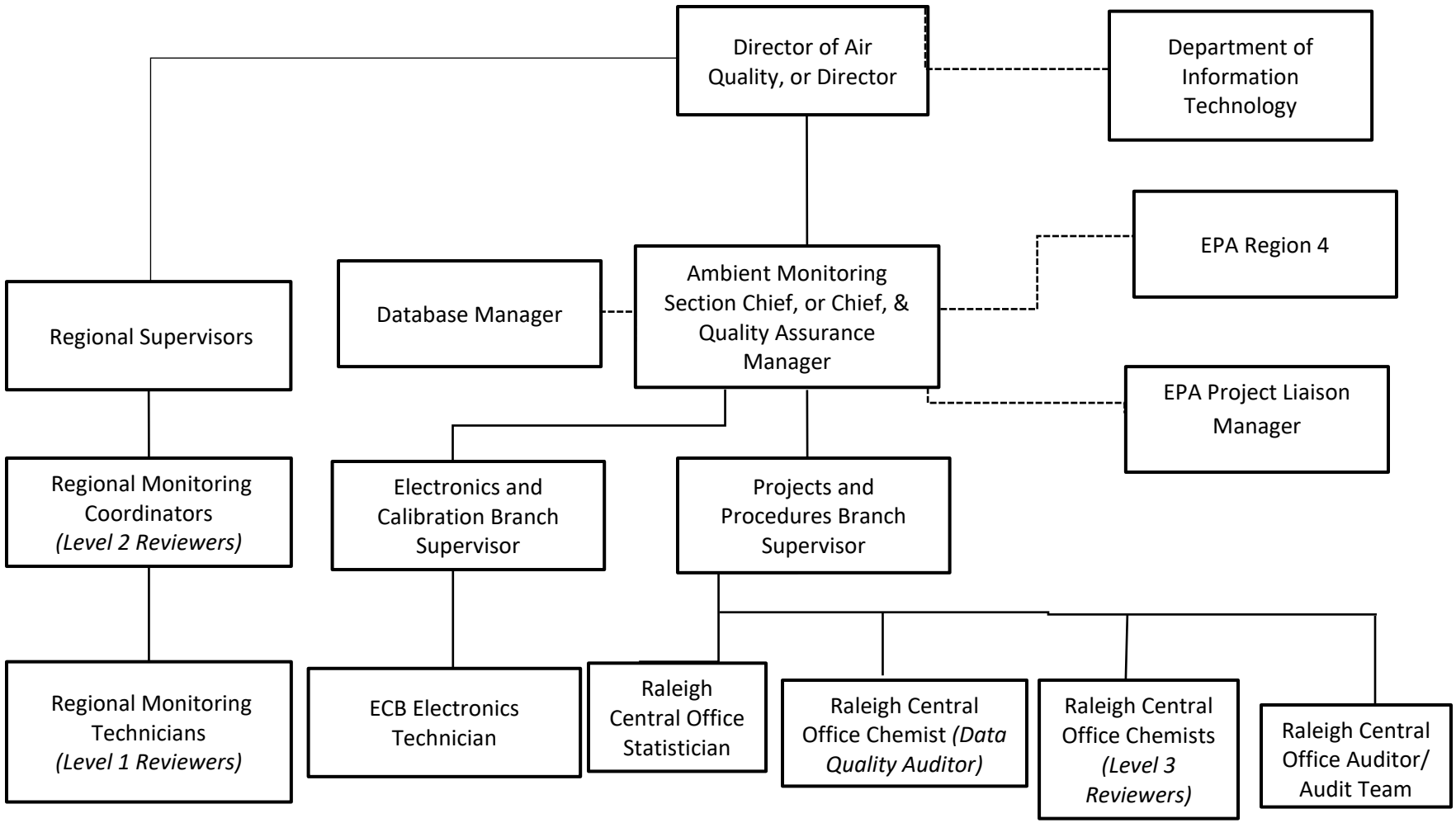
The DAQ director has organized the AMS into three main branches: The Projects and Procedures Branch, or PPB, the Laboratory Analysis Branch, or LAB, and the Electronics and Calibration Branch, or ECB. The AMS Chief (chief) has responsibility for managing these branches per stated policy. The chief delegates the responsibility and authority to develop, organize and maintain and implement quality programs to the supervisors of each branch, in accordance with the EPA-approved quality management plan (QMP). These supervisors have direct responsibility for assuring data quality. The DAQ currently does not use the services of the LAB to implement the background-monitoring program. The AMS shares the monitoring responsibilities with regional monitoring technicians and coordinators in the regional offices.

Figure 4.1 presents the organizational structure for the implementation of the background monitoring program. The following information lists the specific responsibilities of each significant position within the DAQ AMS, the DAQ regional offices, EPA Region 4 and the North Carolina Department of Information Technology (DIT).

4.1 DAQ Director

The DAQ director, or director, supervises the chief and the regional office air quality supervisors. The director is responsible for ensuring adequate human and financial resources are available to support DAQ's background monitoring program. The director has ultimate responsibility and final authority on all aspects of the background monitoring program. The director has authority to stop or resume work. In the event of an emergency or inclement weather, the director implements the Continuity of Operations Plan, including the hurricane readiness procedures. The director also serves as a liaison with other divisions in DEQ, with the North Carolina General Assembly, DIT and with other regional air-monitoring agencies and organizations.

Figure 4.1: Project Organizational Chart



4.2 DAQ Ambient Monitoring Section

The AMS contains the PPB, the LAB (not involved in the background monitoring program) and the ECB and is responsible for coordinating the QA, data collection and data processing aspects of DAQ's background monitoring program.

Ambient Monitoring Section Chief: The AMS chief, or chief, serves as the QA manager, or QAM, and reports to and has direct access to the director on all matters relating to DAQ's background ambient monitoring operation. The chief has ultimate authority for the program's data quality. The chief's duties include, but are not limited to the following:

- Serving as the QAM and maintaining oversight of all QA activities;
- Supervising the AMS staff and delegating responsibilities as appropriate;
- Serving as the liaison to EPA Region 4 monitoring staff;
- Maintaining overall responsibility for the monitoring network design and review, subject to the director's approval, including oversight and approval of the annual network plan and five-year assessment;
- Authorizing the installation and discontinuation of monitors within the network;
- Approving and distributing division standard operating procedures, or SOPs, and QAPPs to the personnel listed in Table 3.1;
- Serving as the tiebreaker in the event of an impasse on how to handle corrective actions or make a final judgment call on data validity;
- Collaborating with DEQ staff in developing, administering and maintaining the QMP;
- Overseeing training for the ambient monitoring staff;
- Certifying the data every year in accordance with 40 CFR Section 58.15;
- Reviewing the quarterly QA reports and the QC summaries to ensure the bias and precision limits are attained;
- Overseeing the management of the agency's documents and records;
- Tracking corrective actions and determining their success;
- Participating in systems audits;
- Assuring that QAPPs are established and effectively implemented for each project as applicable; and
- Reviewing budgets, contracts, grants and proposals.

If the section chief (or designee) is unavailable to perform these duties, the chief will assign someone to fulfill these duties, or if the chief is unable to make that assignment, the director will assign someone to fulfill these duties.

Database Manager: Although the database manager does not report directly to the chief, he has direct access to the chief on all matters relating to management of DAQ's background ambient air monitoring database. The database manager's duties include, but are not limited, to the following:

- Maintaining the RCO data polling station (i.e., Envista Air Resources Manager, or ARM), ensuring it polls hourly, minute and 5-minute data for each hour of every day as well as automated check data for each day;
- Ensuring correct data are being transferred to the DAQ Internet-Based Enterprise Application Management, or IBEAM, database and DAQ real-time air quality data webpage;
- Participating in systems audits;
- Uploading environmental data to the EPA's Air Quality System, or AQS, and AirNow-Tech databases;
- Serving as the AQS administrator for DAQ;
- Maintaining and updating the RCO data polling software and AQS database when sites and monitors are established or shut down, and
- Completing other duties as assigned.

4.2.1 Projects and Procedures Branch

Projects and Procedures Branch Supervisor: The PPB supervisor reports to the chief. This supervisor's duties include the following:

- Directing and supervising the activities of the branch staff;
- Supporting and assisting the QAM in providing oversight of all QA activities;
- Communicating with the QAM to bring to the attention of the QAM QA matters needing attention;
- Verifying implementation of all AMS QAPPs and procedures;
- Assisting the chief with preparing the annual network plan and 5-year network assessment;
- Responding to public records requests and statistical consulting requests;
- Participating in systems audits;
- Ensuring training availability and utilization;
- Approving and implementing procedures; and
- Completing other duties as assigned.

Raleigh Central Office Chemists (level three reviewers): The RCO chemists, who are responsible for the level three review of the data, report to the PPB supervisor and are responsible for coordinating the activities of the background monitoring program. These RCO chemists' duties include the following:

- Organizing the collection, certification and reporting of background air monitoring data through the use of DAQ's electronic logbooks, or e-logs, and correspondence with the regional monitoring technicians and coordinators;
- Assessing the effectiveness of corrective actions taken in the background monitoring network to ensure they are appropriate and effective;

- Assisting the regional offices and the ECB in prescribing corrective actions;
- Writing and ensuring timely and appropriate SOP and QAPP updates;
- Coordinating with the regional and ECB staff the writing, revising and maintaining of SOP updates, including documenting annual SOP and QAPP reviews;
- Validating data by serving as the level 3 reviewer;
- Verifying that all required quality assurance/quality control, or QA/QC, activities are performed and that measurement quality standards are met;
- As the level 3 data reviewer, maintaining QA/QC records, flagging suspect data, and assessing and reporting on data quality;
- Participating in systems audits;
- Identifying data quality problems and initiating corrective actions that result in solutions;
- Providing training and certification to appropriate personnel; and
- Completing other duties as assigned.

Raleigh Central Office Chemist (data quality auditor): The RCO chemist, who is responsible for auditing the data quality, reports to the PPB supervisor and is responsible for assessing, auditing and evaluating the data collected for the background monitoring program. The RCO audit chemist's duties include the following:

- Assessing the effectiveness of the network system;
- Tracking SOP and QAPP annual reviews and updates;
- Verifying that all required QA/QC activities are performed and that measurement quality standards are met, and decisions are documented;
- Maintaining QA/QC records and assessing and reporting on data quality;
- Conducting quarterly completeness evaluations and audits of data quality;
- Planning and conducting data quality assessments, or DQAs, based on interpretation of data,
- Participating in systems audits;
- Identifying data quality problems and initiating corrective actions that result in solutions;
- Determining whether the data meets PSD requirements and can be used for PSD modeling;
- Providing training and certification to appropriate personnel; and
- Completing other duties as assigned.

Raleigh Central Office Internal Systems Auditor or Audit Team: The RCO chemist, or chemists, responsible for conducting the internal systems audit of the background monitoring program report(s) to the PPB supervisor. This person or team of people's duties include the following:

- Assessing the effectiveness of the network system;

- Verifying that all required QA/QC activities are performed and that measurement quality standards are met, and decisions are documented;
- Conducting internal systems audits;
- Identifying data quality problems and recommending corrective actions that result in solutions; and
- Determining whether the data meets PSD requirements and can be used for PSD modeling.

Statistician: The statistician, who reports to the PPB supervisor, provides statistical programming support to the branch supervisor and other staff of the central and regional offices, including:

- Assisting the branch supervisor with responding to consulting and data requests,
- Participating in training and certification programs to keep current on technology,
- Interpreting data,
- Developing each business day and maintaining statistical reports that include tabulations of yesterday's hourly raw data,
- Preparing statistical analysis and summaries of the data, including graphs, for QA and reporting,
- Participating in systems audits,
- Preparing and delivering data and statistical interpretation of the data to the regional offices and RCO,
- Responding to public records requests and statistical consulting requests,
- Serving as a backup to the database manager,
- Uploading data to AQS, and
- Completing other duties as assigned.

4.2.2 Electronics and Calibration Branch

Electronics and Calibration Branch Supervisor: The ECB supervisor reports to and has direct access to the chief. The ECB supervisor has the responsibility and authority to:

- Identify quality problems and initiate corrective action which results in solutions;
- Schedule and document internal performance evaluations and standard certifications;
- Review and approve QAPPs and SOPs;
- Supervise the ECB electronics technicians;
- Participate in systems audits;
- Provide and document training and certification of field personnel; and
- Completing other tasks as assigned.

Electronics and Calibration Branch Electronics Technicians: The ECB electronics technicians report to the ECB supervisor and have the following responsibilities:

- Installing and replacing all field equipment and monitoring sites;

- Purchasing, maintaining and tracking an inventory of spare parts, spare equipment and consumable supplies to prevent unnecessary downtime;
- Calibrating, certifying and tracking all transfer standards or sending them to the vendor to be recertified;
- Returning "local primary standards" to the vendor or EPA for recertification and periodically checking the calibration of backup "local primary standards" to ensure quality calibrations;
- Ordering calibration gases and ensuring DAQ participation in the gas verification program operated by the EPA;
- Maintaining documentation on all transfer standard, "local primary standard" and calibration gas certifications;
- Conducting internal performance evaluations on SO_2 monitors;
- Assisting in prescribing corrective actions;
- Participating in systems audits;
- Recommending changes, when needed, in the QA/QC program;
- Performing and documenting all major maintenance and repair of field equipment as described by SOPs DAQ-12-001.1 and 2.37.1, and
- Completing other tasks as assigned.

4.3 DAQ Regional Offices

DAQ Regional Office Air Quality Supervisors: The DAQ regional office air quality supervisors report to the director and have direct access to the director and chief on all matters relating to DAQ's background monitoring program. The DAQ regional office air quality supervisors' duties include:

- Assuring that division policies are maintained at the regional office level;
- Acquiring needed regional monitoring resources;
- Verifying implementation of quality programs;
- Recommending changes when needed in the QA/QC program;
- Providing regional input for the design of the monitoring network;
- Reviewing and approving the network plan as far as it affects the region;
- Supervising and delineating duties for the regional monitoring technicians and coordinator, and
- Completing other duties as assigned

Regional Monitoring Coordinators: The regional monitoring coordinators, also referred to as monitoring coordinator or coordinator in this QAPP, report directly to their respective DAQ regional office air quality supervisor. Coordinators have the overall responsibility of ensuring the implementation of the QA/QC program at the regional level. The coordinator coordinates the activities of the regional monitoring technicians. The coordinator's responsibilities include:

- Coordinating and reviewing the collection of environmental data;
- Implementing the DAQ QA/QC program within the region;

- Acting as conduits for information to regional monitoring technicians;
- Training other coordinators and regional monitoring technicians in the requirements of the QAPP and SOPs;
- Providing a backup to the regional monitoring technicians;
- Participating in systems audits;
- Recommending changes, when needed, in the QA program;
- Providing regional input on the design and documentation of the monitoring network;
- Performing level 2 data verification activities and flagging suspect data,
- Reviewing electronic logbooks, or e-logs, other documentation and the work of the regional monitoring technicians to ensure they follow the QAPP and associated SOPs,
- Overseeing transfer standard certifications to ensure equipment is returned for recertification before expiration and that all certification documents are appropriately filed and archived;
- Documenting and assessing corrective actions to ensure they are appropriate and effective; and
- Completing other duties as assigned.

Regional Monitoring Technicians: The regional monitoring technicians, also referred to as site operators or operators in this QAPP, report directly to the DAQ regional office air quality supervisor and work under the direction of the regional monitoring coordinator to ensure DAQ meets all monitoring requirements. The regional monitoring technician's duties include:

- Performing all required QC activities and ensuring that measurement quality objectives (MQOs) are met as prescribed in the QAPP and SOPs;
- Performing corrective actions to address any activities that do not meet the acceptance criteria as prescribed in the QAPP and SOPs;
- Ensuring that monitoring programs implement the QA/QC elements of SOPs and QAPPs;
- Participating in and providing hands-on training as needed of new regional monitoring coordinators, monitoring technicians and RCO chemists in the requirements of the SOPs;
- Calibrating and verifying of SO_2 and PM, or particulate matter, monitoring equipment;
- Operating and completing preventative maintenance on all monitoring equipment;
- Performing preventative maintenance and small repairs on PM monitoring equipment;
- Sending all PM flow transfer standards (FTSs) to ECB for calibration and certification, and checking the calibration of primary standards to ensure quality calibrations;
- Ensuring all transfer standards used are within their expiration dates;
- Maintaining a supply of expendable monitoring items;
- Auditing of PM, or particulate matter, monitoring equipment;
- Participating in training and certification activities;
- Documenting deviations from established procedures and methods;
- Reporting nonconforming conditions and corrective actions to the regional monitoring coordinator and the DAQ regional office air quality supervisor;
- Performing level 1 data verification activities and flagging suspect data;

- Conducting 40 CFR Part 58, Appendix E siting criteria evaluations annually as part of the annual network review process;
- Participating in systems audits;
- Recommending changes, when needed, in the QA program;
- Preparing corrective action reports, when needed, for the AMS; and
- Completing other tasks as assigned.

4.4 Department of Information Technology

The DIT provides security for the ambient monitoring computers. They manage, in cooperation with the regional monitoring and ECB electronics technicians and database manager, the computers located at the monitoring sites as well as the primary server that houses the Envista ARM database. Their responsibilities include ensuring the security of the computers and network, updating of the operating system and other standard software on the computer and ensuring that the regional monitoring and ECB electronics technicians maintain adequate access to the computers to perform all necessary monitoring functions.

4.5 United States Environmental Protection Agency, Region 4

The DAQ operates the background monitors as special purpose monitors following the procedures in 40 CFR Section 58.20 Special Purpose Monitors. As a result, the chief includes information on these monitors in the annual network-monitoring plan and the five-year network assessment and the EPA Region 4 ARD director, or his or her designee, will review, comment on and respond to the network plan each year. Likewise, the chief will include the data from these monitors in the annual certification request and the EPA Region 4 ARD director, or his or her designee, will review and apply concurrence codes in AQS in response to DAQ's data certification request. The chief will also submit a QAPP to the EPA Region 4 Laboratory Services and Applied Science Division, or LSASD for EPA approval.

5.0 Problem Definition and Background

The enactment of the Clean Air Act (CAA) of 1970 resulted in a major shift in the federal government's role in air pollution control. This legislation authorized the development of comprehensive federal and state regulations to limit emissions from both stationary or industrial sources and mobile sources. It also established the National Ambient Air Quality Standards, or NAAQS. The CAA and its amendments provide the framework for protecting air quality. To protect air quality, active environmental data collection operations were established and operated in a manner that assures the collection of the most applicable and highest quality data.

The EPA sets primary standards at a level adequate to protect public health within an acceptable margin of safety, while it sets secondary standards at the level needed to protect public welfare. The CAA and its amendments provide the framework for the monitoring of these criteria pollutants, e.g., SO_2, by state, local, and tribal air monitoring organizations. Under the area designations process, the EPA and states typically use data from ambient air monitors to characterize air concentrations for identification of areas that either meet or violate the standard for a specific pollutant.

Prevention of Significant Deterioration applies to new major sources or major modification at existing sources for pollutants where the area the source is located is in attainment or unclassifiable with the NAAQS. PSD requires installation of the Best Available Control Technology, an air quality analysis, an additional impacts analysis and public involvement. PSD is designed to protect public health and welfare, preserve, protect and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value, insure that economic growth will occur in a manner consistent with the preservation of existing clean air resources and assure that any decision to permit increased air pollution in any area to which PSD applies is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participate in the decision making process.

The main purpose of the air quality analysis is to demonstrate that new emissions emitted from a proposed major stationary source or major modification, in conjunction with other applicable emissions increases and decreases from existing sources, will not cause or contribute to a violation of any applicable NAAQS or PSD increment. Generally, the analysis will involve an assessment of existing air quality, which may include ambient monitoring data and air quality dispersion modeling results and predictions, using dispersion modeling, of ambient concentrations that will result from the applicant's proposed project and future growth associated with the project.

The background monitoring network grew out of the sulfur dioxide (SO_2) industrial expansion monitoring network that DAQ operated prior to 2002. The industrial expansion monitoring network started to provide background data for facilities that needed to comply with the PSD requirements in Part C of Title I of the CAA. Section 7473 sets maximum allowable increases over baseline concentration as well as maximum allowable concentrations for SO_2, PM and the other criteria pollutants that the facility cannot exceed when it expands or enters a new area. Certain new major stationary sources, and

major modifications to existing sources, are subject to a preconstruction review. As stated earlier, this preconstruction review includes an ambient air quality analysis. The ambient air quality analysis requires a minimum of one year of monitoring data.

In 2002, DAQ eliminated six of its 12 industrial expansion monitoring sites by replacing two sites with trace-level fine particle precursor monitoring sites and establishing four rotating background sites that operate one year in every three years. Collecting data on a three-year schedule meets the requirements in the Act for recent data, or data three years old or less. After 2007, the SO_2 industrial expansion monitoring network transitioned into a rotating background SO_2 network. In 2011, DAQ established a rotating background monitoring network for particles with aerodynamic diameters of 10 micrometers or less (PM_{10}). In general, two rotating PM_{10} monitors operate each year and each rotating PM_{10} site operates once approximately every three years. For more details on the objectives of this monitoring program, see Section 7.1 Data Quality Objectives. Table 5.1 provides the standards for SO_2 and PM_{10}.

Table 5.1 National Ambient Air Quality Standards for SO_2 and PM_{10}

Pollutant	Primary/ Secondary	Averaging Time	Level	Form
Sulfur Dioxide (SO_2)	Primary	1-hour	75 ppb [a]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hours	0.5 ppm [b]	Not to be exceeded more than once per year
Particulate Matter (PM_{10}) Particulates with diameters of 10 micrometers or less	Primary and Secondary	24-hours	150 µg/m^3 [c]	Not to be exceeded more than once per year on average over 3 years

[a] parts per billion [b] parts per million [c] micrograms per cubic meter

In 2022, DAQ operated four SO_2 and six PM_{10} rotating background monitors at nine ozone or PM state and local air monitoring station, or SLAMS, sites. Table 5.2 provides information about these background monitors and SLAMS sites. The SLAMS sites used for background monitoring sometimes change as the SLAMS network changes or as needs for background data change. Consult the most recent DAQ Annual Network Plan for the most current information.

Table 5.2 North Carolina Background Monitoring Locations and Monitors

Site Name	AQS Identifier	Types of Monitors	Operator
Taylorsville – Liledoun SLAMS Ozone Monitoring Site	37-003-0005	PM_{10} BAM 1020	Mooresville Regional Office
Lenoir SLAMS Ozone Monitoring Site	37-027-0003	SO_2	Asheville Regional Office
Cherry Grove SLAMS Ozone Monitoring Site	37-033-0001	PM_{10} BAM 1020	Winston-Salem Regional Office
Honeycutt Elementary SLAMS Ozone Monitoring Site	37-051-0010	SO_2	Fayetteville Regional Office

Table 5.2 North Carolina Background Monitoring Locations and Monitors

Site Name	AQS Identifier	Types of Monitors	Operator
Lenoir Community College SLAMS Ozone Monitoring Site	37-107-0004	PM_{10} BAM 1020	Washington Regional Office
Jamesville SLAMS Ozone Monitoring Site	37-117-0001	SO_2, PM_{10} BAM 1020	Washington Regional Office
Candor SLAMS $PM_{2.5}$ Monitoring Site	37-123-0001	PM_{10} BAM 1020	Fayetteville Regional Office
Castle Hayne SLAMS Ozone Monitoring Site	37-129-0002	PM_{10} T640X	Wilmington Regional Office
Bethany SLAMS Ozone Monitoring Site	37-157-0099	SO_2	Winston-Salem Regional Office

EPA policy requires that all projects involving the generation, acquisition, and use of environmental data be planned and documented and have an agency-approved QAPP. The QAPP is the critical planning document for any environmental data collection operation because it documents how the DAQ will implement QA and QC activities during the project's life cycle. This project is an ongoing project managed solely by the DAQ. Initially, the criteria monitoring QAPP included the QA procedures for the background monitoring network. The chief will replace this original QAPP, archived in Laserfiche, with this QAPP for the background monitors. An RCO chemist must review the QAPP and associated SOPs annually and update them at least every five years. The RCO chemist will document the annual review of the QAPP by recording his or her name, signature, date and review results on the QAPP annual review documentation form. Grant commitments also require that annual QAPP reviews be recorded in email correspondence to EPA Region 4. QAPP revisions are subject to the approval of EPA's Region 4 QA staff.

The purpose of this QAPP is to prescribe requirements, procedures and guidelines for the DAQ background monitoring program. The DAQ intends this QAPP to serve as a reference document for implementing and expanding the QA program and provide detailed operational procedures for the measurement processes used by DAQ. The QAPP should be particularly beneficial to the regional monitoring technicians and coordinators and RCO chemists responsible for implementing, designing and coordinating the background monitoring program. The QAPP is a compilation of QA requirements, procedures and guidelines applicable to air pollution measurement systems. The EPA and DAQ designed these requirements, procedures and guidelines to ensure DAQ achieves a high percentage of valid data (greater than or equal to 80 percent, as required for PSD monitoring) while maintaining the integrity and accuracy of the data. This QAPP clearly and thoroughly establishes QA protocols and QC criteria required to successfully implement and maintain the background monitoring program. The SOPs DAQ uses set forth additional details and technical specifications for each aspect of the background monitoring program, such as instrument operations (see Table 11.2). The chief is responsible to ensure that the regional monitoring technicians and coordinators, ECB electronics technicians and RCO chemists implement and adhere to the QA programs for the field and data processing phases of this monitoring program.

The RCO chemists will review the QAPP and its associated SOPs annually and update them as needed or at least every five years. The RCO chemist will document the annual review of the QAPP by recording his or her name, signature, date and review results on the QAPP Annual Review Documentation form or the SOP annual review documentation forms available in the QAPP and SOP tracking database.

This version of the QAPP is the first revision to the original document, conditionally approved by EPA on December 21, 2020. A copy of the original QAPP is retained in Laserfiche. Before DAQ implemented the background QAPP, the background monitoring program was included in the Criteria Pollutant QAPP, which EPA approved on Nov. 6, 2006. A copy of the Criteria Pollutant QAPP is archived in Laserfiche.

6.0 Project/Task Description

The chief developed this QAPP to ensure that DAQ's on-going background monitoring network collects ambient pollutant data that meet or exceed EPA QA requirements. DAQ uses the pollutant data collected in this network for determining compliance with PSD. Since the background SPM monitors generally do not operate for three consecutive years, the monitors covered under this QAPP are not used for NAAQS-attainment determinations. The DAQ enters all these data into the EPA AQS database so that they are readily available to anyone who needs them for PSD modeling.

The background monitors are not SLAMS but special purpose monitors. Thus, they do not have to meet the three objectives in 40 CFR Part 58, Appendix D, Section 1.1. The background-monitors will characterize background hourly SO_2 and PM_{10} concentrations in the piedmont and coastal plains of North Carolina. The DAQ will also use the data from these sites to provide the public with air pollution data in a timely manner by displaying the data on the DEQ and AirNow websites. In addition, after collecting 12 months of data, the DAQ will use the data for PSD modeling for PSD permit applications. Section 10.1 Site Selection provides additional objectives for the background monitoring network. The chief designed DAQ's background monitoring network to support these objectives as well as the following specific goal: determining the general background concentration levels in areas of the state where the permit modelers expect industrial expansion to occur. All of the background monitors are collocated at existing SLAMS monitoring sites. See Section 10.3 Sampling Frequency for more information on how monitors are rotated. Table 6.1 lists the monitoring objectives for each background monitor.

Table 6.1 North Carolina Background Monitoring Objectives and Scales of Representativeness

Site Name / AQS Identifier	Type of Monitor	Monitoring Objective	Scale of Representativeness
Taylorsville – Liledoun 37-003-0005	PM_{10} BAM 1020	General/Background	Urban
Lenoir / 37-027-0003	SO_2	General/Background	Regional
Cherry Grove / 37-033-0001	PM_{10} BAM 1020	General/Background Population Exposure Regional Transport	Urban
Honeycutt Elementary 37-051-0010	SO_2	General/Background Population Exposure	Neighborhood
Lenoir Community College 37-107-0004	PM_{10} BAM 1020	General/Background	Urban
Jamesville / 37-117-0001	SO_2	General/Background Upwind Background	Urban
	PM_{10} BAM 1020	General/Background	Regional
Candor / 37-123-0001	PM_{10} BAM 1020	General/Background Welfare Related Impacts	Regional
Castle Hayne / 37-129-0002	PM_{10} T640X	General/Background	Neighborhood
Bethany / 37-157-0099	SO_2	Population Exposure	Urban

At a minimum, background sites must measure:

- Sulfur dioxide [SO_2], or
- PM_{10} mass using continuous monitors.

The regional monitoring coordinators assigned the monitors operated within this program a scale of representativeness based on the definitions of 40 CFR Part 58, Appendix D. The spatial scale of representativeness describes the physical dimensions of a parcel of air, in which pollutant concentrations are reasonably homogeneous throughout. Based on the monitoring objective and site location, the data collected at the background sites will generally be representative of the background SO_2 and PM_{10} concentrations on either a neighborhood, urban or regional scale as indicated in Table 6.1. The neighborhood scale defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range while the urban scale defines the concentrations within an area of city-like dimensions, on the order of 4 to 50 kilometers. Regional scale defines the concentrations within an area from 50 to hundreds of kilometers.

The work required to collect, document and report these data includes, but is not limited to:

- Establishing a monitoring network that has:
    - Appropriate density, location, and sampling frequency; and
    - Accurate and reliable data recording equipment, procedures and software.
- Developing encompassing documentation for:
    - Data and report format, content, and schedules;
    - Quality objectives and criteria; and
    - SOPs providing activities and schedules for:
        - Equipment operation and preventative maintenance; and
        - Instrument calibrations, zero, and span, and precision and accuracy evaluations.
- Establishing assessment criteria and schedules.
- Verifying and validating data, according to the criteria and schedules established in this QAPP.
- Certifying data.

Towards this end, DAQ work products also include a series of assessments and reports to ensure the network and resulting data continuously meet or exceed regulatory requirements as specified in 40 CFR Sections 58.12 and 58.16. The DAQ also maintains this QAPP and the associated SOPs, reviewing them every year and revising them as needed, but at least once every five years to ensure they continuously reflect the requirements of DAQ and the EPA.

6.1 Field Activities

DAQ personnel will perform those activities that support continued successful operation of the DAQ background monitoring network. Personnel will perform field activities that include, but are not necessarily limited to, conducting calibrations and routine QC checks, semi-annual flow verifications, performing periodic preventative maintenance and servicing equipment located at the background air monitoring station. Operational servicing activities may include, but may not be limited to, recording pertinent field data and restocking consumables at the monitoring sites. Additional field activities include relocating sites and/or locating suitable monitoring sites for possible expansion of the network.

Section 4.3 (Regional Offices) provides a more complete description of the field activities that regional monitoring technicians may perform to support the background monitoring program. The ECB electronics technicians also perform performance evaluations on the deployed gaseous monitors.

6.2 ECB Activities

ECB electronics technicians will perform those activities necessary to support the successful operation of the DAQ background monitoring network. They will perform electronic laboratory activities consistent with certifying, calibrating and testing all equipment before installing it in the field. In addition, ECB electronics technicians will perform any functions necessary to support the deployed field equipment. The ECB electronics technicians also complete performance evaluations on the deployed SO_2 monitors every calendar quarter. Section 4.2.2 (Electronics and Calibration Branch) provides a more complete description of the activities ECB electronics technicians may perform in support of this program.

6.3 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, peer review, inspection or surveillance. Section 20.0 Assessments and Response Actions discusses the details of assessments. Table 6.2 provides information on the parties implementing assessments and their frequency.

Table 6.2 Assessment Schedule

Assessment Type	Assessment Agency	Frequency
DAQ Internal Systems Audit	State	When operating
Network Assessment	EPA Region 4 State	Every 5 years
Network Review (40 CFR Part 58, Appendix B, D, and E evaluations)	State	When operating at the time of the annual network review
Network Plan	EPA Region 4 State	Annually
Quarterly Data Completeness	State	Quarterly, when operating
Annual Data Certification	State	Annually, when operating, due to SPM status in AQS and adherence to 40 CFR Part 58.20
Quality Assurance Project Plan Review and Updates	State	Review annually Update as needed and every 5 years
Standard Operating Procedures Reviews	State	Review annually; update as needed but at least every five years
Data Quality Assessment	State	AMP256 and AMP600 Review Quarterly and Annually, when operating Control Chart Review Daily and Monthly, when operating

Table 6.2 Assessment Schedule

Assessment Type	Assessment Agency	Frequency
Performance Evaluations for gaseous monitors	State	At least once per monitoring quarter and every 90 days
Semi-annual Flow Rate Audit for particulate monitors	State	At least once every 5 to 7-months, preferably every quarter

6.4 Project Records

DAQ will establish and maintain procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. Table 6.3 presents the categories and types of records and documents that are applicable to document control for ambient air quality information. Section 9.0 Documentation and Records explains in more detail information on key documents in each category.

Table 6.3 Critical Documents and Records

Categories	Record/Document Type
Site Information	Network descriptions Site files Site maps Site pictures
Environmental Data Operations	Quality assurance project plans Standard operating procedures Field notebooks and logbooks Inspection and maintenance records
Raw Data	Any original data (routine and QC) including data entry forms
Data Reporting	Air quality index reports Annual data certification Data summary reports
Data Management	Data algorithms Data management plans and flowcharts Data management systems
Quality Assurance	Network reviews and assessments Data quality assessments Quality assurance reports (such as the AMP256 and AMP600) DAQ internal systems audit reports Response/corrective action documentation Performance evaluation reports Certification documentation Emails related to QA activities and assessments

7.0 Quality Objectives and Criteria for Measurement Data

The DAQ operates under an EPA-approved QMP that describes the agency's system for communicating and implementing quality within the agency.

A quality system is a structured and documented set of management activities in which an organization applies sufficient QC practices to ensure the data produced by an operation will be of the type and quality needed and expected by the data user. Quality control defines the procedures implemented to assure that the regional monitoring technicians obtain and maintain acceptability in the generated data set. Quality control procedures, when properly executed, provide data that meet or exceed the minimally acceptable quality criteria established to assist management in making confident decisions. The policy of DAQ is to implement a QA program to assure the regional monitoring technicians collect data of known and acceptable precision, bias, sensitivity, completeness, comparability, and representativeness within its background ambient air quality monitoring program.

Defined in Section 7.2 Measurement Quality Objectives, precision, bias, sensitivity, completeness, comparability and representativeness are the principal data quality indicators (DQI) that provide qualitative and quantitative descriptions used in interpreting the degree of acceptability of data. Establishing acceptance criteria for these DQIs sets quantitative goals for the quality of data generated in the measurement process. Of the six principal DQIs, precision, sensitivity and bias are the quantitative measures; representativeness and comparability are qualitative measures; and completeness is a combination of both qualitative and quantitative measures (US EPA QA/G-5, Appendix B[1]). The DAQ establishes the specific requirements of these six DQIs before data collection starts. The goal is to locate and eliminate (or minimize) bias, so the data collected show the true conditions of the area studied. This includes consideration of siting criteria, spatial scales, monitoring objectives, climatic change, source configurations and the duration of the study.

All individuals must adhere to the written procedures and methods in the QAPP and associated SOPs (see Table 11.2) for operating air monitoring instruments and handling data to assure quality data for purposes of collecting background data to use for PSD modeling for industrial expansion. EPA- approved federal reference methods (FRM) are the designated methodologies and basis for operating pollutant monitoring equipment, although the EPA allows agencies to use federal equivalent methods (FEM) as well.

7.1 Data Quality Objectives

This section provides a description of the data quality objectives (DQOs) for the background monitoring program for the state of North Carolina. Data quality objectives are qualitative and quantitative statements that:

- Clarify the intended use of the data,
- Define the type of data needed, and

[1] https://www.epa.gov/sites/production/files/2015-06/documents/g5-final.pdf

- Specify the tolerable limits on the probability of making an erroneous decision due to uncertainty in the data.

7.1.1 Intended Use of Data

The background monitoring program addresses two primary data quality objectives:

a. It measures the background one-hour SO_2 and daily PM_{10} concentrations expected to occur in the piedmont and coastal plains of North Carolina to meet PSD modeling requirements; and
b. It provides data to use to determine the air quality index and to report real-time data to AirNow-Tech and the DEQ website.

The EPA and DAQ will use these data to:

- Monitor current concentrations of these pollutants;
- Observe pollution trends throughout the region;
- Provide data for PSD modeling in support of PSD permit applications;
- Provide real-time data to the public; and
- Determine background levels of SO_2 and PM_{10}

7.1.2 Type of Data Needed

The EPA and DAQ determine the type of data needed by its intended use. Because DAQ primarily uses the background monitoring data for PSD modeling, the DAQ must collect data so that it complies with the PSD requirements in Part C of Title I of the CAA, meets 40 CFR Parts 50, 53, and 58 requirements, and be of such quality that permit-modelers can determine PSD increments with confidence and certainty. The EPA must approve the modeling results, including the monitoring data used by DAQ for PSD modeling. The monitoring data compiled by DAQ is a combination of criteria pollutant and non-criteria pollutant data including:

- Continuous hourly averaged SO_2 (with each hour considered valid if the monitor reports at least 45 valid one-minute concentration values for the hour) and PM_{10} concentration data collected by FRMs or FEMs;
- Continuous shelter temperature measurements for ensuring conformity to environmental requirements of the SO_2 and PM_{10} monitors;
- Precision measurements;
- Bias measurements;
- Site and monitoring metadata for AQS;
- Locational measurements (geographical, topographical, etc.); and
- Minute data for SO_2 and hourly five-minute maximum data for SO_2.

The DAQ background SO_2 monitoring network will operate and collect data in accordance with the schedules codified in 40 CFR 58.12. The ambient SO_2 concentration data will be collected by monitors that have been designated as FRM or FEM, in accordance with 40 CFR Part 58, Appendix C, Section 2.1.

The DAQ uses meteorological data obtained from nearby airports for PSD modeling and the quality assurance of the meteorological data is covered elsewhere. The appendices to 40 CFR Part 50 explain the data reporting and handling conventions for the individual pollutant parameters. 40 CFR Part 50, Appendix T explains the data reporting and handling conventions for SO_2. DAQ will adhere to those reporting conventions.

Section 10.0 Network Description presents specific information on the sampling design, including how to identify the monitoring location.

7.1.3 Tolerable Error Limits

The DQO process defines tolerable limits on the probability of making a wrong decision because of uncertainty in the data (that is, limits on the probability of coming up with a false positive or a false negative error). A decision maker encounters a false positive error when the data indicate a monitor exceeded the NAAQS when in fact, due to random deviations in the data, the monitor did not exceed it. Alternately, a decision maker encounters a false negative error when the data indicate the monitor did not exceed a NAAQS when in fact, due to random deviations in the data, the monitor did exceed the NAAQS. Using the formal DQO process EPA determined the objectives to control precision and bias to reduce the probability of decision errors. The regulations at 40 CFR Part 58, Appendix B, Section 2.3.1 provide the DQOs. The EPA has not completed a formal DQO process for PM_{10}; however, the EPA has provided DQOs for this parameter in the QA Handbook. The background monitoring program has established the acceptable precision, as measured by coefficient of variation, or CV, and acceptable bias for each pollutant as listed in Table 7.1.

Table 7.1. Acceptable Precision as Measured by Coefficient of Variation (CV) and Bias

Pollutant	Acceptable Precision	Acceptable Bias
PM_{10}	Upper 90 percent confidence limit of ≤10.0 percent CV	Within ±10.0 percent
SO_2	Upper 90 percent confidence limit for the CV of ≤10.0 percent	Upper 95 percent confidence limit for the absolute bias of ≤10.0 percent

The DAQ calculates coefficient of variation and absolute bias using the procedures in 40 CFR Part 58, Appendix B, Section 4.

7.2 Measurement Quality Objectives

As air pollution measurement systems increase in both cost and complexity, it becomes essential to have a methodology that will, in a cost-effective manner, increase the completeness and precision and decrease the bias of the data produced by the air pollution measurement systems.

Once a DQO is established, the DAQ evaluates and controls the quality of the data to ensure the DAQ maintains data quality within the established acceptance criteria. The EPA designed the MQOs 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. The DAQ defines the MQOs for North Carolina's background monitoring program in terms of the following DQIs:

- **Precision -** "Precision is a measure of agreement between two replicate measurements of the same property, under prescribed similar conditions (US EPA QA/G-5, Appendix B[2])." This is the random component of error. The DAQ calculates this value using percent differences as described in 40 CFR Part 58, Appendix B, Section 4.
- **Bias -** "Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction (US EPA QA/G-5, Appendix B)." Bias is determined by estimating the positive and negative deviation from the true value as a percentage of the true value.
- **Accuracy –** EPA defines accuracy as the degree of agreement between an observed value and an accepted reference value. Accuracy is a combination of random error (precision) and systematic error (bias). DAQ uses the AMP256 and AMP600 reports to determine accuracy.
- **Comparability -** "Comparability is the qualitative term that expresses the confidence that two data sets can contribute to a common analysis and interpolation. Comparability must be carefully evaluated to establish whether two data sets can be considered equivalent regarding the measurement of a specific variable or groups of variables (US EPA QA/G-5, Appendix B)."
- **Representativeness -** "Representativeness is a measure of the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point or for a process condition or environmental condition. Representativeness is a qualitative term that DAQ should evaluate to determine whether in situ or other measurements are made in such a manner that the resulting data appropriately reflect the media and phenomenon measured or studied (US EPA QA/G-5, Appendix B)."
- **Completeness -** Completeness is a metric quantifying the amount of valid data obtained from a measurement system compared to the expected amount obtained under correct, normal conditions. The DAQ expresses completeness as a percentage. Data completeness requirements for NAAQS are included in 40 CFR Part 50, Appendix K for PM_{10}, and in 40 CFR Part 50, Appendix T for SO_2.
- **Sensitivity** – "Sensitivity is the capability of a method or instrument to discriminate between measurement responses representing different levels of a variable of interest (US EPA QA/G-5, Appendix B)." Currently the DAQ does not perform annual method detection limit, or MDL, studies but relies on manufacturer's specifications for instrument detection limit, or IDL, or something similar.

For each of these attributes, the RCO chemists in consultation with the regional monitoring and ECB electronics technicians developed acceptance criteria using various parts of 40 CFR Parts 50, 53 and 58 and EPA-supplied guidance documents. Tables 7.2 through 7.4 list the MQOs for North Carolina's

[2] https://www.epa.gov/sites/production/files/2015-06/documents/g9-final.pdf

Table 7.2 Sulfur Dioxide Measurement Quality Objectives Parameter – Sulfur Dioxide (SO_2) (Ultraviolet Fluorescence).			
1) Requirement (SO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
CRITICAL CRITERIA- SO_2			
Sampler/Monitor	Not applicable	***Meets requirements listed in FRM/FEM designation***	1) 40 CFR Part 58, Appendix C, Section 2.1) 2) Not applicable 3) 40 CFR Part 53 and FRM/FEM method list
One Point QC Check Single analyzer	***1/14 days is required (The DAQ goal is daily checks)***	DAQ warning limit: ≤ 7.0 percent (percent difference) EPA control limit: < ± 10.1 percent (percent difference) Or < ± 1.5 ppb difference whichever is greater	1 and 2) 40 CFR Part 58, Appendix B, Section 3.1.1 3) Recommendation based on DQO in 40 CFR Part 58, Appendix B, Section 2.3.1.5 (see DAQ SO_2 SOP DAQ-12-001.2 for details) QC Check Concentration range 5 – 80 ppb relative to mean or median monitor concentration
Zero/span check	1/14 days is required (The DAQ goal is daily checks)	Zero drift < ± 3.1 ppb (24 hour) < ± 5.1 ppb (>24hour-14 day) (The DAQ warning limit is < ± 1.5 ppb (24 hour) and < ± 2.5 ppb (>24hour-14 day)) Span drift < ± 10.1 percent (The DAQ warning limit is < ± 5 percent)	1 and 2) QA Handbook Volume 2 Section 12.3 3) Recommendation and related to DQO (see DAQ SO2 SOP for details)
Shelter Temperature Range	Daily (hourly values)	20.0 to 30.0° C (hourly average)	1, 2 and 3) QA Handbook Volume 2 Section 7.2.2 and FRM/FEM method list
OPERATIONAL CRITERIA- SO_2			
Shelter Temperature Control	Daily (hourly values)	< ± 2.1° C standard deviation over 24 hours	1, 2 and 3) QA Handbook Volume 2 Section 7.2.2
Shelter Temperature Device Check	Every 180 days and 2/calendar year	< ± 2.1° C of standard	1, 2 and 3) QA Handbook Volume 2 Section 7.2.2
Internal Performance Evaluation Single Analyzer	***Every site 1/90 days and 1/monitoring quarter***	Percent difference of audit levels 3-10 ≤ ±15.0 percent; audit levels 1 and 2 <± 1.5 ppb difference or < ±15.1 percent whichever is greater	1 and 2) 40 CFR Part 58, Appendix B, Section 3.1.2 3) Recommendation - 3 audit concentrations not including zero. AMTIC Technical Memo
Verification/Calibration	Upon receipt/adjustment/repair/ installation/ moving; When one-point QC check is > 7.0 percent difference; 1/365 days	Span and Span2 within ± 5.0 percent of expected 1-point QC check ≤ 7.0 percent difference Zero within ± 1.0 ppb of expected Slope of best fit line = 1 ± 0.05 and each point within 2 percent of best fit line or ± 1.5 ppb, whichever is greater	1) 40 CFR Part 50, Appendix A-1, Section 4 2 and 3) Recommendation: See SO_2 Operator SOP Multi-point calibration (0 and 3 upscale points)

Table 7.2 Sulfur Dioxide Measurement Quality Objectives Parameter – Sulfur Dioxide (SO_2) (Ultraviolet Fluorescence).			
1) Requirement (SO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Gaseous Standards	***All gas cylinders***	***NIST Traceable (e.g., EPA Protocol Gas)***	1) 40 CFR Part 50, Appendix A-1, Section 4.1.6.1 2) Not applicable, Green Book 3) 40 CFR Part 50, Appendix A-1, Sections 2.2 and 4.1.6.1 Producers must participate in Ambient Air Protocol Gas Verification Program 40 CFR Part 58, Appendix B, Section 2.6.1
Zero Air/ Zero Air Check	Chemicals changed 1/365 days	Concentrations below LDL < 0.1 ppm aromatic hydrocarbons	1) 40 CFR Part 50, Appendix A-1, Section 4.1.6.2 2) Recommendation: See SO_2 ECB SOP 3) Recommendation and 40 CFR Part 50, Appendix A-1, Section 4.1.2
Gas Dilution Systems	Certified 1/365 days or after failure of 1-point QC check or performance evaluation	***Accuracy < ± 2.1 percent***	1) 40 CFR Part 50, Appendix A-1, section 4.1.2 2) Recommendation: See DAQ ECB SO_2 SOP 3) 40 CFR Part 50, Appendix A-1, section 4.1.2
Detection (FEM/FRMs) Noise and Lower Detectable Limits (LDL) are part of the FEM/FRM requirements.			
Noise	Verified by manufacturer at purchase	***≤ 0.001 ppm (standard range)*** ***≤ 0.0005 ppm (lower range)***	1) 40 CFR Section 53.23 (b) (definition and procedure) 2) See DAQ ECB SO_2 SOP 3) 40 CFR Part 53, Table B-1
Lower detectable level	Verified by manufacturer at purchase	***≤ 0.002 ppm (standard range)*** ***≤ 0.001 ppm (lower range)***	1) 40 CFR Section 53.23 (c) (definition and procedure) 2) See DAQ ECB SO_2 SOP 3) 40 CFR Part 53, Table B-1
SYSTEMATIC CRITERIA- SO_2			
Standard Reporting Units	***All data***	***ppb (final units in AQS)***	1, 2 and 3) 40 CFR Part 50, Appendix T, Section 2 (c)
Rounding convention for design value calculation	***All routine concentration data***	***1 place after decimal with digits to right truncated***	1, 2 and 3) 40 CFR Part 50, Appendix T, Section 2 (c) The rounding convention is for averaging values for comparison to the NAAQS and not for reporting individual hourly values to AQS.
Completeness	***1-hour standard***	Hour – ≥ 75 percent of hour ***Day- ≥ 75 percent of hourly concentrations*** ***Quarter- ≥ 75 percent complete days*** ***Years-4 complete quarters*** 5-minute values – ≥ 75 percent of minutes ***5-minute maximum value reported only for valid hours***	1, 2 and 3) 40 CFR Part 50, Appendix T, Section 3 (b), (c) More details in CFR on acceptable completeness.
	PSD determinations	12-month period - ≥ 80 percent of hours	1, 2 and 3) Ambient Monitoring Guidelines for Prevention of Significant Deterioration, Section 2.4.2.

Table 7.2 Sulfur Dioxide Measurement Quality Objectives Parameter – Sulfur Dioxide (SO_2) (Ultraviolet Fluorescence).			
1) Requirement (SO_2)	**2) Frequency**	**3) Acceptance Criteria**	**Information /Action**
Sample Residence Time Verification	At installation, 1/365 days and 1/calendar year (the DAQ goal is every 30 days)	***< 20 seconds***	1) 40 CFR Part 58, Appendix E, section 9 (c) 2) See DAQ SO_2 SOPs 3) 40 CFR Part 58, Appendix E, section 9 (c)
Sample Probe, Inlet, Sampling train	***All sites***	***Borosilicate glass (e.g., Pyrex®) or Teflon®*** (The EPA has accepted FEP and PFA as equivalent material to Teflon.)	1, 2 and 3) 40 CFR Part 58, Appendix E, section 9 (a) Replace when monitor is installed and at least every 2 years if the monitor operates for more than 24 months; more frequently if pollutant load or contamination dictate
Siting	1/365 days	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58, Appendix E, sections 2-6 2) See DAQ Network Review SOP 2.43 3) 40 CFR Part 58, Appendix E, sections 2-6
Precision (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***90 percent confidence limit CV < 10.1 percent***	1) 40 CFR Part 58, Appendix B, section 2.3.1.5 and 3.1.1 2) 40 CFR Part 58, Appendix B, section 4 (b) 3) 40 CFR Part 58, Appendix B, section 4.1.2
Bias (using 1-point QC checks)	***Calculated annually and as appropriate for design value estimates***	***95 percent confidence limit < ± 10.1 percent***	1) 40 CFR Part 58, Appendix B, section 2.3.1.5 and 3.1.1 2) 40 CFR Part 58, Appendix B, section 4 (b) 3) 40 CFR Part 58, Appendix B, section 4.1.3

Table 7.3. PM_{10} Measurement Quality Objectives: PM_{10} (Continuous Met One BAM 1020, Standard Temperature and Pressure, or STP)			
Criteria (PM_{10} STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
CRITICAL CRITERIA – PM_{10} Continuous, BAM 1020, STP			
Sampler/Monitor	Not applicable	***Meets requirements listed in the FRM or FEM designation*** Confirm method designation on front panel or just inside instrument	1) 40 CFR Part 58, Appendix C Section 2.1 2) Not applicable 3) 40 CFR Part 53 and FRM/FEM method list
Firmware of monitor	At setup	1. Must be the firmware (or later version) as identified in the published method designation summary. 2. ***Firmware settings must be set for flowrate to operate and report at STP***.	1, 2 and 3) 40 CFR Part 50, Appendix J, Section 2.2
Data Reporting Period	Report every hour	1. The BAM 1020 bases the calculation of a valid hour of data on the collection of 42 valid minutes of data per hour. 2. A 24-hour period is calculated in AQS if 18 or more valid hours are reported for a day	1) and 2) 40 CFR Part 50 Appendix N, Section 3 (c) 3) See BAM 1020 operator's manual and 40 CFR Part 50 Appendix N, Section 3 (c) Hourly data are always reported as the start of the hour on local standard time
Sampling Instrument			
PM_{10} Inlet	At setup	Must be a Louvered PM_{10} size selective inlet as specified in 40 CFR Part 50, Appendix L, Figures L-2 through L-19	1, 2 and 3) 40 CFR Part 50, Appendix L, Figures L-2 through L-19
Average Flow Rate	every 24 hours of operation, each hour can be checked	average within ± 5 percent of 16.67 LPM at local conditions	1, 2 and 3) 40 CFR Part 50, Appendix L, Section 7.4.3.1
Variability in Flow Rate	every 24 hours of operation	CV* ≤ 2 percent	1, 2 and 3) 40 CFR Part 50, Appendix L, Section 7.4.3.2

Table 7.3. PM_{10} Measurement Quality Objectives: PM_{10} (Continuous Met One BAM 1020, Standard Temperature and Pressure, or STP)			
Criteria (PM_{10} STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Verification/Calibration			
One-point Flow Rate Verification	Every 30 days, each separated by 14 days (DAQ goal is 2/month separated by 14 to 18 days)	< ± 4.1 percent of transfer standard (DAQ's warning limit goal is ≤± 3 percent of transfer standard) < ± 5.1 percent of flow rate design value (DAQ's warning limit goal is ≤± 4 percent of flow rate design value)	1 and 2) 40 CFR Part 58, Appendix B, Section 3.3.1 and *DAQ BAM SOP*, Section 7.0 3) 40 CFR Part 50, Appendix L, Section 9.2.5 and 7.4.3.1 and *DAQ BAM SOP*, Section 7.0
Design Flow Rate Adjustment	***after multi-point calibration or verification***	***< ± 2.1 percent of design flow rate***	1, 2 and 3) 40 CFR Part 50, Appendix L, Section 9.2.6
OPERATIONAL CRITERIA – PM_{10} Continuous, BAM 1020, STP			
Annual Multi-point Verifications and Calibrations			
External Leak Check	**Before each flow rate verification of calibration**	< 1.5 LPM	1) 40 CFR Part 50 Appendix L, Section 7.4.6.1 2) 40 CFR Part 50 Appendix L, Section 9.2.3 and Method 2-12 Section 7.4.3 3) 40 CFR Part 50 Appendix L, Section 7.4.6.1 and DAQ BAM SOP Sections 6 and 7
Internal Leak Check	**Whenever the external leak check fails**	< 0.2 LPM	1) 40 CFR Part 50 Appendix L, Section 7.4.6.2 2) Method 2-12 Section 7.4.4 3) 40 CFR Part 50 Appendix L, Section 7.4.6.2 and DAQ BAM SOP 2.37.2 Appendix A: Internal Leak Check Procedures
Tape/Sample Stream Temperature multi-point Verification or Calibration	On installation, electromechanical maintenance, transport or every 365 days and 1/calendar year	< ± 2.1°C	1) 40 CFR Part 50, Appendix L, Section 9.3 2 and 3) Method 2.12, Section 6.4.4

Table 7.3. PM_{10} Measurement Quality Objectives: PM_{10} (Continuous Met One BAM 1020, Standard Temperature and Pressure, or STP)			
Criteria (PM_{10} STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
One-Point Ambient Pressure Verification or Calibration	On installation, electromechanical maintenance, transport or every 365 days and 1/calendar year	<± 10.1 millimeters mercury	1) 40 CFR Part 50, Appendix L, Section 9.3 2 and 3) Method 2.12, Section 6.5 Barometric pressure verified against an independent standard verified against a laboratory primary standard that is certified NIST traceable 1/365 days
Flow Rate Multi-point Verification or Calibration	On installation, electromechanical maintenance, transport or every 365 days and 1/calendar year	<±10.1 % of design value (DAQ goal is <± 2.1 percent of transfer standard)	1) 40 CFR Part 50, Appendix J, Section 8.0. 2) 40 CFR Part 50, Appendix L, Section 9.1.3, Method 2.10, Section 2.2.4 3) Method 2.10, Section 2.2.4
Routine One-Point Verifications			
Leak Check	1/30 days	< 1.5 LPM	1) 40 CFR Part 50 Appendix L, Section 7.4.6.1 2) DAQ BAM SOP Section 7.1 3) DAQ BAM SOP Section 7.1
One-point Temperature Verification	1/30 days	<± 2.1°C	1) 40 CFR Part 50, Appendix L, Section 9.3 2) Method 2.12 Sec. 7.4.5 and Table 6-1 3) DAQ BAM SOP Section 7.1
One-point Pressure Verification	1/30 days	<± 10.1 millimeters mercury	1) 40 CFR Part 50, Appendix L, Section 9.3 2) DAQ BAM SOP Section 7.1 3) DAQ BAM SOP Section 7.1
Other Monitor Calibrations and Checks	Per manufacturer's operation manual	Annual zero test on Met One BAM 1020	1, 2 and 3) Per manufacturer's operating manual. Note: more frequent zero tests may be appropriate in areas with seasonal changes in dew points.

Table 7.3. PM_{10} Measurement Quality Objectives: PM_{10} (Continuous Met One BAM 1020, Standard Temperature and Pressure, or STP)			
Criteria (PM_{10} STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Accuracy			
Temperature Audit	Every 180 days and at time of flow rate audit (DAQ goal is every 91 days)	<± 2.1°C	1) Method 2.12 Sec. 11.2.2 2) Method 2.12 Sec. 11.2.2 (and DAQ BAM SOP Section 5.0) 3) Method 2.12 Sec. 11.2.2
Pressure Audit	Every 180 days and at time of flow rate audit (DAQ goal is every 91 days)	<±10.1 millimeters mercury	1) Method 2.12 Sec. 11.2.3 2) Method 2.12 Sec. 11.2.3 (and DAQ BAM SOP Section 5.0) 3) Method 2.12 Sec. 11.2.3
Semi Annual Flow Rate Audit	***Twice a calendar year and 5 to 7 months apart*** (DAQ goal is every 91 days)	<± 4.1 percent of audit standard; <± 5.1 percent of design flow rate (DAQ's warning limit goal for percent of transfer standard and flow design value is ≤ ± 3.0 and ≤ ± 4.0 percent, respectively)	1) Part 58, Appendix B, Sec. 3.3.2 2) Part 58, Appendix B, Sec. 3.3.2 (and DAQ BAM SOP Section 5.0) 3) Method 2.10 Sec. 7.1.5 (and DAQ BAM SOP Section 5.0)
Cabinet Temperature			
Temperature Range	At set-up	0 to 50 ° C	1, 2 and 3) BAM 1020 Operation Manual
Temperature Control	Hourly values	Within ± 2 ° C	1, 2 and 3) BAM 1020 Operation Manual
Temperature Device Check	Every 180 calendar days and twice a calendar year	< ± 2.1° C	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Monitor Maintenance			
Inlet Cleaning	Every 30 days	cleaned	1,2 and 3) Method 2.12, Section 8.3
Downtube Cleaning	every 90 days	cleaned	1,2 and 3) Method 2.12 Sec. 8.4
Filter Housing Assembly Cleaning	Every 30 days	cleaned	1,2 and 3) Method 2.12, Section 8.3
Circulating Fan Filter Cleaning	Every 30 days	Cleaned or changed	1,2 and 3) Method 2.12, Section 8.3

Table 7.3. PM_{10} Measurement Quality Objectives: PM_{10} (Continuous Met One BAM 1020, Standard Temperature and Pressure, or STP)			
Criteria (PM_{10} STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Manufacturer Recommended Maintenance for BAM 1020 Monitors			
Replace or Clean Pump Muffler	1/182 days and 2/calendar year	cleaned or changed	1, 2 and 3) BAM 1020 Operations Manual
Capstan shaft and pinch roller cleaning (BAM)	Every 30 days	cleaned	1, 2 and 3) BAM SOP Section 10.1.3
Internal debris filter	1/365 days and 1/calendar year	Cleaned or replaced	1, 2 and 3) BAM 1020 Operations Manual
BAM Specific Operational Criteria			
Check of membrane span foil	Daily	Avg. < + 5.1% of ABS	1, 2 and 3) BAM 1020 Operations Manual
Electrical Grounding	At Installation, 1/year	1. Ground the chassis of the BAM 2. Ground the downtube to the chassis at the collar (i.e., with setscrews)	1, 2 and 3) BAM 1020 Operations Manual
Nozzle and Vane Cleaning	Every 30 days or more often as needed	cleaned	1, 2 and 3) DAQ BAM SOP Section 8
Zero filter test	At installation and 1/365 days	Standard deviation of the data from a 72-hour zero test < 2.4 µg/m3	1, 2 and 3) BAM SOP Section 7
Internal/External Data Logger Data Comparison	Every month highest value on three randomly selected days	agree exactly (digital) and <± 1 µg/m^3 (analog)	1 and 3) BAM SOP Section 10.1.9 2) DAQ practice
Smart Heater Test	1/30 days	heater turns off when forced off	1, 2 and 3) BAM 1020 Operations Manual
Beta detector count rate	1/365 days	between 600,00 and 1,000,000	1, 2 and 3) BAM 1020 Operations Manual

Table 7.3. PM_{10} Measurement Quality Objectives: PM_{10} (Continuous Met One BAM 1020, Standard Temperature and Pressure, or STP)			
Criteria (PM_{10} STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
SYSTEMATIC CRITERIA – PM_{10} Continuous, BAM 1020, STP			
Siting	1/365 days and 1/calendar year	***Meets siting criteria or waiver documented***	1) 40 CFR Part 58, Appendix E, sections 2-6 2) Recommendation (See DAQ Annual Network Review SOP) 3) 40 CFR Part 58, Appendix E, sections 2-6
Data Completeness	24-hour quarterly	≥ 75 percent of hours per day and ≥ 75 percent scheduled sampling days in each quarter	1, 2 and 3) 40 CFR Part 50, Appendix K, Section 2.3 (a)
	PSD determinations	12-month period - ≥ 80 percent of hours	1, 2 and 3) Ambient Monitoring Guidelines for Prevention of Significant Deterioration, Section 2.4.2.
Reporting Units	all hourly and 24-hour values	µg/m^3 at STP	1, 2 and 3) 40 CFR Part 50, Appendix K
Rounding convention for data reported to AQS	all hourly averages	to one decimal place, with additional digits to the right being truncated	1. 2 and 3) 40 CFR Part 50, Appendix N, Section 3.0 (b)
Rounding convention for design value calculation			
24-hour, 3-year average	***quarterly***	***nearest 10 µg/m^3 at STP (≥ 5 round up)***	1. 2 and 3) 40 CFR Part 50, Appendix K Section 1
Recertifications of Verification and Calibration Standards - All standards should have multi-point certifications against NIST-traceable standards			
Flow Rate Transfer Standard	1/365 days and once per calendar year	***< ± 2.1 percent of NIST-traceable Standard***	1) 40 CFR Part 50, Appendix J, Section 7.3 2) Method 2.11, Section 1.1.3 3) 40 CFR Part 50, Appendix J, Section 7.3
Field Thermometer	1/365 days and once per calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12, Section 4.2.2
Field Barometer	1/365 days and once per calendar year	± 1-millimeter mercury resolution, ± 5 millimeters mercury accuracy	1, 2 and 3) Method 2.10, Section 1.1.2
Field Manometer	1/365 days and once per calendar year	± 0.1 inches water resolution, ± 1.0 inches water accuracy	1, 2 and 3) Method 2.12, Section 4.2.2

Table 7.3. PM_{10} Measurement Quality Objectives: PM_{10} (Continuous Met One BAM 1020, Standard Temperature and Pressure, or STP)			
Criteria (PM_{10} STP)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Clock/timer Verification	1/30 days	***± 1 minute/month***	1and 2) Method 2.12, Table 8-1 3) 40 CFR Part 50, Appendix L, Section 7.4.12
Precision (using flow rate verifications – no collocation is required for continuous PM_{10})			
Primary Quality Assurance Organization	Annual and 3-year estimates (if monitor operated that long)	Upper 90 percent confidence limit for the CV < 10.1 percent	1, 2 and 3) 40 CFR Part 58, Appendix B, Sections 2.3.1.1, 4.2.2 and 3.3.1
Bias (using flow rate verifications – no NPAP or PEP is available for PM_{10})			
Primary quality assurance organization	Annual and 3-year estimates (if monitor operated that long)	≤ ±10.0 percent for total bias	1, 2 and 3) 40 CFR Part 58, Appendix B, Section 2.3.1.1, 4.2.2 and 3.3.1

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)			
1) Criteria (PM T640X)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
CRITICAL CRITERIA - Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)			
Sampler/Monitor	Not applicable	meets requirements listed in FRM/FEM designation; confirm method designation on front panel or just inside instrument	1) 40 CFR Part 58, Appendix C, Section 2.1 2) Not applicable 3) 40 CFR Part 53 and FRM/FEM method list
Firmware of monitor	At setup and as updated	1. Must be the firmware (or later version) as identified in the published method designation summary. 2. Firmware settings must be set for flowrate to operate and report at (1) "local conditions" for PM2.5 and (2) STP for PM10.	1) FEM: EQPM-0516-238/239 2) EPA T640x SOP 3) 1. FEM: EQPM-0516-238/239 2. 40 CFR Part 50 App N. sec. 1 (c)
Data Reporting Period	Report every hour	1. The calculation of an hour of data is dependent on the design of the method. 2. A 24-hour period is calculated in AQS if 18 or more valid hours are reported for a day.	1, 2 and 3) See operator's manual. Hourly data are always reported as the start of the hour on local standard time 40 CFR Part 50 App N. Sec 3 (c)
Sampling Period			
PM_{10} Inlet	At setup	Must be a Louvered PM_{10} size selective inlet as specified in 40 CFR Part 50, appendix L, Figures L-2 through L-19	1) FEM: EQPM-0516-238/239 2) EPA T640x SOP 3) FEM: EQPM-0516-238/239
Average Flow Rate	every 24 hours of operation, alternatively, each hour can be checked	average within ±5 percent of 16.67 LPM for total flow	1, 2 and 3) 40 CFR Part 50 App L Sec. 7.4.3.1

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)

1) Criteria (PM T640X)	2) Frequency	3) Acceptable Range	Information /Action
Variability in Flow Rate	every 24 hours of operation	CV* ≤ 2 percent	1, 2 and 3) 40 CFR Part 50, Appendix L, Section 7.4.3.2
One-point Flow Rate Verification (Total Flow)	Every 30 days, each separated by 14 days (DAQ goal is 2/month separated by 14 to 18 days)	< ± 4.1 percent of transfer standard (DAQ's warning limit is ≤± 3 percent of transfer standard); < ± 5.1 percent of flow rate design value (DAQ's warning limit is ≤± 4 percent of flow rate design value)	1, 2 and 3) 40 CFR Part 50, Appendix L, Section 9.2.5 and 7.4.3.1 and 40 CFR Part 58, Appendix B Section 3.2.1 and 3.3.1 3) *DAQ T640X SOP*, Section 7.0
One-point Flow Rate Verification (Sample Flow)	1/30 days, separated by 14 days (DAQ goal is 2/month separated by 14 to 18 days)	< ± 4.1% of transfer standard (DAQ's warning limit is ≤± 3 percent of transfer standard)	1, 2 and 3) 40 CFR Part 50, App.L, Sec. 9.2.5, 40 CFR Part 58, Appendix B, Sec. 3.2.1, 3) DAQ T640X SOP, Section 7.0
PMT verification	every 90 days	≤ ± 1.5 of SpanDust™ value stated on bottle	1) Teledyne T640 manual 2) EPA T640x SOP 3) To meet DQO set forth in 40 CFR Part 58, Appendix B, Sec. 2.3.1.1 and DAQ T640X SOP, Section 7.0

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)

1) Criteria (PM T640X)	2) Frequency	3) Acceptable Range	Information /Action
OPERATIONAL CRITERIA - Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)			
Routine Verifications			
Mid-Month Flow Rate Verification	1/30 days	Total Flow < ± 4.1% of transfer standard (DAQ's warning limit is ≤± 3 percent of transfer standard); < ± 5.1% of flow rate design value (DAQ's warning limit is ≤± 4 percent of flowrate design value) Sample Flow < ± 4.1% of transfer standard (DAQ's warning limit is ≤± 3 percent of transfer standard)	1) 40 CFR Part 50, Appendix L, Section 9.2.5 and 40 CFR Part 58, Appendix B, Section 3.2.1 2) Recommendation 3) *DAQ T640X SOP*, Section 7.0
One-point Temperature Verification	1/30 days	< ± 2.1 °C	1) Teledyne T640 manual and 40 CFR Part 50, Appendix L, Section 9.3 2) EPA T640x SOP 3) Teledyne T640 manual and *DAQ T640X SOP*, Section 7.0
Pressure Verification	1/30 days	< ± 10.1 millimeters mercury	1) Teledyne T640 manual and 40 CFR Part 50, Appendix L, Section 9.3 2) EPA T640x SOP 3) Teledyne T640 manual and *DAQ T640X SOP*, Section 7.0
Leak Check (Zero Test)	every 30 days	≤ 0.2 µg/m^3	1) Teledyne T640 manual and 40 CFR Part 50, Appendix L, Section 7.4.6.1 2) EPA T640x SOP 3) Teledyne T640 manual and *DAQ T640X SOP*, Section 7.0. DAQ designates this as an operational criterion.

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)

1) Criteria (PM T640X)	2) Frequency	3) Acceptable Range	Information /Action
Span Deviation Tracker	Daily	If flagged	1, 2 and 3) Recommended. Teledyne representatives suggest monitoring this metric as a leading indicator of potential instrument malfunction.
Signal Length	Daily	Logged	1, 2 and 3) Recommended. Teledyne representatives suggest monitoring this metric because it is useful when diagnosing instrument malfunction.
Annual Multi-Point Calibrations			
Pressure Verification or Calibration	On installation, electromechanical maintenance or transport or 1/365 days and once per calendar year	<± 10.1 millimeters mercury	1) Teledyne T640 manual and 40 CFR Part 50, Appendix L, Section 9.3 2) Method 2.12, section 6.5 3) Teledyne T640 manual and Method 2.12, section 6.5 Barometric pressure verified against an independent standard verified against a laboratory primary standard that is certified NIST-traceable 1/365 days
Flow Rate Multi-Point Calibration	Electromechanical maintenance or transport or 1/365 days and once per calendar year	<± 2.1 percent of transfer standard for all flows	1) 40 CFR Part 50, Appendix L, Section 9.2. 2) 40 CFR Part 50, Appendix L, Section 9.1.3, Method 2.12 Section 6.3 and Table 6-1 3) 40 CFR Part 50, Appendix L, Section 9.2.5
Accuracy			
Temperature Audit	1/90 days and at time of flow rate audit	± 2°C	1, 2 and 3) Method 2.12, Section 11.2.2

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)

1) Criteria (PM T640X)	2) Frequency	3) Acceptable Range	Information /Action
Pressure Audit	1/90 days and at time of flow rate audit	<±10 millimeters mercury	1, 2 and 3) Method 2.12, Section 11.2.3
Semi-Annual Flow Rate Audit (Total Flow)	1/90 days	< ± 4.1 percent of audit standard; < ± 5.1 percent of design flow rate (DAQ's warning limit for percent of transfer standard and flow design value is ≤±3.0 and ≤±4.0 percent, respectively)	1 and 2) 40 CFR Part 58, Appendix B, Sections 3.2.2 and 3.3.2 3) Method 2.12 Section 11.2.1
Semi-Annual Flow Rate Audit (Sample Flow)	1/90 days	< ± 4.1 percent of audit standard; (DAQ's warning limit for percent of transfer standard a is ≤±3.0 percent)	1 and 2) 40 CFR Part 58, Appendix B, Sections 3.2.2 and 3.3.2 3) Method 2.12 Section 11.2.1
Shelter Temperature			
Temperature range	During operation	0 - 50°C	1) Teledyne T640 manual 2) Recommendation 3) Teledyne T640 manual
Temperature Control	Daily (hourly values)	< 2.1 ° C SD over 24 hours	1, 2 and 3) QA Handbook Volume 2 Sec. 7.2.2
Temperature Device Check	every 180 days and twice a calendar year	< ± 2.1° C	1, 2 and 3) QA Handbook Volume 2 Section 7.2.2
Monitor Maintenance			
Clean inlet (PM_{10} Head)	Every 30 days	cleaned	1) DAQ T640X SOP Section 8.0 and Teledyne T640 manual 2) Teledyne T640 manual 3) DAQ T640X SOP Section 8.0 and Teledyne T640 manual
Downtube Cleaning	every 90 days	cleaned	1) Teledyne T640 manual

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)

1) Criteria (PM T640X)	2) Frequency	3) Acceptable Range	Information /Action
			2) and 3) Method 2.12 Sec. 8.4
Inspect and clean optical chamber and relative humidity/temperature (RH/T) sensors	every 180 days and twice a calendar year. More frequently with high loading	cleaned or changed	1) DAQ T640X SOP Section 8.0 and Teledyne T640 manual 2) EPA T640X SOP 3) DAQ T640X SOP Section 8.0 and EPA T640X SOP
Replace Disposable Filter Unit	Annually or when Pump PWM value approaches 80%.	cleaned or changed	1) DAQ T640X SOP Section 8.0 and Teledyne T640 manual 2) EPA T640X SOP 3) DAQ T640X SOP Section 8.0 and EPA T640X SOP
Inspect Downtube and ASC to ensure vertically plumbed	every 90 days	Plumb (90° from instrument horizontal axis)	1) Teledyne T640 manual 2) Recommendation 3) Teledyne T640 manual
Check Pump Performance (Pump)	Every 30 days	PWM value 30 < 80%	1) DAQ T640X SOP Section 8.0 and Teledyne T640 manual 2) EPA T640X SOP 3) DAQ T640X SOP Section 8.0 and Teledyne T640 manual
Check Pump Performance (Valve)	Every 30 days	PWM value 50 < 85%	1) DAQ T640X SOP Section 8.0 and Teledyne T640 manual 2) EPA T640X SOP 3) DAQ T640X SOP Section 8.0 and Teledyne T640 manual
Inspect inner and outer sample tubes	Every 30 days	Inspected and cleaned as needed	1,2 and 3) Teledyne T640 manual
Empty Water Collection Bottle	Every 30 days	cleaned	1) DAQ T640X SOP Section 8.0 2) DAQ practice 3) DAQ T640X SOP Section 8.0

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)			
1) Criteria (PM T640X)	**2) Frequency**	**3) Acceptable Range**	**Information /Action**
Inspect O-rings	Every 30 days	Visual inspection	1) DAQ T640X SOP Section 8.0 2) DAQ practice 3) DAQ T640X SOP Section 8.0
Clean Temperature Probe Solar Shield	1/90 days	cleaned	1) DAQ T640X SOP Section 8.0 2) DAQ practice 3) DAQ T640X SOP Section 8.0
Internal/External Data Logger Data	Every month highest value on three randomly selected days	agree exactly (digital) and ± 1 µg/m^3 (analog)	1) DAQ T640X SOP Section 9.0 2) DAQ practice 3) DAQ T640X SOP Section 9.0
ASC Test	1/30 days	heater turns on when forced off	1) DAQ T640X SOP Section 8.0 2) DAQ practice 3) DAQ T640X SOP Section 8.0
Manufacturer Recommended Maintenance	per manufacturers' manual	per manufacturers' manual	1, 2 and 3) Manufacturer-Recommended Maintenance
SYSTEMATIC CRITERIA - Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)			
Siting	1/365 days and 1/calendar year	meets siting criteria or waiver documented	1) 40 CFR Part 58 Appendix E, sections 2-6 2) Recommendation (See DAQ Annual Network Review SOP) 3) 40 CFR Part 58 Appendix E, sections 2-6
Data Completeness	Annual Standard ($PM_{2.5}$)	≥ 75 percent of scheduled sampling days in each quarter	1, 2 and 3) 40 CFR Part 50, Appendix N, Section 4.1 (b) 4.2 (a)
	24-hour averages and quarterly	≥ 75 percent of hours per day and scheduled sampling days in each quarter	1, 2 and 3) 40 CFR Part 50, Appendix N, Section 4.1 (b) 4.2 (a)
	PSD determinations	12-month period - ≥ 80 percent of hours	1, 2 and 3) Ambient Monitoring Guidelines for Prevention of Significant Deterioration, Section 2.4.2.

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)

1) Criteria (PM T640X)	2) Frequency	3) Acceptable Range	Information /Action
Reporting Units	all hourly and 24-hour values	µg/m3 at ambient temperature and pressure ($PM_{2.5}$, PM_{10}, $PM_{10-2.5}$) µg/m^3 at STP (PM_{10})	1, 2 and 3) 40 CFR Part 50, Appendix N, Section 3.0 (b), 40 CFR Part 50, Appendix K, Section 2.3 (a)
Rounding convention for data reported to AQS	all 1-hour averages	to one decimal place, with additional digits to the right being truncated or as reported by instrument	1. 2 and 3) 40 CFR Part 50, Appendix N, Section 3.0 (b) Rounding rule for AQS data is a recommendation
Rounding convention for PM_{10} design value calculation	All 24-hour averages from midnight to midnight	nearest 10 µg/m^3 at STP (≥ 5 round up)	1, 2 and 3) 40 CFR Part 50, Appendix K, Section 1 The rounding convention is for averaging values for comparison to the NAAQS and not for reporting individual values to AQS.
Rounding convention for annual 3-yr average for $PM_{2.5}$	all concentrations	all concentrations nearest 0.1 µg/m^3 (≥ 0.05 round up)	1,2 and 3) 40 CFR Part 50, Appendix N, Section 3 and 4, the rounding convention for comparison to NAAQS not for reporting individual values
Rounding convention for 24-hour, 3-yr average for $PM_{2.5}$	all concentrations	all concentrations nearest 1 µg/m^3 (≥ 0.5 round up)	1,2 and 3) 40 CFR Part 50, Appendix N, Section 3 and 4, the rounding convention for comparison to NAAQS not for reporting individual values
Verification/Calibration Standards and Recertifications - All standards should have multi-point certifications against NIST Traceable standards			
Flow Rate Transfer Standard	1/365 days and once each calendar year	< ± 2 percent of NIST-Traceable Standard	1) 40 CFR Part 50, Appendix L, Section 9.1 and 9.3 and Appendix J, Section 7.3 2) Method 2-12, Section 4.2.3 and 6.3.3 and Method 2.11 Section 1.1.3 3) 40 CFR Part 50, Appendix L, Section 9.1 and 9.3 and Appendix J, Section 7.3
Field Thermometer	1/365 days and once each calendar year	± 0.1° C resolution, ± 0.5° C accuracy	1, 2 and 3) Method 2.12 Section 4.2.2
Field Barometer	1/365 days and once each calendar year	± 1 millimeter mercury resolution, ± 5 millimeters mercury accuracy	1, 2 and 3) Method 2.12 Section 4.2.2
Field Manometer	1/365 days and once each calendar year	± 0.1 in water resolution, ± 1.0 in water accuracy	1, 2 and 3) Method 2.12, Table 4-1

Table 7.4. Measurement Quality Objectives: Teledyne T640X Continuous $PM_{2.5}$, PM_{10} and $PM_{10-2.5}$ Local Conditions and PM_{10} Standard Temperature and Pressure (STP)

1) Criteria (PM T640X)	2) Frequency	3) Acceptable Range	Information /Action
Clock/timer Verification	1/30 days	± 1 minute/month	1 and 2) Method 2.12 Table 3-1 3) 40 CFR Part 50, Appendix L Section 7.4.12
Precision (using flow rate verifications – no collocation is required for continuous PM10)			
Primary Quality Assurance Organization	Annual and 3-year estimates (if monitor operated that long)	90 percent confidence limit of CV* < 10.1 percent for values ≥ 3.0 µg/m^3	1, 2 and 3) 40 CFR Part 58, Appendix B, Section 3.2.1, 3.3.1, 4.2.2 and 2.3.1.1.
Bias (using flow rate verifications – no NPAP or PEP is available for PM_{10})			
Primary quality assurance organization	Annual and 3-year estimates (if monitor operated that long)	≤ ±10.0 percent for total bias	1, 2 and 3) 40 CFR Part 58, Appendix B, Section 2.3.1.1, 4.2.2 and 3.3.1

ASC = Aerosol Sample Conditioner

background monitoring program. The RCO chemists based these tables on validation templates in the EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, referred to as the QA Handbook. As described in the QA Handbook and implemented here, for each criteria pollutant, Tables 7.2 through 7.4 list three validation criteria: critical, operational and systematic. The tables discriminate between:

- Criteria that must be met to ensure the quality of the data, i.e., critical criteria,
- Criteria that indicate there may be issues with the quality of the data and further investigation is warranted before determining the validity of the datum or data, i.e., operational criteria, and
- Criteria that indicate a potentially systematic problem with the environmental data collection activity that may limit the ability to make decisions with the data, i.e., systematic criteria.

For each criterion, the tables include: (1) the requirement, (2) the frequency with which compliance is to be evaluated, (3) the acceptance criteria, and (4) information where the requirement can be found or additional guidance on the requirement.

North Carolina has adopted and implemented EPA Region 4's LSASD recommended warning limits or an even stricter warning limit for SO_2 and PM_{10} monitoring. The RCO chemists define warning limits as the level of allowable imprecision before a regional monitoring technician must calibrate an analyzer or take other corrective action. The RCO chemists set the warning limits lower than the MQOs or control limits to reduce imprecision and bias and enhance data recovery.

The RCO chemists define control limits as the level of allowable imprecision before data invalidation and corrective actions are required. The RCO chemists cannot set control limits higher than the MQOs. The RCO chemists use these limits when validating ambient air measurements against single point precision checks. The use of both warning and control limits strengthens the precision of these measurements and improves the data validation practices to meet regulatory requirements. Tables 7.2 through 7.4 include both the DAQ established warning limits and EPA established control limits.

Other elements, as well as the SOPs associated with this QAPP that are specific to each monitor type, provide more detailed descriptions of these MQOs and how they will be used to control and assess measurement uncertainty.

7.2.1 General Data Quality Objectives

The background monitoring program pollutant data will be collected using hourly concentration data (for gaseous monitors the EPA considers each hour valid if the monitor collected at least 45 valid 1-minute readings), 5-minute SO2 data and 1-hour PM_{10} concentration data. For each of these pollutants, quarterly data capture will need to be ≥ 80 percent completeness. The collection of precision and bias data is also required. In addition to these requirements, the data needed for the DAQ background monitoring program will meet the following principal quality objectives:

- All data should be traceable to a National Institute of Standards and Technology, or NIST, primary standard;

- All data shall be of a known and documented quality. Two major measurements used to define quality are precision and bias. Refer to Section 7.2 Measurement Quality Objectives for definitions of the metrics precision and bias;
- All data shall be comparable. This means DAQ shall produce all data in a similar and scientific manner. The use of the standard methodologies for sampling, calibration, auditing, etc. referenced in the QAPP and associated SOPs should achieve this goal;
- All data shall be representative of the measured parameters with respect to time, location and the conditions from which DAQ obtains the data. The use of approved standard methodologies should ensure that the data generated are representative. Support in achieving representativeness is also provided through adhering to the requirements prescribed in 40 CFR Part 58, Appendices D and E;
- All data shall be as complete as possible and DAQ will supplement the data, as needed, using either a collocated data logger for shelter temperature or data stored in the monitor for the SO_2 and PM_{10}; and
- The QAPP and its associated SOPs must be dynamic to continue to achieve its stated goals as techniques, systems, concepts and project goals change.

8.0 Training Requirements

Adequate education and training are integral to any monitoring program that strives for reliable and comparable data. DAQ personnel will meet the educational requirements, accountability standards and training requirements for their positions. Section 4 of the QMP describes the DEQ training program. DAQ requires all staff to take specific, mandatory governmental training courses, such as safety training, defensive driving and harassment awareness courses, among others. The DAQ maintains records on personnel qualifications and training in several locations, dependent upon the applicability of the information. For example, staff may maintain copies of certificates received from classes or workshops, whereas human resources will keep records of personnel qualifications. The DAQ uses the North Carolina Learning Management System, or LMS, to track training by DIT and the Office of State Human Resources.

The DAQ aims ambient air monitoring training at increasing the effectiveness of employees as well as the effectiveness of DAQ. In general, training for the ambient air monitoring program consists of a combination of required reading, ambient monitoring monthly meetings, active cross-training amongst staff, completion of EPA-led training classes and attendance at DAQ and EPA workshops and conferences. Currently, no recurring annual training is required for the background monitoring staff other than attendance at the annual ambient monitoring workshop. Observations made during internal systems audits may result in the need for specific refresher training provided by DAQ staff. Completion of additional training – such as self-instructional air monitoring courses and EPA-provided webinars – is encouraged by all staff.

Specific air monitoring personnel training consists of required reading before implementing the requirements of this QAPP. Documents monitoring personnel must read shall include this QAPP and the SOPs and instrument manuals specific to the equipment personnel will be working with or servicing. Employee supervisors or trainers typically document required reading on a form indicating the employee has read and understood the QAPP and SOP. These forms are archived in Laserfiche. Specific training requirements are provided in SOP DAQ-15-003 (*in draft and under review at this time*). DAQ continually revises the training program and updates the training forms used to document training as needed.

All positions have a training guide that provides suggested training for employees to complete to achieve competency in that position. Staff are encouraged to also read applicable parts of the CFR (e.g., 40 CFR, Part 50 and 58), the QA Handbook, Vol. II, and EPA's data validation guidance documents and policy memoranda. See Table 11.2 for relevant SOPs to review.

The DAQ makes efforts to ensure all employees receive timely training and periodic refreshers in accordance with the established training guide. Experienced staff members provide on-the-job training. As the Raleigh Regional Office (RRO) has the largest ambient monitoring staff with the most diversified monitoring equipment, the chief often calls upon the RRO to provide hands-on training when needed. The chief, PPB supervisor or equivalent typically makes arrangement for this training. In some cases, the chief calls upon other regional offices, the ECB electronics technicians and RCO chemists to provide

hands-on training. The employee documents this training on the provided training forms (obtained from Laserfiche), which are archived in Laserfiche as well as in the employee's valuing individual performance (VIP). Before 2021, the employee may also have archived training records in the North Carolina Learning Management System, or LMS.

The DAQ supervisors actively encourage all employees to pursue training opportunities whenever possible and as needed, because the chief continually evaluates DAQ's background monitoring network to ensure it continues to meet its objectives. Because of these evaluations, the chief could add new equipment, procedures or new personnel to the project. DAQ provides vendor-based training for its personnel when DAQ obtains new equipment. The employees document this training on the provided training forms (obtained from Laserfiche), which are archived in Laserfiche. The employee may also archive the training records in the LMS, if he or she chooses to do so. Additionally, personnel are encouraged to periodically identify, request, and attend pertinent courses and seminars. The DAQ may provide these courses and seminars as videotapes, closed circuit transmission, web based real-time interactive formats, live instruction or a combination of one or more. Organizations that provide these training opportunities include local and regional universities, the Air and Waste Management Association, the Mid Atlantic Regional Air Management Association and EPA. The employees document this training on the appropriate training form and archive it in Laserfiche. Air monitoring personnel have sufficient training to currently perform necessary functions at an acceptable level.

The DAQ supervisors also evaluate employee proficiency, based on performance and feedback from peers and other coworkers. During the VIP review, the supervisors recommend any refresher training the employee may need and develop a plan for the employee to receive the needed training. The LMS provides and archives certificates of completion for any course work taken through the LMS.

Prior to the start of on-site work, DAQ provides all field personnel instruction specific to the project covering the following areas:

- Organization and lines of communication and authority,
- Overview of the QAPP, including monitoring maintenance, calibration, and QC activities,
- Quality assurance / quality control, or QA/QC, requirements,
- Document requirements, and
- Health and safety requirements.

Monitoring staff provide new monitoring personnel and the background monitoring station technicians, who operate these sites, necessary on-the-job training for their individual monitoring tasks, including data review, verification and validation. Upon completion of training, the trainee will be performance tested on knowledge, skills, and abilities in the field and at the office. Upon successful demonstration of initial competency, the trainer will complete Form DAQ-16-022 DAQ Initial Demonstration of Competency. Continuing demonstration of competency is noted during VIP reviews and internal TSAs and documented using Form DAQ-16-019 DAQ Continuing Demonstration of Competency. The employee documents all on-the-job training on the appropriate form and archives it in Laserfiche.

Ongoing proficiency is reviewed on an as needed basis. No certificates are provided to the trainee and trainee proficiency is documented as part of the on-the-job training process and documentation.

The chief invites the coordinators and regional monitoring technicians to the North Carolina DAQ ambient monitoring workshop held each year. This workshop provides an opportunity to discuss and train on monitoring and the QC and QA processes, including data review and verification, to ensure the collection of valid data. A senior staff member provides hands-on instruction with the analyzers as on the job training when new employees are hired. The vendor provides training when DAQ purchases new monitors and other equipment. The DAQ staff provides training annually during the monitoring workshop. All available presentations and materials generated at the workshop are maintained on the RCO group drive or in SharePoint for archival purposes. No formal evaluation forms are collected during or after the workshop.

DEQ - DAQ Training Links

Air Monitoring: https://www.epa.gov/amtic/conferences-and-training

Professional Skills: http://oshr.nc.gov/state-employee-resources/training

9.0 Documentation and Records

The following information describes DAQ's management of documents and records, including this QAPP, for the background monitoring program. Currently, DAQ does not have a single designated position responsible for policing documents and/or records for the entire AMS. A dedicated document and records custodian would be a tremendous asset; however, such a position is unlikely to be created anytime in the foreseeable future due to a lack of funding. Also, this huge responsibility cannot be assigned to a single position within the already overburdened monitoring staff. Therefore, the AMS has established that the individual staff members who generate the original document and/or record are responsible for the placement, maintenance and archival of their respective documents and records. DAQ-14-003 provides additional details on document retention procedures.

DIT maintains a shared group drive for use by Ambient Monitoring personnel in the RCO and regional offices. Access to this drive is restricted to DAQ personnel and assigned DIT personnel. Although it is commonly referred to as the "P" drive, the group drive may have different letter designations in the regional offices. To reduce confusion, the group drive will be referred to as the "RCO group drive" in this QAPP.

Microsoft SharePoint is used as an access-restricted document and records storage repository by the seven regional offices. The regional ambient monitoring coordinator is responsible for all ambient monitoring documents and/or records stored on their specific SharePoint site. Access to each SharePoint page is restricted to its respective regional office personnel. Regional records and/or documents are stored on the regional SharePoint sites and the regions retain their records and/or documents according to the retention schedule. RCO chemists do not have access to the regional SharePoint sites. Therefore, any document and/or record requiring RCO review is placed on the RCO group drive for the RCO chemist to review and approve. The RCO chemists are assigned specific program areas for which they are responsible. For instance, each chemist is responsible for a specific criteria pollutant, such as ozone, particulate matter, SO_2, nitrogen oxides, and carbon monoxide (CO). Also, a specific RCO chemist is assigned to meteorology data and a specific RCO Chemist is assigned to air toxics data. These chemists are responsible for the final approved records that are stored on the RCO group drive.

Documents and records are archived in the internal access restricted Laserfiche. The RCO staff also utilize SharePoint to share information such as reference materials, meeting notes, draft copies of documents, news articles, workshop materials, presentations, and other miscellaneous information.

The RCO SharePoint page is for internal division usage by the AMS and access is restricted to specific North Carolina air quality and DAQ staff, but it is not the official location of the approved QMP, QAPPs and SOPs. The approved QMP, QAPPs and SOPs are posted to the DEQ/DAQ website for the ease of access for all State, Local and Tribal staff at any location where internet access is available, such as the monitoring sites. All approved documents are posted to the website under strict approval processes and protocols.

DIT routinely creates backups of all data stored on the RCO group drive and Laserfiche. Files stored in the "Ambient Monitoring" module of Laserfiche are protected from deletion; any file a user attempts to delete remains in the database but is hidden from view. A supervisor can restore that file to its previous location via a request to the Laserfiche administration staff. As a cloud-based file storage location, SharePoint file backups are facilitated by Microsoft, Inc.; all files are backed up twice daily and Microsoft provides a 90-day window for recovery of documents from inadvertent editing or deletion.

The DAQ secures all electronic documents using encrypted laptops or password protected computers and by storing paper documents in limited access areas. Additionally, SOPs must not conflict with any part of this QAPP or with any other relevant local, state or federal regulation.

Table 9.1 lists the documents and records pertaining to all data the EPA requires DAQ to collect and all other data deemed important by DAQ's policies and records management procedures, including documents and records required to support the concentration data reported to EPA.

Table 9.1. Documentation and Records Information

Categories	Record / Document Type	File Location
Management and Organization	State Implementation Plan Reporting agency information EPA directives Grant allocations Support contracts	Raleigh, North Carolina – Raleigh Central Office
	Quality Management Plan	DEQ Website
	Organizational structure	Ambient Monitoring Administration Page on SharePoint
	Personnel qualifications and training	DEQ Human Resources and DAQ Training page on SharePoint
	Training records and certification	Learning Management System, Laserfiche Ambient Monitoring Module and Valuing Individual Performance
Site Information	Network descriptions Site files Site maps Site pictures	Raleigh Central Office group drive, Regional Office SharePoint page, Laserfiche Ambient Monitoring Module
Environmental Data Operations	Quality Assurance Project Plans QA bulletins and technical notes	DEQ Website for official repository. Other file locations may include Laserfiche Ambient Monitoring Module for archived versions, North Carolina AMS QAPP page on SharePoint or Raleigh Central Office group drive (see below)
	Standard Operating Procedures QA bulletins and technical notes	
	Field and site notebooks	Raleigh Central Office group drive, Regional Office SharePoint page, monitoring site

Table 9.1. Documentation and Records Information

Categories	Record / Document Type	File Location
	Inspection, Equipment and Maintenance Records	Raleigh Central Office group drive, Regional Office SharePoint page, ECB
Raw Data	Any original data (routine and QC) Including data entry forms	Raleigh, North Carolina – Raleigh Central Office, Regional Offices, ECB
Data Reporting	Air Quality Index Reports	DAQ Website, Laserfiche Ambient Monitoring Module
	Annual Certification Report	Laserfiche Ambient Monitoring Module
	Data Summary Reports	DAQ Website, Laserfiche Ambient Monitoring Module
	Journals/ articles/ papers/ presentations	Raleigh Central Office group drive, Laserfiche Ambient Monitoring Module
Data Management	Data Algorithms Data Management Plans/ Flow Charts Data Management Systems	Raleigh, NC- Raleigh Central Office
	Pollutant Data Minute Data	Envista ARM database
	Meteorological Data (from State Climate Office)	Raleigh Central Office group drive
Quality Assurance	Network Reviews and assessments Control Charts Certification Documentation Data Quality Assessments Quality Assurance Reports Internal / EPA Technical Systems Audit Reports Response/ Corrective Action reports Site Audits Emails relating to QA activities and assessments	Raleigh, NC- Raleigh Central Office, Regional Offices, and ECB Laserfiche Ambient Monitoring Module

The state of North Carolina considers all emails official records and the state of North Carolina retains all email correspondence for a minimum of 10 years. In addition, DAQ archives emails that are critical in documenting official decisions regarding network decisions and data quality decisions in Laserfiche.

Most documentation and records produced by DAQ's background monitoring program consist of data and information gathered to support the data collection activities. Documentation and records include:

- QAPPs;
- SOPs;
- Logbooks and data collection records in electronic and written format;
- Instrument and equipment calibration information;
- QA documentation in electronic and written format; and
- Documentation that supports data review, validation and certification activities.

Upon assuming a new role working with DAQ documents and/or records, personnel are trained on the appropriate specific locations for each of the document and record types listed in Table 9.1, how to access the various locations, and proper procedures for maintaining those documents and/or records for which they are responsible. If DAQ personnel require access to documents or records outside of their sphere of responsibility, they may contact the appropriate RCO branch supervisor or regional monitoring coordinator for more information.

Section 19.0 Data Management contains detailed information regarding how DAQ will manage data from the background network, including information on data recording, transmittal, storage and retrieval.

9.1 Statewide Policy and Procedure Documentation

DAQ maintains records of program policy and procedure documentation. Documents in this category include:

- QAPPs,
- SOPs,
- Electronic QA/QC data forms that technicians must use to document their work, and
- QA and technical notes, which provide air monitoring policy interpretations or best practices.

The DAQ ensures that document numbers and revision numbers and dates are clearly discernible, generally in the header and on the cover page. The DAQ generates document numbers for these documents using the DAQ Document ID Builder, which can be found on the RCO SharePoint page. Detailed instructions for drafting SOPs can be found in DAQ-14-001 - Standard Operating Procedure (SOP) for Preparing SOPs for the North Carolina Division of Air Quality (NCDAQ).

As of this QAPP revision, DAQ has purchased and is in the process of implementing a new document and record storage database, which may result in changes to these procedures and locations. When these changes are made, this QAPP and relevant SOPs will be revised to reflect new procedures and document and record locations.

The DAQ currently uses Laserfiche for a controlled internal locale for archiving all QA/QC forms, SOPs and QAPPs. PPB chemists are responsible for the blank QA/QC forms and final records concerning their assigned pollutant(s). Intermediate records are the responsibility of the regional ambient monitoring coordinator. In Laserfiche, documents that are archived are marked as *OBSOLETE* in the title so that staff know not to use them for current procedures. The QAM or his designee is responsible for changing the title to *OBSOLETE* when a new version is approved. QA/Tech Notes are also stored in Laserfiche. The DEQ website is the official DAQ repository for controlled QMPs, QAPPs and SOPs, i.e., current approved versions. All other QMPs, QAPPs and SOPs not on the website or in Laserfiche are uncontrolled and therefore not considered official. Personnel are responsible for obtaining and utilizing current versions of documents.

Also, at the time of this QAPP revision, RCO uses the RCO group drive and SharePoint as repositories for working documents. Regional offices use SharePoint as a repository for working documents, and transfer completed documents to the RCO group drive. Draft documents will be watermarked as *DRAFT* so that no confusion arises as to the finality of the document. The QAM or designee receives final versions for review and approval. Once all approvers sign the QAPPs and SOPs, the QAM or designee will upload or assign someone to upload the document to the website and the Laserfiche Ambient Monitoring Module. The QAM will notify staff of the issuance of the new document via email and on the next ambient monitoring work group call. The chief and RCO chemists may change these procedures as the new document and record storage database is implemented and will revise the QAPP as changes are made.

9.2 Data Collection Records and Logbooks

Table 9.1 lists the documents and records DAQ must retain. The appropriate sections of this QAPP will discuss the details of these various documents and records. The DAQ will collect all raw data required for calculations, the submissions to the AQS database and QA/QC data electronically, in e-logs, spreadsheets or on data forms recorded in the field; see Section 11.0 Sampling Methods Requirements for additional information.

All regional monitoring technicians, coordinators, ECB electronics technicians, RCO chemists and other DAQ personnel shall fill out information in the site visit logbook in indelible ink. In addition, the ECB electronics technicians will fill out instrument maintenance logs and Air Quality Section Maintenance Order or AQ-109 forms and Continuous Monitor Performance Audit Report or AQ-121 forms in indelible ink. They shall make corrections by inserting one line through the incorrect entry, initialing and dating this correction and placing the correct entry alongside the incorrect entry, if they can accomplish this legibly, or by providing the information on a new line if the above is not possible.

9.2.1 Logbooks

Each regional monitoring technician will be responsible for obtaining, maintaining and documenting the appropriate logbooks or associated QA/QC data forms. Each background monitor type has an e-log created for that specific monitor type. The e-log contains all data entry forms required by a regional monitoring technician to document all routine operations. After each use, the regional monitoring technician uniquely numbers these e-logs by giving them a specific file name before saving them to a storage device such as a laptop computer. From the laptop computer, the regional monitoring technician will transfer the e-log to the appropriate DAQ SharePoint page for the regional monitoring coordinator to review. The regional monitoring technician will use these e-logs to record information about the site operations, as well as document routine operations. The e-logs are editable, but the original e-logs remain on the access-restricted regional office SharePoint page, which tracks changes and edits and are recoverable in the event of inadvertent deletion. Once the regional office monitoring coordinators have reviewed and approved an e-log, they upload it to the RCO group drive, which is the official repository of these records. The ECB electronics technicians will fill out instrument maintenance logs, Air Quality Section Maintenance Order or AQ-109 forms, and Continuous Monitor Performance

Audit Report or AQ-121 forms. The original AQ-109 forms are retained at the ECB facility. The AQ-121 forms are scanned and stored in Laserfiche; hard-copies are stored in a filing cabinet at RCO.

The regional monitoring and ECB electronics technicians must complete e-logs, instrument maintenance logbooks and Air Quality Section Maintenance Order or AQ-109 forms associated with all routine environmental data operations, even when the site logbooks contain all appropriate and associated information required for the routine operation performed.

Field Logbooks – The DAQ uses a combination of bound paper logbooks and e-logs for recordkeeping for each sampling site, sampling instrument, specific program or individual. Each paper logbook should be hardbound and paginated. The regional monitoring and ECB electronics technicians use the paper site logbooks to document site visits and other activities, including who is at a site, when and why. Every visitor must sign the site logbook. In addition, the background monitoring sites contain a bound paper logbook, generated and maintained by the regional offices. The logbooks generated and maintained by regional office staff are filed and archived at the appropriate regional office once completed. Logbooks generated and maintained by ECB staff are filed and archived at the ECB once completed. The e-logs capture monitor maintenance and QA/QC activities, including calibrations.

9.2.2 Electronic Data Collection

All instrument types currently used in the DAQ background network can provide an automated means for collecting information that DAQ would otherwise record on data entry forms. Section 19.0 Data Management provides detailed information on these systems. To reduce the potential for data entry errors, the DAQ will use automated systems where appropriate and will record the same information the regional monitoring technician would record on data entry forms. To provide a backup, the PPB staff will store electronic copies of the automated data collection information (daily poll) for an appropriate period on the RCO group drive. Electronic backup copies of automated data collection information will also be stored on the site computers.

9.3 QA/QC Records

The DAQ achieves QA/QC through the performance of periodic activities such as:

- Internal systems audits,
- One-point QC checks,
- Zero and span checks,
- Verification and calibration procedures,
- Maintenance activities,
- Performance evaluations,
- EPA performance audits such as the Ambient Air Protocol Gas Verification Program,
- Traceability certifications and calibrations and
- Corrective actions.

The DAQ documents internal systems audits in the form of a written report. The DAQ typically documents and maintains most of the other QA/QC activities using a variety of activities, including

emails, Excel spreadsheets, fillable PDF data forms, worksheets and data management systems such as Envidas Ultimate and Envista ARM, both developed by the software developer, Envitech. The associated SOPs describe the use of these methods to create air monitoring QA/QC records. The DAQ retains and archives these records according to the procedures identified in Section 9.5 Data Archiving and Retrieval. The DAQ corrects records either by crossing out the incorrect information with a single line and entering the correct information followed by the person's initials or by creating a revised form from the original with the correct information, retaining both forms. The regional monitoring technician or coordinator names the revised document following naming conventions in SOPs DAQ-12-001.2, 2.37.2 and 2.47.2.

However, for some of the QA/QC activities described above – such as the traceability certifications – the ECB retains many of those records at the ECB. Currently, the vendors typically provide the certificates of analyses that accompany gas cylinders in paper format, which the ECB stores in a file in the office. If DAQ personnel require information related to these documents, they may contact the ECB for assistance. The regional monitoring coordinators store certifications for PM equipment provided by the vendors in file cabinets at the appropriate regional office and in Laserfiche. Records for internal certifications of the calibrators used in the field and for audits are stored electronically on the computers in the certification room. The division has purchased a database for generating and archiving these types of records and is in the process of implementing it. When the database is fully implemented, the chief and RCO chemists will review the new record generating and retention processes and will revise the QAPP.

9.4 Reference Materials

Because of the technical nature of ambient air monitoring, DAQ requires numerous reference materials to administer the background monitoring program effectively. This category includes publications such as instrument operation manuals, troubleshooting guides, EPA guidance documentation, EPA technical memoranda and various other reports. DAQ maintains access to applicable reference materials if DAQ has an administrative need for them. DAQ retains these documents at the RCO, in the Laserfiche Ambient Monitoring Module, or on the RCO group-drive.

9.5 Data Archiving and Retrieval

The DAQ classifies documentation according to its intended use, future applicability and regulatory requirement for retention. DAQ follows the state of North Carolina's functional schedules for files. Files used and created by DAQ will be kept for a minimum amount of time set by these functional schedules. To meet DAQ's contractual obligation to the EPA, DAQ will retain all the information listed in Table 9.1 for a minimum of four complete calendar years from the date of collection in accordance with 2 CFR Part 200.334. However, if any litigation, claim, negotiation, audit or other action involving the records has been started before the expiration of the four-year period, DAQ will retain the records until completion of the action and resolution of all issues that arise from it, until the end of the regular four-year period or until the minimum time required by the state of North Carolina functional schedules,

whichever is later. The records custodians are responsible for ensuring these retention times are met and disposing of records after their retention period has elapsed.

DAQ stores electronic records within the data management systems located at the background sites, or Envidas Ultimate, the RCO, or Envista ARM, and on network servers in the DAQ regional offices and RCO. The DIT backs up records stored on the RCO group drive nightly and stores these backups off site. The database manager regularly backs up the Envista ARM database following the procedures in Section 5.7 of DAQ-05-001.5 AMS Database Manager Standard Operating Procedure.

10.0 Network Description

The primary function of the background monitoring program is to measure the background levels of SO_2 and PM_{10} in the piedmont and coastal plain areas of North Carolina to meet PSD monitoring requirements for PSD modeling. Although the DAQ does not collect the data over a continuous three-year period, the DAQ also compares the data collected over the 12-month period to the NAAQS to evaluate the quality of the air and identify any potential air quality problems. The program also provides real-time data to the public. The DAQ may use the data to determine trends over time.

Sampling network design and monitoring site selection comply with the following appendices of 40 CFR Part 58 and PSD guidance:

- 40 CFR Part 58, Appendix B - Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitoring
- 40 CFR Part 58, Appendix D - Network Design Criteria for Ambient Air Quality Monitoring
- 40 CFR Part 58, Appendix E - Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring
- Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD), EPA-450/4-87-007, May 1987

Network monitoring objectives and spatial scales of representation are discussed in Section 6.0 Project/Task Description.

10.1 Site Selection

Table 5.2 lists the background monitor sites. Figures 10.1 through 10.10 display aerial views of the sites. The annual network monitoring plan contains additional information on the sites.

Figure 10.1 Aerial View of the Taylorsville Liledoun Rotating PM_{10} site (orange marker) at latitude 35.913800 and longitude -81.19100

Figure 10.2 Aerial View of the Lenoir Rotating SO_2 site (purple marker) at latitude 35.935833 and longitude -81.530278

Figure 10.3 Aerial View of the Cherry Grove Rotating PM_{10} site (orange marker) at latitude 36.307033 and longitude -79.467417

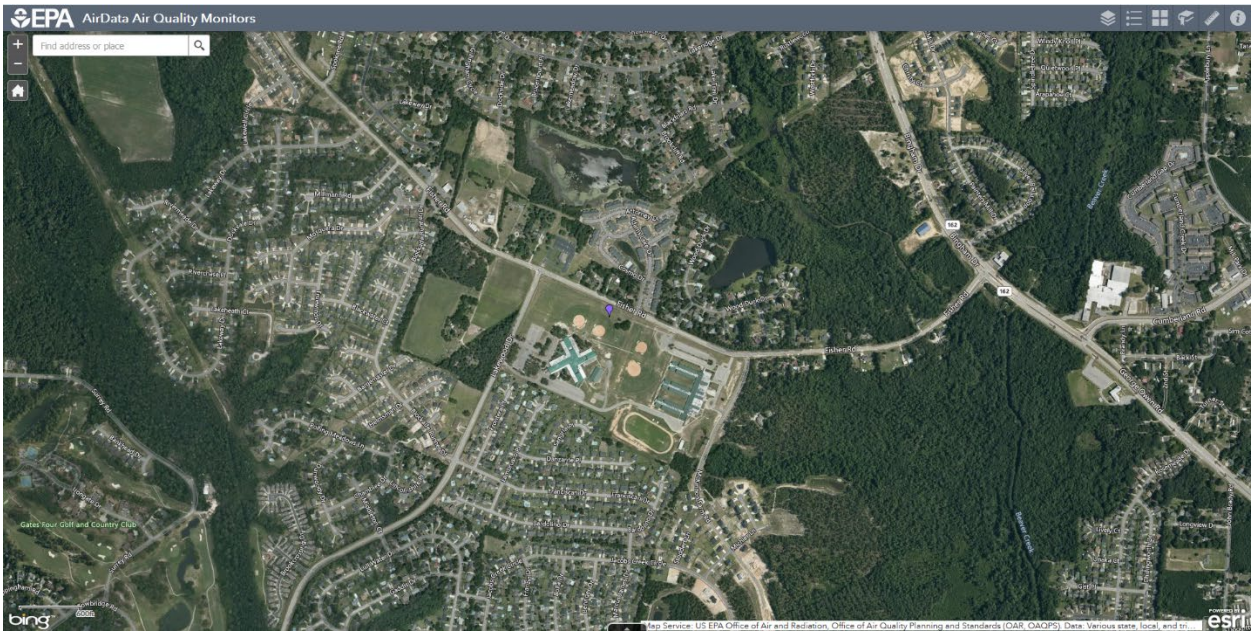


Figure 10.4 Aerial View of the Honeycutt Rotating SO_2 site (purple marker) at latitude 35.002304 and longitude -78.991692

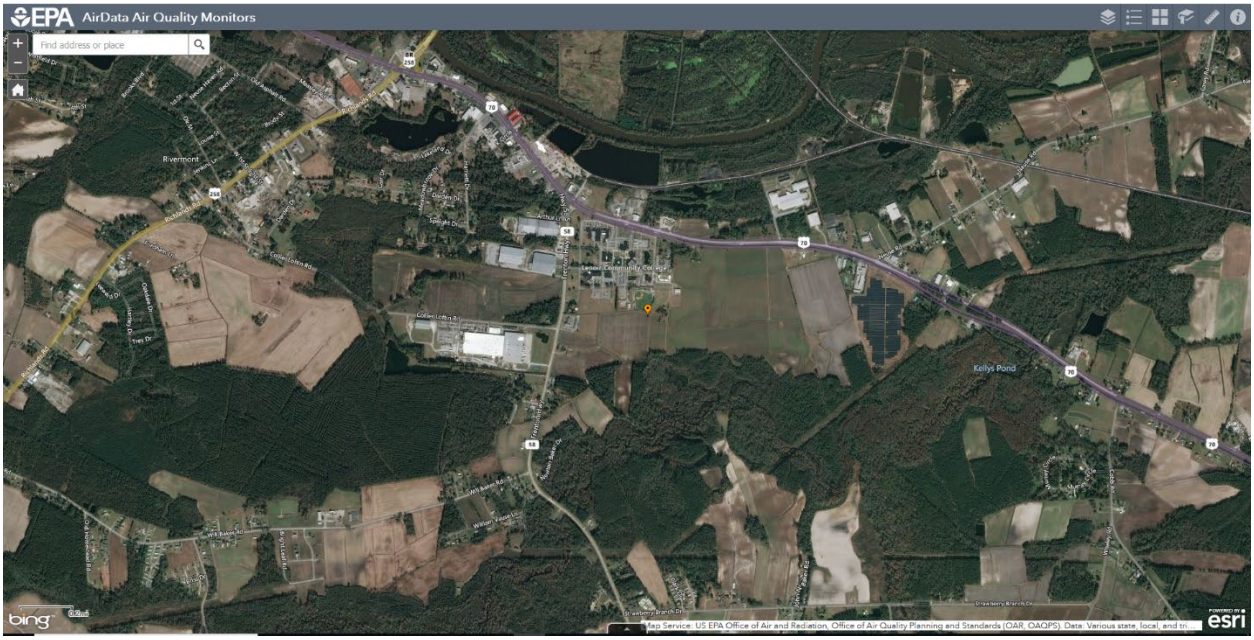


Figure 10.5 Aerial View of the Lenoir Community College Rotating PM_{10} site (orange marker) at latitude 35.231459 and longitude -77.568792

Figure 10.6 Aerial View of the Jamesville Rotating PM_{10} and SO_2 site (orange marker) at latitude 35.810660 and longitude -76.906249

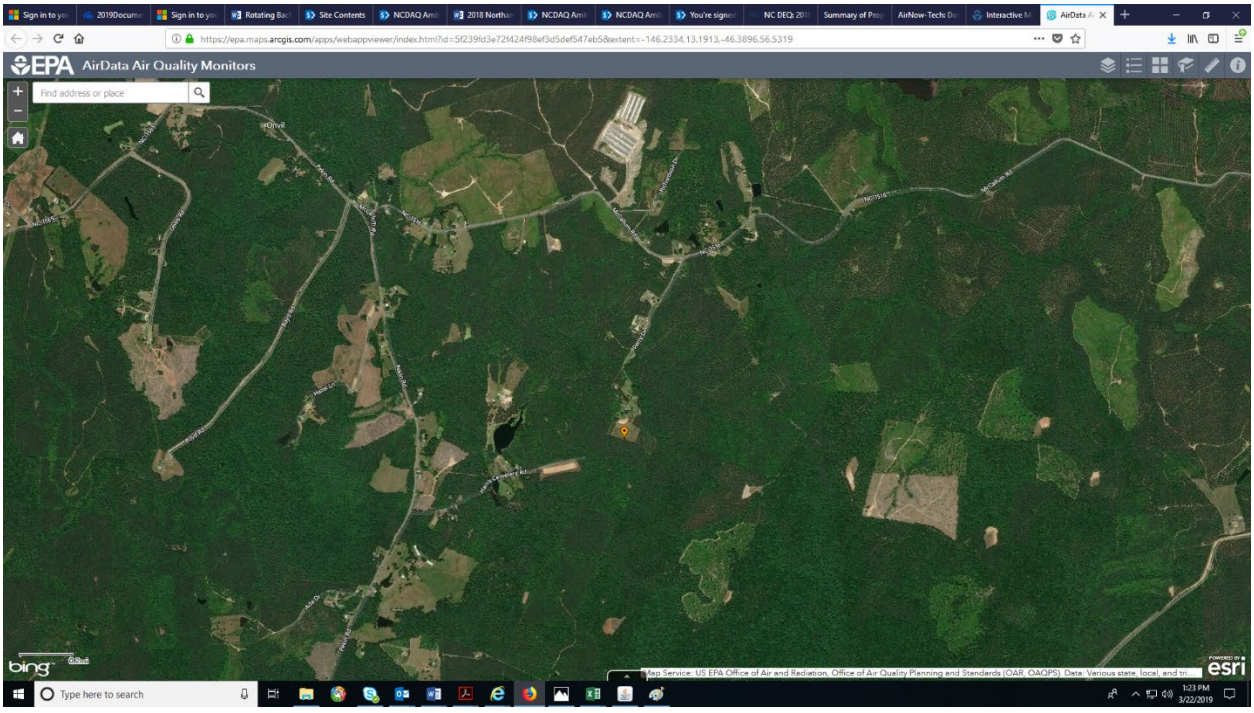


Figure 10.7 Aerial View of the Candor Rotating PM_{10} site (orange marker) at latitude 35.263200 and longitude -79.836613

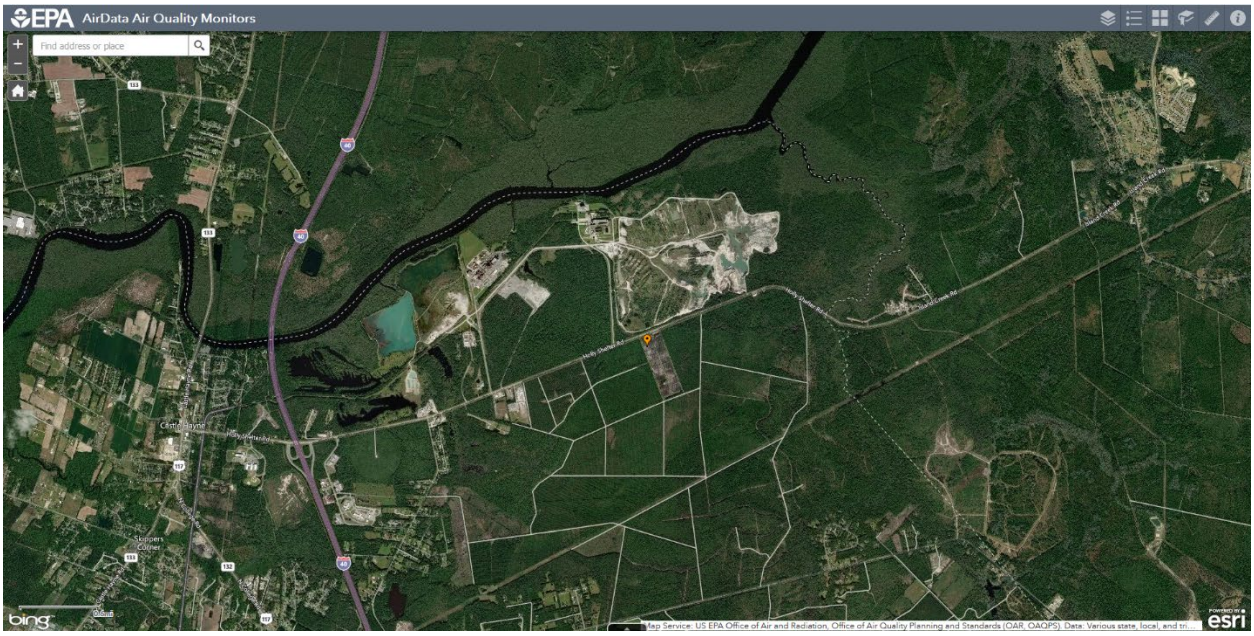


Figure 10.8 Aerial View of the Castle Hayne Rotating PM_{10} site (orange marker) at latitude 34.364167 and longitude -77.838611

Figure 10.9 Aerial View of the Bethany Rotating SO_2 site (purple marker) at latitude 36.308889 and longitude -79.859167

When selecting a site, the chief adheres to the site selection criteria specified in 40 CFR Part 58, Appendix D. The selection of a specific monitoring site includes the following activities:

- Developing and understanding the regional monitoring objective and appropriate DQOs,
- Identifying the spatial scale most appropriate for the monitoring objective of the site,

- Identifying potential locations where the monitoring site could be placed, and
- Identifying the specific monitoring site.

The regional monitoring technician will evaluate the monitoring site each year the rotating monitor is operating to assure it adheres to the site selection criteria specified in 40 CFR Part 58, Appendix E.

10.1.1 Site Location

The chief considers four criteria when evaluating potential background sites:

- Location of potential pollution sources,
- Topography of the area,
- Predominant wind direction in relation to any potential pollutant sources, and
- Potential population exposure.

Selection per these criteria requires detailed information concerning the types and location of pollutant sources, geographic variability of ambient pollutant concentrations in the background environment, meteorological conditions and population density. Selection of the number, geographic locations and types of background stations is, therefore, a complex process. The chief uses EPA provided guidance to assist in selecting the geographic locations of background monitoring locations. In addition, the sampling site selection process also involves consideration of the following factors:

- **Economics -** The quantity of resources required to accomplish all data collection activities, including instrumentation, installation, maintenance, data retrieval, data analysis, QA, and data interpretation, must be established.
- **Security -** In some cases, a preferred location may have associated problems that compromise the security of monitoring equipment (i.e., high risk of theft, vandalism, etc.). If such problems cannot be remedied using standard measures such as additional lighting, fencing, etc., then an attempt to locate the site as near to the preferred location as possible shall be made.
- **Logistics -** This process includes procurement, maintenance and transportation of material and personnel for the monitoring operation. The logistics process requires full knowledge of all aspects of the data collection operation: planning, reconnaissance, training, scheduling, safety, staffing, procuring goods and services, communications, and inventory management.
- **Atmospheric Considerations -** These considerations may include spatial and temporal variability of pollutants and their transport. Effects of buildings, terrain, and heat sources or sinks on air trajectories can produce localized anomalies of pollutant concentrations. The chief must consider meteorology in determining the geographic location of a site as well as the height, direction, and extension of sampling probes. Evaluation of a local wind rose is essential to properly locate many monitoring sites.
- **Topography –** The chief evaluated the local topography based upon land use maps, U.S. Geological Survey topographic maps, and other available resources. The chief must also identify and evaluate minor and major topological features that impact both the transport

and diffusion of air pollutants. Minor features may include an adjacent tree lined stream or tall structures either upwind or downwind of a point source, each of which may exert small influences on pollutant dispersion patterns. Major features include river canyons or deep valleys, mountain ranges, and large lakes. Major features significantly impact the prevailing wind patterns or create their own local weather such as katabatic or anabatic winds.

- **Pollutant Considerations** – The monitoring site location for a specific pollutant may or may not be appropriate for another pollutant. The chief must evaluate the changes that pollutants undergo temporally and spatially to determine the applicability of each site for a specific pollutant.

An interdependence exists between all the factors listed above. Consequently, the chief must employ an iterative procedure to select successfully appropriate sites that can provide the data necessary to accomplish the project's stated objectives. In situations where the sites do not specifically meet the requirements necessary to obtain the project objectives, reevaluation of the project priorities may be necessary before the final monitoring site selection. Experience in the operation of air quality measurement systems; estimates of air quality; field and theoretical studies of air diffusion; and considerations of atmospheric chemistry and air pollution effects make up the required expertise needed to select the optimum sampling site for obtaining data necessary to fulfill the monitoring objectives. The AMS staff as well as other DAQ staff share these responsibilities.

10.1.2. Monitor Placement

General inlet siting criteria for monitors at the DAQ background site shall adhere to the requirements in 40 CFR Part 58, Appendix E. Final placement of a monitor at a selected site is dependent on physical obstructions and activities in the immediate area. The ECB electronics technicians must place monitors away from obstructions such as trees and fences to avoid their effects on airflow. To prevent sampling bias, airflow around monitor sampling probes must be representative of the general airflow in the area. In addition, the availability of utilities (i.e., electricity and internet services) is critical.

10.2 Probe Siting Criteria for Pollutant Monitor/Analyzer

General probe and monitoring path siting criteria for criteria pollutants shall adhere to the requirements listed in 40 CFR Part 58, Appendix E.

10.3 Sampling Frequency

As prescribed in 40 CFR 58.12, the EPA establishes the minimum sampling frequencies of the monitors. The DAQ follows the EPA's requirements for the sampling frequencies of monitors. The monitors used in the background monitoring project collect data continuously and report values every hour. The DAQ ensures the monitors collect the minimum amount of data required to calculate the appropriate summary statistics. At least 80 percent of the total possible observations must be present before summary statistics are calculated. The exact requirements appear in "Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)" EPA-450/4-87-007, May 1987. The DAQ also follows the requirements in 40 CFR Part 50, Appendices K and T. Table 10.1 summarizes these requirements. To

meet PSD monitoring requirements, the rotating monitors operate for at least 12 months at each SLAMS location selected to have a background monitor. In the following month, the ECB electronics technicians relocate the monitors to the next SLAMS location. Thus, the monitors return to each location within 39 months to meet the PSD requirement that permittees use data collected in the three-year period preceding the permit application to demonstrate the PSD requirements are met. Table 10.2 and 40 CFR Section 58.12 provide the sampling schedule and frequency for each background method.

Table 10.1 Requirements for Calculating Summary Statistics.

Pollutant	Completeness Requirement (percent)	Time Frame
SO_2	75 percent	Per 5-minutes, hour, hours/ day, and days/ quarter 4 valid quarters/ year
	80 percent	Of all available hours for 12 month period
PM_{10}	75 percent	Per day and quarter
	80 percent	Of all available hours for 12 month period

Table 10.2. Background Monitoring Sampling Schedule and Frequency

Pollutant	Time Frame	Frequency
SO_2	Hourly (60 minutes/hour)	24 hours a day and 7 days a week/for 12 months every 36 to 39 months
PM_{10}	Hourly	24 hours a day and 7 days a week/for 12 months every 36 to 39 months

10.4. Rationale for DAQ's Background Monitoring Network

The primary rationale for the operation of the DAQ background monitoring network is to measure background levels of SO_2 and PM_{10} to meet PSD monitoring requirements for modeling. The DAQ will also use the data to provide the public with information on current air quality and to compare the data collected over the 12-month period to the NAAQS to evaluate the quality of the air and identify any potential air quality problems.

11.0 Sampling Methods Requirements

11.1 Analyzer or Sensor Methodology

In accordance with 40 CFR Part 58, Appendix C, Section 2.1, a criteria pollutant monitoring method used for making NAAQS decisions at a SLAMS site must be a reference or equivalent method. Even though most of the monitors in the background monitoring network are not SLAMS, the DAQ uses only EPA-approved FRM or FEM instrumentation to measure criteria pollutants at these sites. Criteria pollutant analyzer methods that have received FRM or FEM status have been rigorously tested, in accordance with 40 CFR Part 53 requirements, and found to meet or be comparable to the EPA reference methods codified in 40 CFR Part 50, Appendices A-1 and J. For the detailed specifications upon which a specific monitoring method has received its FRM or FEM status, see the List of Designated Reference and Equivalent Methods, issued by the EPA Office of Research and Development, which can be found on the Ambient Monitoring Technology Information Center, or AMTIC, website Air Monitoring Methods - Criteria Pollutants | US EPA). The DAQ will operate each analyzer in accordance with these designation specifications. To ensure the monitors meet these specifications DAQ uses the criteria in the validation templates in Section 7.0 and will follow procedures set forth in the associated SOPs (see Table 11.2 of this QAPP). These data collection methods use real-time or near real-time (continuous) data collection and analysis. As a result, the DAQ does not collect physical samples. The analyzer performs "in-situ" analysis of the composition of the ambient air sample within the analyzer itself using a specific methodology. DAQ maintains copies of the instrument manuals at the sites, at the regional offices and at the ECB facility.

This subsection describes the data collection methods used in the DAQ background monitoring network. Table 11.1 lists the specific analyzers used. The analyzer used for SO_2 is designated as an FEM and the analyzer for PM_{10} is also designated as an FEM. When the current analyzers used in the network become obsolete, the ECB supervisor and electronics technicians in consultation with the chief, RCO chemists and regional monitoring staff will select a new monitor type to replace the existing monitor type used throughout the network. Rollout of the new monitor type will be coordinated by the chief with input from the ECB, RCO and regional monitoring staff.

Table 11.1. DAQ Background Monitoring Network Analyzers

Pollutant	Analyzer	EPA Reference/Equivalence
Sulfur dioxide	Thermo Environmental Instruments, Inc. Model 43i	EQSA-0486-060
PM_{10} STP, continuous	Met One Instruments BAM 1020 (with PM_{10} head and down tube) Teledyne T640x (with PM_{10} head)	EQPM-0798-122 EQPM-0516-239
Indoor Shelter Temperature	Comet temperature transmitter, Model T0310 primary, HOBO as backup	No FRM or FEM, AQS Method Code 013

11.1.1. Sulfur Dioxide (Ultraviolet Fluorescence)

The SO_2 background monitoring network uses the Thermo 43i SO_2 analyzers. These analyzers use ultraviolet (UV) fluorescence. The physical principle used in SO_2 measurement relies on exciting an electron shell of a SO_2 molecule, which occurs in the presence of a specific wavelength (214 nanometers) of UV radiation, and the subsequent relaxation, which produces a photon of light. A photo multiplier tube measures the light emissions as the SO_2 molecule returns to the ground state. The intensity of this light is proportional to the quantity of SO_2 present in the ambient air. A reference detector continuously monitors the intensity of the UV lamp, used to excite the SO_2, and allows use of a ratio metric measurement technique that compensates for lamp degradation. A hydrocarbon scrubbing system, containing no consumable material, removes interfering hydrocarbons prior to the ambient air entering the measurement chamber.

11.1.2. Particulate Matter (Continuous Operation, BAM*)*

A beta attenuation monitor (BAM) is composed of sensing and control units. The heart of the sensing unit, the carbon 14 beta radiation source and glass fiber filter tape, combine in a measurement technique for making near-real-time direct measurement of particle mass collected on the filter tape. This measuring equipment can determine the fine changes in mass that accumulate on the filter tape as a constant stream of air passes through it.

Met One configured the BAM 1020 to operate on 1-hour cycles. During this one-hour cycle, the unit makes two 8-minute beta measurements (one for the background or blank and one for the sample) and collects one 42-minute sample for a combined total of 58 minutes. The BAM 1020 uses the remaining 2-minutes of each hour for filter tape and nozzle movements. The combination of the difference between blank and sample radiation counts, coupled with the air's known volumetric flow rate, yields an accurate method of determining the concentration of PM in the air. The equipment can calculate the 1-hour, 8-hour, and 24-hour averages. The control unit employs a microprocessor system, flow control hardware, temperature and humidity sensors, transformers and power supplies, and a software algorithm to determine when to advance the filter tape.

Initially, the inlet system filters the air stream through an inertial separator specifically designed to eliminate particles with aerodynamic diameters greater than 10 micrometers. This equipment draws in 16.7 liters per minute (LPM), or 1.0 cubic meters per hour, of air. After the air stream exits the inertial separator, the stream passes through a defined spot on the filter tape. The mass transducer is a radiation scintillation counter. The system measures the accumulated mass every hour. Information required for installing and maintaining the BAM PM monitor is available in the North Carolina SOP Section 2.37.1 and the Met One BAM 1020 Continuous Particulate Monitor manual.

11.1.3 Particulate Matter (Continuous Operation, T640X)

The Model T640X PM Mass Monitor is an optical aerosol spectrometer that converts optical measurements to mass measurements by determining sampled particle size via scattered light at the single particle level according to Lorenz-Mie Theory. Briefly, the sampling head draws in ambient air, which is dried (i.e., brought below 35 percent relative humidity) with the Aerosol Sample Conditioner

(ASC) and moved into the optical particle sensor where scattered light intensity is measured to determine particle size diameter. The particles move separately into the T-aperture through an optically differentiated measurement volume that is homogeneously illuminated with polychromatic light. The polychromatic light source, a LED, combined with a 90° scattered light detection, achieves a precise and unambiguous calibration curve in the Mie range, resulting in a large size resolution.

Each particle generates a scattered light impulse that is detected at an 85° to 95° angle where amplitude (height) and signal length are measured; the amplitude of the scattered light impulse is directly related to the particle size diameter. The T-aperture and simultaneous signal length measurements eliminate border zone error, which is characterized by the partial illumination of particles at the border of the measurement range.

The T640x operates at 16.7 LPM and uses an EPA-approved PM_{10} inlet. The EPA approved this configuration as an FEM for PM_{10}, fine particles ($PM_{2.5}$) and coarse particles ($PM_{10\text{-}2.5}$). The monitor reports sample volume in actual conditions and converts it to standard conditions by using the instrument's ambient temperature (AT) and barometric pressure sensor data.

11.1.4 Indoor Shelter Temperature

The DAQ measures shelter temperature using a Comet temperature transmitter. The sensor measures temperature in the range of -30 to +80 degrees Celsius (°C) with an accuracy of ± 0.4 °C and resolution of 0.1 °C. The DAQ collects shelter temperature measurements every minute. The DAQ collects backup temperature measurements using a HOBO data logger and temperature sensor. The regional monitoring technician downloads data from the HOBO at least once a month and archives the data. The data verifiers and validators only use the HOBO data when the Comet data are unavailable.

11.2 Data Collection Methodology

Table 11.2 lists specific SOP titles used in the network.

Table 11.2. List of SOPs Associated with this Quality Assurance Project Plan

General Standard Operating Procedures
DAQ-05-001.5 AMS Database Manager Standard Operating Procedure Version 0.0, March 5, 2021
DAQ-14-001 SOP for Preparing SOPs for the DAQ, Revision 2.0, May 21, 2021
DAQ-14-002.5 Quality Assurance Project Plan and Standard Operating Procedure Tracking Database Procedure, Revision 0, Dec. 1, 2020
DAQ-14-003 Document Retention Procedure, Revision 1, Nov. 1, 2022
DAQ-15-002 North Carolina Division of Air Quality Corrective Action Process Operator Responsibilities, Revision 0, Dec. 1, 2021
Section 2.43 SOP for Completing the Annual Network Review for the DAQ, Revision 2, Sep. 29, 2017
Section 2.39.4 SOP for Quarterly Completeness Data Review, Revision 1, June 12, 2020

Table 11.2. List of SOPs Associated with this Quality Assurance Project Plan

Calibration and Maintenance Procedures for Background Monitoring Support Equipment
DAQ-13-002.1 SOP for the DryWell 3101 Temperature Generator, Revision 0, May 5, 2021
DAQ-13-006.1 Field Barometer Certification, Revision 0, Sept. 20, 2022
DAQ-15-001.1 Verification of Ambient Monitoring Thermometers Version 0.0, November 13, 2020 Calibration of the Dwyer and SPER Manometers, Revision 2020, February 18, 2020
Section 2.3.4 Thermo Environmental Model 146C Calibrator Certification, Revision 12.2, Sept. 17, 2014
Standard Operating Procedures for Collecting and Validating Sulfur Dioxide Background Monitoring Data
DAQ-12-001.1 ECB Responsibilities Sulfur Dioxide Standard Operating Procedure, Revision 11, Aug. 10, 2022
DAQ-12-001.2 Sulfur Dioxide SOP for Operators, Revision 14.1, May 27, 2022
DAQ-15-005.5 Data Validation for Continuous Gaseous Monitors and Meteorological Data Raleigh Central Office Responsibilities, Revision 2.0, May 1, 2022
Standard Operating Procedures for Collecting and Validating PM_{10} Background Monitoring Data
DAQ-11-002.1 Installation, Calibration, and Maintenance Responsibilities of the Electronics and Calibration Branch for the Met One Instruments Beta Attenuation Monitor (under development)
Section 2.37.1 Installation, Calibration and Maintenance Responsibilities of the Electronics and Calibration Branch for the Met One Instruments Beta Attenuation Monitor, Revision 0, Oct. 8, 2008
Section 2.37.2 Site Operator's Responsibilities for the Operation of the Met One Instruments Beta Attenuation Monitor (BAM 1020) and BAM 1020 with Touch Screen Option, Revision 2020, Dec. 4, 2019
Section 2.47.2 Teledyne Model 640X Standard Procedures for Operators, Revision 2020, Dec. 16, 2019
DAQ-13-001.1 Standard Operating Procedure (SOP) for the BGI TetraCal Flow Transfer Standards ECB Responsibilities, Revision 0.0, May 7, 2021
Section 2.49.2 BGI TetraCal Standard Procedures for Operators, Revision 2020, Dec. 16, 2019
Section 2.63.4 Standard Operating Procedures for Validation of Particulate Matter, Revision 0, August 15, 2020

Electronic data collection is possible for the continuous monitors through the network's data acquisition system, or DAS, which is currently Envidas Ultimate and wireless modems. This equipment is in a shelter where the DAS records the data history and the modem provides a path to download the data for analysis. The database manager configures the computers in the state's RCO, managed by DIT, to connect automatically to the stations at least hourly to retrieve these data for analysis. Regional monitoring personnel can log into the station remotely to retrieve data through the Envista DAS or determine the status of the systems. The Envista ARM data software automatically sends all data to AirNow-Tech and the IBEAM database for real time reporting of ambient concentrations and the air quality index to the public via EPA's AirNow website and the DEQ real-time web page.

IBEAM is a Java-based web application system used by DAQ as a primary repository and tracking system for many of the division's business processes including facility tracking, permits, mobile sources, emission source inventories, ambient monitoring data, forecast data, compliance and enforcement actions, and source tests.

The DAQ modeled the design architecture of IBEAM after the standard n-tier architecture supported by Tomcat Application Server running on a Windows Server. The system uses a thin client interface for presenting information, via HTML and Java Server Pages, or JSP's, in Internet Explorer. The DAQ designed the system in a modular format with each module containing sub categories as appropriate. The DAQ defined security at the module level with a range of security options appropriate to staff requirements. Although IBEAM displays systems in a modular format, it stores the data in the background in an integrated data structure managed by the Oracle Relational Database Management System, or RDBMS. This means no duplication of data or data entry and a single point source for reporting and information dissemination.

11.3 Support Facilities

This subsection describes the monitoring shelters used in the DAQ background monitoring network.

11.3.1 Monitoring Station Design

The monitoring station design must encompass the operational needs of the equipment, provide an environment that supports data collection integrity and allow the regional monitoring technicians, who operate the sites, to safely and easily service and maintain the equipment. The chief considers winter and hurricane weather conditions during site selection to meet the station safety and serviceability requirements.

11.3.2 Shelter Criteria

The ECB electronics technicians house all SO_2 and PM_{10} pollution analyzers in a shelter capable of fulfilling the following requirements:

- The regional monitoring technicians must maintain the shelter temperature at a temperature that meets the reference or equivalency method requirements for all instrumentation that it contains.
- In addition, for shelters that contain BAM 1020 monitors, the regional monitoring technician must maintain the shelter temperature between 20 and 30 °C.
- The power supply should not vary more than ±10 percent from 117 alternating current voltage. The ECB electronics technicians should provide some type of voltage regulation to accomplish this, if needed.
- The shelter must protect the instrumentation from precipitation and excessive dust and dirt, provide third wire grounding as in modern electrical codes, and meet federal Occupational Safety and Health Administration regulations.
- The regional monitoring technician must clean the shelter regularly to prevent a buildup of dust.

- The shelter must protect the instrumentation from any environmental stress such as vibration, corrosive chemicals, intense light or radiation.

The DAQ uses either wooden shelters or Ekto Manufacturing Corporation shelters. For the gaseous monitors, the ECB electronics technicians use insulated heat-tape wrapped single sample lines to provide ambient air to the monitor. The analyzers draw air from the probe inlet. The probe material and sample lines must be either borosilicate glass or an acceptable inert plastic, such as polytetrafluoroethylene, perfluoroalkoxy (PFA), or other Teflon™-type materials. The ECB electronics technicians use Teflon™ probe lines to ensure the probe material is non-reactive with SO_2. The probe, intake vent and interconnecting tubing design must provide a minimum number of bends to avoid particles impacting on the surfaces. Impacted particles may provide surfaces to which SO_2 may adsorb, or, if the impacted particle is metallic, catalyze to a non-criteria species. In addition, the ECB electronics technicians attach the probe lines to a PM filter to prevent contaminants from entering the analyzer. Typically, the ECB electronics technicians locate the filter within the protected shelter, between the probe inlet and the analyzer. The analyzers are calibrated through the PM filter and the 1-point QC checks also enter the analyzer via the PM filter. The internal performance evaluations for the SO_2 analyzers are also conducted through the probe inlet.

The ECB electronics technicians insulate and wrap the sample lines in heat tape to reduce condensation. Additionally, the ECB electronics technicians use part of a Teflon™ filter holder on the end of the probe to prevent rainwater from entering the analyzers. Any liquid water will absorb pollutants, impacting the SO_2 concentration by removing it from the ambient air, and consequently, yielding inaccurate environmental data.

Residence time is the amount of time it takes for a sample of air to travel from the opening of the probe inlet to the inlet of the instrument. The residence time in the probe must be 20 seconds or less. The regional monitoring technician evaluates the residence time at every site visit and documents it in the e-log. If the physical configuration of the probe restricts the flow such that the probe configuration cannot meet the residence time, then the ECB electronics technicians will modify the physical configuration to fix this deficiency. They may accomplish this by reducing the length of interconnecting tubing, using tubing with a smaller inner diameter or decreasing the bends in the tubing between the probe and analyzer, or other alterations that allow the system to meet the residence time requirements.

The ECB electronics technicians replace all probe sample lines at least once every two years or as needed when the line is damaged or contaminated. Based on years of monitoring experience and evaluation of the data, DAQ has not observed any problems with probe lines between one and two years except in situations where other problems occurred. Situations that may cause probe problems include, but are not limited to, the monitor pulling rain or other precipitation into the probe, insects entering the probe or a cold spot developing along the probe, causing condensate to form in the probe.

12.0 Sample Handling and Custody

The background monitoring program does not require the regional monitoring technician to collect any samples that would warrant a sample custody procedure. The instrumentation located at the background monitoring locations directly analyzes the ambient air and reports the SO_2 or PM_{10} concentrations.

13.0 Analytical Methods

In this document, the DAQ intends the term analytical methods to mean laboratory analytical methods. The background monitoring program uses FRMs or FEMs designated as equivalent methods to the FRMs. The FRMs and FEMs do not use any laboratory analytical methods to complete the analysis of SO_2 or PM_{10} samples. The instrument vendors designed the SO_2 and PM_{10} analyzers (Table 11.1) as completely contained monitoring units that do not require additional analytical methods to establish the pollutant's environmental concentrations. The respective operations manuals provide specifics on how the monitors analyze sampled air. Section 11.1 Sample Methodology also provides a summary of the operation principles used for each monitor.

14.0 Quality Control Requirements and Procedures

The DAQ must perform two distinct and important interrelated functions to assure the quality of data from air monitoring measurements. One function is the control of the measurement process through broad QA activities, such as establishing policies and procedures, developing DQOs, 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 QC procedures, such as audits, calibrations, checks, replicates, routine self-assessments, etc.

Quality control is the overall system of technical activities that measure the attributes and performance of a process, item or service against defined standards to verify they meet the stated requirements established by the end user. For the background monitoring network, the DAQ uses QC activities to ensure the DAQ maintains measurement uncertainty, as discussed in Section 7.0 Quality Objectives and Criteria for Measurement Data, within acceptance criteria for the attainment of the DQOs. The SOPs referenced in Table 11.2, relevant instrument manuals and Table 14.2 provide lists of pertinent QC checks.

The DAQ achieves QC through:

- Daily automated calibration checks consisting of a zero, span and 1-point QC check;
- Daily review of instrument measurements;
- Annual, or as needed, multipoint calibrations;
- Verifications following calibrations;
- Monthly operational checks by the regional monitoring technician;
- Performance evaluations;
- Periodic maintenance;
- Flow rate verifications and audits;
- Acceptance test procedures;
- Accuracy, bias, and precision checks;
- Control charts; and
- Other verification techniques.

Zero, span and 1-point QC-checks are required once every fourteen days for SO_2 analyzers. The DAQ chooses to use a goal of daily checks for the SO_2 analyzers. Data analyzed from monitors in the DAQ background network do not undergo routine post-processing to correct for zero and span drift. In the sections that follow, the RCO chemists embedded the calculations for the following QC procedures in e-log books. Regional monitoring technicians and ECB electronics technicians do not compute any calculations by hand. The RCO chemists derived the formulas from relevant sections of 40 CFR Part 58 and the appendices to 40 CFR Part 50. Tables 7.2 through 7.4 provide specific QC procedures and associated acceptance criteria.

14.1 Calibrations

Adjusted calibration, which DAQ calls calibration, is the process used to verify and rectify an instrument's measurements to minimize deviation from a standard. This multiphase process begins with certifying a calibration or transfer standard against a NIST traceable, authoritative standard. The regional monitoring technician compares the analytical instrument's measurements to this calibration or transfer standard. If significant deviations, as described in Tables 7.2 through 7.4, exist between the instrument's measurements and the calibration or transfer standard's measurements, the regional monitoring technician adjusts the instrument's response to rectify the analytical instrument's measurements.

SOPs DAQ-12-001.2, 2.37.2, and 2.47.2 and the specific instruments' operations manuals provide calibration requirements for the critical field equipment. For the PM monitors, the regional monitoring technician adjusts flow rate when performing a calibration, upon installation, after a failed verification, after major maintenance and annually, if for some reason the monitor operates for more than 12 months (for example, to meet the 80 % annual completeness requirement). The design or desired flowrate of low-volume PM samplers is 16.67 LPM. The measurement principle involves separating particles by size using a PM10 inlet head and then either collecting them on a filter tape or measuring them by the way they diffract light. Therefore, the flow rate is set higher than human air intake (normally 0.5 LPM) to collect a quantity of PM that is sufficient for a reliable and repeatable measurement. One benefit of such a comparatively high flow rate is that it minimizes diffusion losses of the smallest particles and allows for a sharp cut-off curve at the upper limit for coarse particles.

Calibration of the sampler's flow rate measurement device must consist of at least three separate flow rate measurements (a multi-point calibration), evenly spaced within the range of -10 to +10 percent of the sampler's operational flow rate (40 CFR Part 50, Appendix L, Section 9.2.4). The sampler's flow control system shall allow for the regional monitoring technician to adjust the operational flow rate of the sampler over a range of at least ±15 percent of the targeted flow rate (40 CFR Part 50, Appendix L, Section 7.4.2).

After the regional monitoring technician has adjusted the flow rate, the regional monitoring technician performs a post-calibration validation of the flow rate to ensure the calibration is successful. Using a certified FTS, flow rate is measured and a comparison between the known (transfer standard) and the measured (sampler) is calculated using percent difference. This calibration verification must be within 2.0 percent for the calibration to be successful.

To calibrate the SO_2 analyzers within the background monitoring network the DAQ uses a gas dilution system to generate specific upscale calibration points. The ECB electronics technicians established the calibration scales for the SO_2 monitors at 500 ppb based on the highest average minute concentrations expected to occur at the site. In Table 14.1 below, the zero and span represent the calibration scale of the monitor. The regional monitoring technicians generally follow the calibration frequencies in the QA Handbook to calibrate the SO_2 monitors. The selected schedule requires calibration of the SO_2 monitors at installation, when the 1-point-QC check fails, when the monitor is without power for 72-hours, after major maintenance and each calendar year, when monitors are operated for a 12-month period that

spans two calendar years. For the SO_2 monitor, during a calibration, the regional monitoring technician adjusts the zero and span and then runs a multi-point verification consisting of zero and three upscale points. These four points have tight acceptance ranges, between which the analyzers' measured values must fall.

After the regional monitoring technician calibrates the monitor by adjusting the zero and span, he or she verifies the calibration by repeating the zero and span points, running two additional upscale points and performing a linearity check. The regional monitoring technician then performs zero and span checks, ideally each night, but at least every 14 days to demonstrate the monitor remains calibrated within the specified criteria. SOP DAQ-12-001.2 and the instrument's operation manual provide specific calibration requirements for the SO_2 analyzers. Table 14.1 shows a summary of these requirements.

Table 14.1 Acceptance Criteria for SO_2 Calibrations and Multi-Point Verifications

	Zero	Span	Span 2	Span 3
Concentration [A] (ppb)	0	400	100	20
Acceptance (±)	1 ppb	5 percent difference	5 percent difference	7 percent difference
Linearity test – slope must be 1 ± 0.05; each point must be within 2.0 percent of the best fit line or ± 1.5 ppb whichever is greater				

[A] Concentrations are nominal values

Currently, the DAQ SO_2 calibration procedure does not use four upscale points for the linearity verification as recommended by the EPA. For SO_2 the DAQ uses zero and three upscale points. The DAQ will retain the use of three upscale points but revised its procedures in 2020 to include linear regression analysis. The DAQ reviewed and revised the SOP to incorporate the new calibration procedures.

14.2 Precision Checks

The EPA defines precision as the measure of agreement among individual measurements of the same property, usually under prescribed similar conditions. To meet the DQOs for precision, DAQ will ensure the entire measurement process is within statistical control and will employ various tools to evaluate and monitor precision measurements. For the SO_2 monitors, to measure precision the monitoring technicians challenge the instruments with a 1-point-QC check at least every 14 days, preferably every night, to provide evidence of deviations from the required precision measurement as described in 40 CFR, Part 58, Appendix B, Section 3. SOP DAQ-12-001.2, the SO_2 instrument operations manual and Table 14.1 provide the 1-point-QC check and precision requirements for the SO_2 analyzers. Precision calculations follow the procedures described in 40 CFR, Part 58, Appendix B, Section 4. For PM monitoring, viewing data integrity with control charts will provide evidence of deviations from the required precision measurement. A check may be invalid due to a problem with the calibrator or zero air

system, or a bad solenoid. The SOP and instrument operations manual provides 1-point QC checks and precision requirements for the SO_2 monitors. The DAQ will employ various tools in evaluating and monitoring precision measurements. To evaluate precision for the background monitoring program, the DAQ will perform the following checks.

14.2.1 One-Point QC Checks

For SO_2 and pursuant to 40 CFR Part 58, Appendix B, Section 3.1.1, a one-point QC check or auto-precision/zero/span, or PZS, must be performed at least once every 2 weeks on each continuous analyzer used to measure the gaseous criteria pollutants. The 1-point-QC check will provide evidence of deviations from the required precision measurement as described in 40 CFR Part 58, Appendix B, Section 3. The ECB electronics technicians set up equipment at the site to challenge the analyzer with a NIST traceable, QC check gas of a known concentration that is representative of the mean or median concentrations within the DAQ network of monitors. At DAQ's background monitoring sites the QC check gas concentration must be between the prescribed range of 5 and 80 parts per billion (ppb) for SO2 per 40 CFR Part 58, Appendix B.

For SO2, the background monitoring network uses only daily automated calibration checks. The equipment at the site typically performs an auto-PZS check daily. Regional monitoring technicians typically refer to the automated check as either an "auto-PZS", a "PZS", or a 1-point QC. The RCO chemists use all these terms in the statewide instrument SOPs. Automated checks must include a precision measurement, but also include the span and zero. For each check, the DAS calculates a percent difference (or absolute difference for the zero check) and compares it to the acceptance criteria established in Table 7.2, and as specified in the SOP. When automated checks are outside the DAQ warning limits, the regional monitoring technicians may, at their discretion, perform a manual check. Table 14.2 summarizes this information. The regulations at 40 CFR Part 58, Appendix B, Section 4.1.2 provide the calculation for the precision measurement (i.e., percent difference) and the RCO chemists also embed this calculation in the e-logs used by the regional monitoring technicians. Precision checks (1-point QC and PZSs) verify or confirm the analyzer is in good working order, and, therefore, support the defensibility of the data.

The regional monitoring technician must perform a calibration if the 1-point QC check or PZS fails and the calibration and analytical equipment are working properly. Normally if either of these checks fails, a problem exists within the monitoring system that needs addressing (i.e., results in equipment maintenance and/or repair). If the zero check or span check exceed the specifications in Table 14.2, then a calibration will be done after the equipment failure is diagnosed, repaired, and the instrument is cleared for normal operation.

However, if a typical slow drift causes the check to fail, no routine maintenance may be necessary – the drift may simply indicate it is time to recalibrate the analyzer. The DAQ staff do not adjust ambient concentration data to correct for zero drift. A failure at the zero or span points will require investigation and if deemed appropriate (based on a weight-of-evidence approach), the data will be invalidated based on the failed check.

Table 14.2 Criteria for Daily Auto-Calibration Checks

Criteria for Daily SO_2 Auto-Calibration Checks			
SO_2	Zero	Span	1-point QC (Span 1)
Concentration [A] (ppb)	0	400	20 [B]
Acceptance (±)	<3.1 ppb	<10.1 percent (percent difference)	<10.1 percent (percent difference) [C]

[A] Concentrations are nominal values
[B] Value must be between 5 and 80 ppb per 40 CFR Part 58 Appendix B Section 3.1.1
[C] This is the control limit; the warning limit is > 7.0 percent

14.2.2 Flow Rate Verifications

In accordance with 40 CFR Part 58, Appendix B, Sections 3.3.1, a regional monitoring technician must perform a one-point flow rate verification check at least once every month on each sampler used to measure low-volume PM_{10}. DAQ has set a goal to complete these verifications every 14 to 18 days, except during audit months. The regional monitoring technician makes the verification by checking the operational flow rate of the sampler. If the regional monitoring technician makes the verification in conjunction with a flow rate adjustment (calibration), he or she must complete the verification before the adjustment. The regional monitoring technician compares the flow rate of the transfer standard to the flow rate measured by the sampler. The regional monitoring technician calculates the percent difference between the two readings and compares the results to the acceptance criteria listed in Table 7.3 or 7.4 using the calculations embedded in the e-log. The regional monitoring technician also calculates the percent difference between the design flow rate of the sampler, i.e. 16.67 LPM, and the flow rate measured by the transfer standard during the check for PM_{10} using the calculations embedded in the e-log. These QC checks verify or confirm the PM sampler is in good working order and, therefore, support the defensibility of the data.

14.3 Accuracy or Bias Checks

The EPA defines accuracy as the degree of agreement between an observed value and an accepted reference value. Accuracy is a combination of random error (precision), and systematic error (bias). For the PM_{10} monitor, the regional monitoring technician will use control charts to provide evidence of deviations from the required precision measurements. These charts will document percent difference measurements and flow rates (obtained during flow rate verifications) in lieu of concentrations, to assess the bias as described in 40 CFR Part 58, Appendix B, Section 4.2.2. For the SO_2 monitors, the instrument's operations manual and SOP DAQ-12-001.2 provide precision requirements. Bias calculations follow the procedures described in 40 CFR Part 58, Appendix B, Section 4.1.3. SOPs DAQ-12-001.2, 2.37.2 and 2.47.2 (see Table 11.2 for SOP titles) and the specific instruments' operations manuals provide accuracy and bias requirements for these monitors.

14.3.1 Performance Evaluations

For the SO_2instruments, ECB electronics technicians will perform internal performance evaluations at least every 90 days and once per monitoring quarter and whenever requested by the chief. The ECB electronics technicians perform these evaluations by comparing the analyzer measurements to

independent standards or references. The ECB electronics technicians determine audit concentrations following requirements in 40 CFR Part 58, Appendix B, Section 3. The audit concentrations selected for evaluation include a value at or near the detection limit of the monitor, a value near the level of the primary NAAQS, and a value that is less than the 99th percentile of the data within the network. The ECB electronics technicians use a different gas cylinder and calibrator to complete the audit than the gas cylinder and calibrator used to calibrate the monitor and complete the daily 1-point QC checks. However, the ECB may reference both the calibration standard and the audit standard to the same primary standard. The DAQ designates the ECB electronics technicians, who are not normally involved in the routine operational activities of the SO_2 monitors, to do the internal 90-day performance evaluations using dedicated QA equipment. The applicable instrument operations manual and SOP DAQ-12-001.1 (see Table 11.2 for SOP title) provide details for implementing internal performance evaluations. The EPA has designed these checks to access the accuracy and measure the bias.

14.3.2 Flow Rate Audits

For the PM_{10} instrument, a regional monitoring technician or coordinator, who is not involved in the regular operation of the monitor, will perform a minimum of three flow rate audits during the time the PM10 monitor is operating, doing one at least every 5 to 7 months, preferably every quarter, and at least initially, midway through the sampling period and at the end. The auditor completes the audit by measuring the analyzer's normal operating flow rate using a certified flow rate transfer standard. The flow rate standard used for auditing must not be the same flow rate standard used to calibrate the analyzer or complete the monthly flowrate verifications. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. Tables 7.3 and 7.4, the applicable instruments' operations manuals and SOPs 2.37.2 and 2.47.2 provide details for implementing flow audits. The auditor uses the calculations embedded in the e-log to determine the percent differences. See Table 14.3 for example corrective actions for failed flow rate audits.

14.3.3 External Agency Audits

The DAQ participates in the EPA Ambient Air Protocol Gas Verification Program. Information on the EPA's Ambient Air Protocol Gas Verification Program is available at https://www.epa.gov/amtic/ambient-air-protocol-gas-verification-program.

14.4 Reference Membrane Span Foil Verification

For the BAM 1020 instruments, the monitor must perform an automated reference-membrane span foil verification once every 24 hours. The reference-membrane span foil verification monitors the stability and performance of the beta counter. If the verification fails, the regional monitoring technician will call the ECB to have the BAM 1020 replaced.

14.5 BAM Background Tests

The regional monitoring technician must perform a zero-background test on the BAM, after the initial installation and calibration, as soon as the weather conditions meet the minimum weather requirements: 72 hours of clear weather with no precipitation forecasted. The ECB electronics

technicians may also perform a zero-background test indoors before they install the monitor; weather requirements are waived in this circumstance, yet they must still use the smart heater. This test corrects the background value to compensate for minor variations caused by local conditions such as grounding and shelter characteristics. The regional monitoring technicians will perform subsequent background tests on an annual basis in early spring (March/April/May) or fall (September/ October/ November) when dew points are generally at a low point if the monitor operates for more than 12 months. The test collects data for 72 consecutive hours having the PM_{10} inlet replaced with a high efficiency particulate air filter (BX-302) on a flow audit adapter. At the end of a completed 72-hour period, the regional monitoring technician must download the data and statistically analyze it using a spreadsheet template. After the regional monitoring technician has calculated a new background value and compared it with the factory zero, the DAQ procedures recommend that the monitoring technician should audit the new coefficient for 24 hours before installing the monitor or resuming normal data collection; especially if the BAM is close to failing the background test. See Table 7.3 for the acceptance criteria. If a failing test occurs, repeat the test in another window of suitable weather. If the unit fails to pass, call ECB and the RCO PM Chemist. See SOP 2.37.2 for additional information regarding this procedure.

14.6 Corrective Actions

All DAQ personnel take corrective action measures as necessary to ensure DAQ attains the MQOs. Given the number of monitors, the diversity of monitoring activities and the complexity of the instruments, a potential exists that issues may arise with the analytical measurement systems. In the background monitoring network, the DAQ has anticipated many of the issues in advance and prepared and equipped the staff to address the issues as they arise.

However, the staff will encounter unexpected or unforeseen circumstances, such as a failed QA/QC check, so they will also need to implement corrective actions on an "as-necessary" basis. The DAQ SOPs listed in Table 11.2 contain examples of corrective actions the staff may need to complete under certain circumstances. Regional monitoring technicians should consult SOPs DAQ-12-001.2, 2.37.2 and 2.47.2 for technique-specific checks, required frequency of checks, acceptance criteria and additional corrective action guidance. Table 14.3 is an abridged list for typical problems that require corrective action. According to DAQ policy, the regional monitoring and ECB electronics technicians and RCO chemists must report the need for corrective actions to the coordinator or appropriate supervisor within two business days and address the issue as soon as possible, ideally within five business days. The regional monitoring technicians, ECB electronics technicians and RCO chemists can resolve most problems within one or two business days, but occasionally it takes longer to identify what caused the problem and find a solution. When equipment is down, staff must work to repair the problem as quickly as possible to limit the amount of data loss.

Table 14.3 Corrective Actions

Activity	Problem	Likely Actions
QA/QC Check	Out of specification; flow rate check or failed flow rate audit exceeds acceptance criteria	1) Verify / reproduce performance check findings. Use an alternate transfer standard to confirm failures. 2) Perform alternate performance checks to determine cause (for example – leak tests to aid in flow rate issues). 3) Recalibrate the monitor following the SOP. 4) Identify any required procedural changes to prevent reoccurrence. 5) Document actions in the e-log or site logbook as appropriate. 6) Notify coordinator of flow rate audit failures as soon as practical.
	Zero/Span/1-point-QC check exceeds acceptance criteria; Monitor/Program fails to meet operational or critical criteria	1) Verify / reproduce performance check findings (e.g. Zero, Span and Precision). Use an alternate transfer standard to confirm failures. 2) Perform alternate performance checks to determine cause (for example – filter change and leak tests). 3) Replace solenoid and send old solenoid to ECB for testing. 4) Recalibrate the monitor using SOP DAQ-12-001.2. 5) Identify any required procedural changes to prevent reoccurrence. 6) Document actions on audit worksheet or logbook as appropriate. 7) Notify the coordinator of check failures as soon as practical.
Probe Line Integrity Check	Probe wet or contaminated	1) Verify probe inlet is intact and protectors from rain, insects and dirt are in place. 2) Check line for cold spots and bends or low points where water could accumulate. 3) Blow line out with zero air and dry for several hours if needed. 4) Document cause and any actions in the e-log or site logbook as appropriate.
Power	Loss or interruptions	1) Verify power supply integrity. 2) Verify circuit breaker and fuse integrity. 3) Document cause and actions taken on electronic logbooks or site logbook as appropriate.
Internal Performance Evaluation	Out of specification	1) Verify integrity of the audit equipment. 2) If a problem exists with the audit equipment, repair the equipment and repeat the audit. 3) If the audit equipment is good, verify the monitor is operating correctly and if problems exist, fix them. 4) If no problems exist with the audit equipment or monitor, notify the regional monitoring technician so he or she can recalibrate the monitor. 5) Document cause and actions taken on the audit data sheets or site logbook as appropriate.
Data Review	Data missing from data acquisition system (DAS)	1) Verify DAS operation. 2) Ensure monitor polling is current. 3) Isolate telecommunications problem by connecting to the monitor using alternate processes. 4) Verify monitor operations remotely. 5) Notify the database manager or ECB, as appropriate. 6) Perform site visit to resolve monitor or telecommunication issues.

14.7 Documentation

The regional monitoring technicians will document all events including routine site visits, calibrations, analyzer maintenance and calibration equipment maintenance in e-logs and site logbooks. The ECB electronics technicians will document all their activities, including site visits, internal performance evaluations, and equipment installs, in the site logbooks and removals and monitoring and calibration equipment maintenance on Air Quality Section Maintenance Order or AQ-109 forms and Continuous Monitor Performance Audit Report or AQ-121 forms. The ECB electronics technicians will also record in indelible ink field maintenance activities associated with equipment used by the regional monitoring technicians in dedicated instrument logbooks as well, which are stored at the ECB. The records generated by the regional monitoring technicians or at the monitoring sites will normally be controlled by the regional monitoring coordinators and located in the field site when in use or at the regional office when being reviewed or used for data verification. The regional coordinator transfers these records to the RCO group drive for RCO chemists to use to validate the data. At the time of this QAPP revision, the DAQ is reviewing these processes to improve and streamline them and will update this QAPP when DAQ finalizes the revisions.

15.0 Equipment Testing, Inspection and Maintenance Requirements

15.1 Purpose/Background

Preventative maintenance is a foundational element to an effective QA program. The ECB in the Maywood facility operates the maintenance and repair shop, referred to as the "shop," for off-site repair, maintenance and field readiness certification of equipment. This section discusses the procedures regional monitoring and ECB electronics technicians use to maintain all instruments and equipment, including spare analyzers, in sound operating condition and verify they can operate at acceptable performance levels. Refer to the instrument specific SOPs (DAQ-12-001.1 and 2.37.1 listed in Table 11.2) for more details on the specific preventative maintenance and repair activities. The regional monitoring and ECB electronics technicians must document and file all instrument inspection and maintenance activities. See Section (9.0 Documentation and Records) for document and record details.

15.2 Testing

For all criteria pollutant monitors used in the monitoring network, the DAQ shall purchase equipment listed on the EPA's List of Reference or Equivalent Methods. Therefore, the DAQ assumes the monitors and procedures used to be of sufficient quality for the data collection operation. Table 11.1 identifies the model designations for the monitors used in the background monitoring program. For indoor shelter temperature, where EPA equivalent or reference methods do not exist, DAQ will follow EPA guidance. Currently when the DAQ purchases new monitors, the DAQ makes every effort to evaluate the monitor as soon as possible after receipt to ensure the monitor is working so DAQ can address any problems while the monitor is still under warranty. The ECB electronics technicians will create a new maintenance logbook for each new piece of equipment.

Before the ECB electronics technicians install monitors for the background monitoring program, the ECB electronics technicians assemble and operate newly purchased or repaired monitors at the ECB. For the SO_2 analyzers and spares, the analyzers shall successfully undergo at least one zero and span calibration and multi-point verification and must meet the specifications in SOP DAQ-12-001.2. If the monitor meets the acceptance criteria, the ECB electronics technician allows it to operate in the shop until he can confirm functionality. Functionality is determined by the analyzers undergoing at least one zero, span and multi-point calibration using the criteria found in Table 14.1. If any of these checks are out of specification, the ECB electronics technician will contact the vendor for initial corrective action. Often these contacts are documented via email. The ECB electronics technician will not deploy an analyzer to the field until it has successfully passed all required checks. SOP DAQ-12-001.1 provides further information on the instrument specific testing that new and recently repaired SO_2 analyzers must undergo. Following site installation, the regional monitoring technicians will initiate, observe and document the successful completion of a zero/span cycle by the ECB electronics technicians installing the equipment. If the analyzers meet the zero/span acceptance criteria (see Table 7.2), the ECB electronics technicians will assume the monitors are operating properly and ready for calibration by the regional monitoring technician. The ECB electronics technician will properly document and file these tests in the instrument maintenance logbooks stored at the ECB.

For the PM_{10} monitors and spares, the ECB electronics technicians will perform external and internal leak checks and temperature, pressure and flow rate multi-point verification checks until the monitor passes. If the monitor meets the acceptance criteria, it operates outside the shop in a secured area until the ECB electronics technician can confirm the monitor is operating properly by observing the recorded PM_{10} measurements and ensuring that they fluctuate as expected and appear reasonable and that all diagnostic parameters fall within recommended ranges prescribed in the instrument manual. See Tables 7.3 and 7.4 for the criteria the monitors must meet. If any of these checks are out of specification, the ECB will contact the vendor, and initiate corrective action. Any communications with the vendor may be documented in an email, invoice, service request or instrument logbook. The ECB electronics technicians may also perform a background test on the monitor before installing it at the site. Although the designation of the FRM/FEM status ensures the make/model of the instrument meets EPA requirements for use in the network, DAQ must still ensure individual instruments perform as expected before deployed in the field. In general, the ECB electronics technicians perform the following acceptance/testing activities upon receipt of new monitors and samplers:

- Verify that instrument contains its EPA equivalent or reference method decal and meets the specifications of the purchase request.
- Verify that all expected parts arrived with the instrument and that nothing is physically broken. Contact the vendor if there are issues.
- Perform field readiness “certification” testing, summarized as follows:
    - Check the diagnostics of the sampler, looking for any fault lights or warnings, and document the status.
    - Check, and if need be, calibrate, the temperature and pressure sensors.
    - Perform flow rate checks and make sure they fall within the acceptance criteria.
    - For continuous PM samplers, the ECB electronics technician runs the sampler in the lab and observes the ambient concentration values; they should be low (as this is indoor air) and track steadily.

If the equipment is new and fails to meet the field readiness certification described above, the ECB electronics technician will contact the vendor. If an instrument has undergone significant repair and fails to meet the field readiness certification (testing), the ECB electronics technician will contact the vendor. If after working with the vendor, the ECB electronics technician cannot repair the instrument such that it passes performance testing, then he will shelve the instrument (i.e., discontinue its field use). At that point, the ECB electronics technician tags the instrument as inoperable and uses it for spare parts. If the shelved and tagged instrument was a back-up instrument, then the ECB will begin the process to purchase a new instrument to replace it, such that a spare is once again available for use.

Once installed at the site, the regional monitoring technicians will again run the tests mentioned above. If the sampling instrument meets the acceptance criteria, the ECB electronics technician will assume the monitor is operating properly. SOP 2.37.1 provides detailed information on the instrument specific testing that PM_{10} monitors must undergo before field deployment. The ECB electronics technician will properly document and file these tests in the instrument maintenance logbooks stored at the ECB.

15.3 Inspection

Several items periodically require field inspection. The applicable equipment SOPs DAQ-12-001.1, 2.37.2 and 2.47.2 (see Table 11.2 for SOP titles) and equipment operations manuals present greater detail on these items and procedures. In general, the following inspection activities are used:

- The regional monitoring technicians inspect monitoring shelters, probe inlets and other enclosures during each site visit and at least once per month to ensure conditions do not adversely affect monitor operation or data integrity. The ECB electronics technicians inspect monitoring shelters, probe inlets and other enclosures during internal quarterly performance evaluations to ensure conditions do not adversely affect monitor operation or data integrity.
- A zero-air system is a vital piece of support equipment maintained at SO_2 background stations. The calibrator blends zero air with calibration gases to dilute them to the necessary concentrations for conducting routine calibrations, precision checks, including 1-point QC checks and zero-span-precision checks, and performance evaluations or audits. Zero air systems used by DAQ for conducting these QA/QC checks and audits should be able to deliver 10 LPM of air that is free of ozone, NO, nitrogen dioxide (NO_2,) SO_2, CO and non-methane hydrocarbons to below the instruments' method detection limits. Zero air supplies do not have to be NIST traceable but will be inspected and serviced annually by the ECB electronics technicians to ensure they remain free of contaminants.
- The regional monitoring technicians and coordinators and RCO chemists and statistician review data collection and data quality each business day. They inspect the data for trends and signs of problems. Data trends that signal a need for further inspection include issues such as frozen numbers for multiple hours in a row or erratic spikes or valleys in concentrations obtained.
- Inspections on equipment also occur during site visits to verify the entire system is in good working order. Site visit checklists are available to the regional monitoring and ECB electronics technicians, who document equipment operating parameters on the zero-span-precision, calibration and maintenance tracking forms within the e-logs, as well as on performance evaluation audit forms. During each site visit the regional monitoring technician also does a probe-line integrity check to ensure the probe line remains attached to the monitor, is intact, dry and clear of debris and insects.
- The ECB electronics technicians test and inspect spare equipment at the time of purchase or after major repairs and before deployment to the field. When the equipment passes the tests and inspections, the ECB electronics technicians certify equipment as field ready and store it on a shelf or monitoring bench (typically at the ECB) until deployment.
- The regional monitoring technicians review the site and monitors annually to ensure continuing compliance with 40 CFR Part 58, Appendices B, D and E. The regional monitoring technicians document the review on the DAQ site review forms.

All monitors also undergo routine maintenance as part of the monthly site visit. If necessary, the regional monitoring technicians may contact the ECB electronics technicians for specific non-routine maintenance.

15.4 Routine Maintenance

The following are general routine maintenance protocols:

- The ECB electronics technicians maintain a limited supply of critical spare parts in the ECB maintenance / repair shop to aid in rapid response to issues. For example, pump rebuild kits, spare pumps, filters, and other expendable supplies are routinely on hand.
- The regional monitoring and ECB electronics technicians schedule preventative maintenance ahead of time, so they can have all parts and tools easily available to complete the tasks, to minimize data loss.
- The regional monitoring technicians typically perform preventative maintenance activities in the field, although the ECB electronics technicians may complete some activities in the shop.
- The regional monitoring technicians maintain the grounds within the secured area for each SO_2 and PM_{10} site as needed.

The specific equipment SOPs DAQ-12-001.1, DAQ-12-001.2, 2.37.1, 2.37.2 and 2.47.2 (see Table 11.2 for SOP titles) detail the routine preventive activities and schedules and the equipment user manuals supplement these procedures. The regional monitoring technicians perform diagnostic checks and document them before and after preventive maintenance. They document these diagnostic checks in the e-log. The regional monitoring technicians service the PM inlet heads and down-tubes at least every 30 days. They also replace SO_2instrument PM filters at least monthly.

16.0 Instrument Calibration and Frequency

The EPA defines “calibration” as the 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 adjustment. Use of the term "calibration" indicates that an adjustment in either the instrument or the software occurred. The EPA recommends that regional monitoring technicians minimize adjustments to prevent introducing measurement uncertainty and verifications, "i.e., checks without correction (adjustment)," be used to confirm whether an instrument is operating within its acceptance range. Thus, the purpose of calibration is to minimize bias. Section 14.0 Quality Control Requirements and Procedures discusses calibrations of the analyzers in more detail. The applicable SOPs listed in Table 11.2 describe the calibration procedures for each specific piece of equipment.

Title 40 CFR Part 58, Appendix B, Section 2.6 requires that gaseous standards (i.e., gas cylinders) and flow rate standards used in the ambient-air monitoring network be traceable to NIST. The ECB electronics technicians procure and maintain dedicated NIST traceable standards for the certification of the ambient air quality monitoring systems. These standards provide a direct link to established national standards (i.e. NIST) and are the foundation for the collection of the highest quality ambient air pollution data possible in accordance with current procedures and existing federal regulations and guidelines. Traceable is defined in 40 CFR Parts 50 and 58 as meaning that a local standard (i.e., one maintained by a monitoring organization) has been compared and certified, either directly or via not more than one intermediate standard, to a primary standard such as a NIST Standard. Similarly, traceability is the property of a measurement result whereby the DAQ or an auditor can relate the result to a stated reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty. Standard traceability, therefore, is the process of transferring the accuracy or authority of a primary standard to a field-usable standard, resulting in a documented unbroken chain of calibrations/certifications. The applicable SOPs (see Table 11.2) or operation manuals provide specific calibration procedures for and timeframes for certifications of field equipment. See Tables 7.2 through 7.4 for applicable equipment certification frequencies and acceptance criteria.

To achieve and ensure traceability, DAQ adheres to the following principles:

- Devices are recertified at least annually. The DAQ keeps records of these certifications at the ECB and in the regional office.
- Where applicable, in-house certification procedures (i.e., certifying a transfer standard against a certified primary standard - i.e., one of higher authority) are performed using SOPs DAQ-13-002.1, DAQ-13-006.1, DAQ-15-001.1 and 2.3.4. The ECB maintains documentation of these procedures in the ECB shop on appropriate forms.
- The regional monitoring coordinators maintain records of all instrument calibrations, using the traceable standards (with instrument identification numbers clearly documented), on the appropriate group network drives in the regional offices and RCO.

In this manner, documentation exists that provides a documentation trail that links all DAQ calibrations back to NIST.

The following summarizes the standards used in the DAQ network and their recertification process. The regional monitoring and ECB electronics technicians monitor all certification periods to ensure the regional monitoring technicians do not use equipment beyond the documented certification expiration dates. The regional monitoring technicians are responsible for verifying the equipment they are using is within certification and contacting ECB at least 30 days before the certification expires.

The ECB is responsible for procuring and maintaining dedicated traceable standards and gases for the calibration of the ambient air quality monitoring systems. These standards provide a direct link to established national standards (NIST) and are the foundation for the collection of the highest quality ambient air pollution data possible in accordance with current procedures and existing Federal Regulations and Guidelines.

16.1 Calibration of Local Primary Standards

A primary standard has sufficient accuracy such that it does not require calibration by and is not subordinate to other standards. The DAQ uses primary standards to calibrate other standards referred to as working standards. The DAQ uses "local primary standards" or standards certified against NIST-traceable standards and kept in the ECB shop for the sole purpose of certifying transfer standards used in the field to calibrate equipment and verify equipment calibrations. The DAQ owns two "local primary standards" for each type of device. The ECB sends each "local primary standard" to the vendor for recertification in alternate years ensuring that one local primary standard is always available for use and has been certified within 365 days. The vendor provides the DAQ with a certificate of authentication. DAQ staggers the rotation of standards such that one device always remains in certification. The ECB electronics technician compares the "local primary standard" that did not return to the vendor to the one that did return to the vendor to certify it and uses it to certify equipment for the next year. The vendors provide the certificates of calibration that accompany the primary standards in paper format. The ECB electronics technicians store these certifications at the ECB. The DAQ is currently reviewing this record retention process and will revise the QAPP when a new process is implemented.

16.1.1. "Local Primary Flow Rate Standard"

The DAQ uses a dedicated Alicat mass flow meter as a "local primary flow standard" used to certify the accuracy of the calibrator mass flow meters. This "local primary flow rate standard" is a dedicated unit, and as such, the ECB electronics technicians use it only to certify the accuracy of mass flow meters used in the field. An ECB electronics technician sends it to the vendor for recertification against a NIST-traceable standard every 365 days.

16.1.2. "Local Primary Temperature Standard"

The ECB uses an Omega Digital Thermometer DP-41 (with resistance temperature detectors) RTD-805-Lab Standard (LS) as a "local primary temperature standard" to verify the accuracy of the field temperature transfer standards. An ECB electronics technician sends the "local primary standard" to the vendor for recertification against a NIST primary standard every 365 days.

16.1.3. "Local Primary Pressure Standard"

The ECB uses a Mensor Model # 2500 as a "local primary pressure standard" used to verify the accuracy of the field barometer transfer standards. An ECB electronics technician sends it to the vendor for recertification against a NIST-traceable standard every 365 days.

16.1.4. "Local Primary Time Standard"

The ECB and regional monitoring technicians use the WWV NIST atomic clock in Boulder, Colorado (telephone number: 1-303-499-7111) as a primary time standard. The regional monitoring and ECB electronics technicians can also obtain the correct time via the website http://nist.time.gov. Regional monitoring technicians can also call the ECB electronics technicians to request the NIST Time. The DIT configures all state network resources and devices, including the site computers at the background sites, to receive time settings from the web clock at Nist.gov (primary) and the Internet Time Service at bldroc.gov (backup). The DIT also configures the site computer at the background sites to remain on Eastern Standard Time throughout the year, which is the local standard time for North Carolina.

16.2 Calibration of Transfer Standards

The ECB electronics technicians or the vendor certifies all transfer standards against either a primary standard or the "local primary standard." This establishes the traceability of the calibration.

16.2.1 Flow Transfer Standards

The field FTSs used for PM_{10} flow rate calibration will have their own certifications and will be NIST-traceable to the factory primary flow rate standard. The ECB electronics technicians will supply streamline FTS or Tetra-Cal (or equivalent) for field calibrations and flow rate verifications of the flow rates of the background PM_{10} samplers. The ECB will also provide an additional set of field FTSs to conduct independent performance audits. All devices have the advantage of providing volumetric flow rate values directly, without requiring conversion for mass flow measurements, temperature, pressure or water vapor content. The manufacturer establishes (and verifies as needed) a calibration relationship for the flow rate standard, such as an equation, curve, or family of curves, as accurate to within 2 percent over the expected range of ATs and pressures at which the flow rate standard is used. The vendor shall recalibrate and recertify the flow rate standards at least annually. An ECB electronics technician sends them to the vendor for recertification against a NIST-traceable standard every 365 days. The vendors typically provide the certificates of calibration that accompany FTSs in paper format. The regional monitoring coordinators store these certifications at the regional offices and in the Laserfiche Ambient Monitoring Module. The DAQ is currently reviewing this record retention process and will revise the QAPP when a new process is implemented.

16.2.2 Temperature Transfer Standards

The field temperature transfer standards used for calibration of temperature sensors will be mineral thermometers or Tetra-Cals that have their own certification by the vendor. ECB electronics technicians are responsible for returning the Tetra-Cals to the vendor for annual certification. The mineral

thermometers will be reverified/recertified at least annually, by ECB electronics technicians, against the "local primary temperature standard," or auditor's transfer standard, to within ±1 ° C, over the expected range of ATs at which the regional monitoring and ECB electronics technicians expect to use the temperature standard. The ECB electronics technicians audit the shelter temperature during each internal performance evaluation. They record the results of their audits on the AQ-121 forms.

16.2.3 Pressure Transfer Standards

The field pressure transfer standards will be handheld digital barometers or Tetra-Cals that will have their own certification by the vendor. The ECB electronics technicians will recertify the handheld digital barometers at least annually against the "local primary pressure standard."

16.2.4 Calibrators

The field calibrators are transfer standards that will have their own certification against "local primary standards." The ECB electronics technicians use the Thermo 146i calibrators as the field calibration device and as the audit device for SO_2 monitoring at the background sites.

The ECB electronics technician certifies the mass flow controllers within field calibrators and audit calibrators every 12 months using Alicat flow measurement units. SOP 2.3.4 contains further details on the certification procedures.

16.3 Calibration Gases

All SO_2 calibration gases must be EPA protocol (NIST traceable) and include the following information:

- Cylinder serial number,
- SO_2 concentration,
- Recertification status,
- Gas type,
- Cylinder pressure (double checked upon receipt),
- Impurity concentration, and
- Expiration date.

The ECB electronics technicians service the zero air generators used at background monitoring sites annually, or more frequently if needed. The ECB electronics technicians use a separate zero air generator when conducting performance evaluations. These zero air generators are serviced annually by ECB electronics technicians. The ECB electronics technicians maintain independent gas standards purchased from the same vendor, which they designate for independent SO_2 performance audits. The calibration gas standards will have their own certifications. The vendor will reverify or recertify the SO_2 calibration-gas standards after four years.

16.4 Calibration of Field Equipment

The SOPs DAQ-12-001.2, 2.37.2 and 2.47.2 (see Table 11.2 for SOP titles) or operation manuals provide specific calibration procedures for the field equipment.

16.5 Documentation

See the appropriate SOPs in Table 11.2 for field QC checks that include frequency and acceptance criteria and references for calibration and verification tests of analyzer concentration responses, monitor flow rates, temperature, pressure and time synchronization. The field monitor flow rate, temperature and pressure sensor verification checks include one-point checks at least monthly. The analyzer verification checks include 1-point-QC check for SO_2 at least every 14 days (DAQ's goal for SO_2 is daily checks) and multipoint verifications at least once per calendar year for monitors that operate for a 12-month period spanning two calendar years, as documented by tracking on control charts.

The regional monitoring technicians will document all these events, as well as analyzer and calibration equipment maintenance, in field data records and logbooks and annotate these events with appropriate flags. The regional monitoring technicians will also keep field activities associated with equipment used by the technical staff in record logbooks as well. The regional monitoring coordinator will normally control these records. The records are located in the field sites when in use or at the regional offices when being reviewed or used for data validation.

The ECB electronics technicians will retain calibrator and gas cylinder certification documentation at the ECB facility in Raleigh, North Carolina. Please reference Table 9.1 for the storage location of all documentation.

17.0 Inspection and Acceptance of Supplies and Consumables

DAQ SOPs (listed in Table 11.2) itemize the apparatus, equipment, materials and supplies required for various monitoring equipment. In general, the ECB electronics technicians procure supplies and consumables directly from the vendor manufacturing the monitors used by DAQ. Most manufacturers' operating manuals itemize parts lists, including recommended replacement schedules. The DAQ uses this information to determine the appropriate procurement schedule and volume of consumables required to support continuing operations.

Regional monitoring technicians track supplies and consumables (e.g., BAM filter tape and gas analyzer in-line PM filters); when the regional monitoring technicians need replacements, they notify the ECB. The ECB then supplies the needed items out of its inventory or purchases what the regional monitoring technician needs. The ECB electronics technicians maintain an inventory of supplies in the ECB shop for later distribution. The ECB electronics technicians inspect received materials to ensure they received the proper part number as ordered. They also perform a general inspection to identify any damaged products. They do not retain supplies deemed unsuitable. The ECB electronics technicians date parts received so they can easily determine storage duration. The ECB uses a revolving inventory system (first in, first out) to ensure storage times do not affect the material's integrity. If a manufacturer or EPA requirement indicates a specific expiration period for supplies, the ECB discards those supplies exceeding expiration dates if not used within the acceptable period.

Probe lines and fittings are important supplies. Since SO_2 is a reactive gas, the probe lines and fittings must be fluorinated ethylene propylene (FEP) Teflon™ or equivalent. A consumable that is critical to the successful operation of the SO_2 monitors are the gas cylinders used for calibration and QC checks of SO_2 analyzers, as well as gas cylinders used to conduct internal performance audits. Gas cylinders ordered by DAQ are EPA Protocol Cylinders. The ECB electronics technicians review certificates of analyses upon receipt of new gas cylinders to ensure the cylinders meet purchase specifications. The certificates indicate the expiration date of the gases contained within the cylinders. DAQ abides by these expiration dates; the ECB electronics technicians track dates and usage, replacing cylinders when the regional monitoring technicians notify them that less than 500 pounds per square inch, gauge, (psig) remains in the cylinder or before they expire. Additionally, DAQ participates in the EPA Ambient Air Protocol Gas Verification program (https://www.epa.gov/amtic/ambient-air-protocol-gas-verification-program). This program allows the independent assessment of gas cylinders to ensure their integrity and that of the supplier.

18.0 Non-Direct Measurements

This section addresses data the DAQ uses to support the background monitoring program but does not obtain by direct measurement. This includes data provided by outside sources and historical monitoring data. These databases and types of data and information include:

- Chemical and physical properties data,
- Sampler manufacturers' operational literature,
- Geographic location data (e.g., site metadata for AQS),
- Historical monitoring information,
- External monitoring databases,
- Census data,
- Emissions inventory or other source emissions modelling data,
- National Weather Service data, and
- Traffic count data from the North Carolina Department of Transportation.

Any use of outside data will be quality controlled and documented to the extent possible following QA procedures outlined in this document and in applicable EPA guidance documents.

19.0 Data Management

19.1 Purpose/Background

The primary work product of the DAQ background monitoring program is data. Thus, DAQ established formalized procedures to ensure successful data management. Data management describes an inter-related set of standardized processes used to acquire, transmit, transform, reduce, analyze, store and retrieve data. When documented and followed, a data management system helps maintain the data integrity and validity of the data throughout its entire life cycle. DAQ's air monitoring data follows a documented flow path. The data life cycle starts before data collection begins and ends with use of the data. The following subsections identify the processes and procedures the DAQ follows to acquire, transmit, transform, reduce, analyze, store and retrieve data. These processes and procedures maintain the data integrity and validity through application of the identified data custody protocols.

Figures 19.1 and 19.2 display the generalized flow path of the DAQ ambient air monitoring data, including the QA/QC data collected within the background monitoring program. The DAQ follows the procedures in SOP DAQ-15-005.5 or SOP 2.63.4. The regional monitoring technicians and coordinators, ECB electronics technicians, RCO chemists, statistician and database manager acquire and process the ambient air monitoring data. Section 4.0 Project/Task Organization describes staff responsibilities.

19.2 Data Collection and Recording

The DAQ will use ambient air monitoring analyzers which the EPA has designated as FRMs or FEMs to collect data used for PSD modeling. Upon installation and at regular intervals as specified, the regional monitoring technicians calibrate the ambient air monitoring instrumentation following the specific pollutant SOPs identified in Table 11.2 of this QAPP. Note: When DAQ establishes a new site, the coordinator and ECB electronics technicians manually collect metadata for the site (global positioning system, or GPS, coordinates, etc.). The database manager maintains the metadata and uploads it into AQS, as appropriate. The regional monitoring technicians and coordinators review the metadata annually during the network review and update it as needed.

For the background-monitoring network, DAQ records all raw data electronically. The site computer is equipped with a DAS, called Envidas Ultimate, and a wireless modem used to transmit data to the master polling system, i.e., the Envista ARM data storage database, which is a separate software package located on a state server. The DAS and site computer have the capability to record the output of the monitors at the site, perform any required data transformation and format the resulting data in preparation for downloading to the Envista ARM database or a Microsoft Excel spreadsheet. The Envidas Ultimate and Envista ARM databases do not allow the deletion of raw (i.e., original) data. The DAQ uses the Envista ARM database for data verification, validation and reporting; and it is capable of producing plots of the minute data. The database uses replicate versions of the raw data to avoid violating the integrity of the original dataset. The Envidas Ultimate and Envista ARM databases do not allow the deletion of data and track all changes made to the data. The regional monitoring technicians and

Figure 19.1 Background Monitoring Data Flow

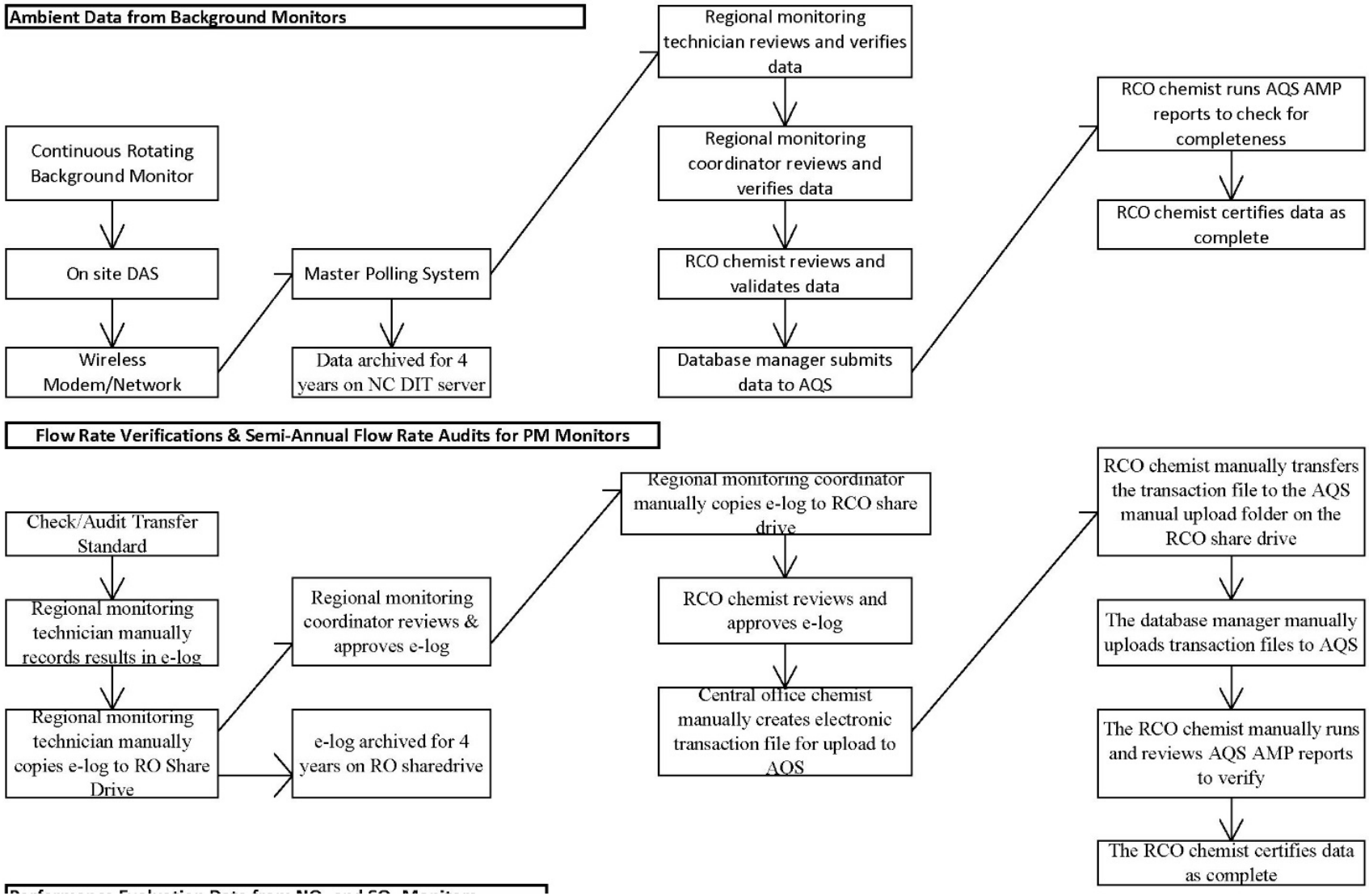
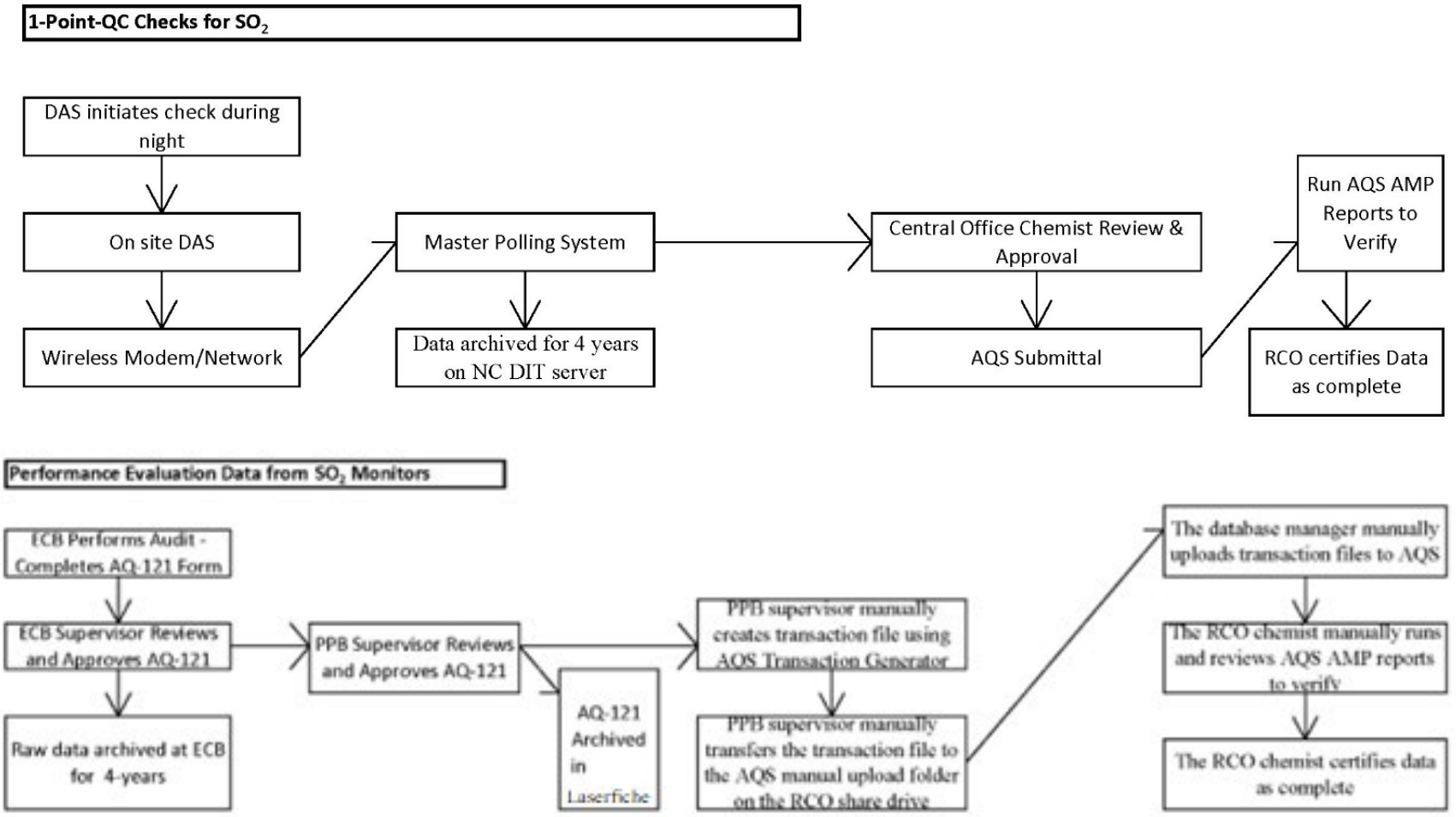


Figure 19.2 Background Monitoring Data Flow for Gaseous Monitor QC Data



coordinators, RCO chemists and database manager can modify, flag or void data stored in the Envista ARM "edit" database as needed; the DAS records and makes available an edit history to track changes made to the data. The procedures to test and audit the acceptability of the hardware and software used for data management at the background sites are delineated in SOP DAQ-05-001.5.

For the AQ-121 reports from the performance evaluations, which are paper documents, the PPB supervisor or designee manually creates records to upload to AQS as described in DAQ-15-005.5, archives a scanned copy of the paper document in the Laserfiche Ambient Monitoring Module and files the paper copy in a secured file cabinet in the RCO. The PPB supervisor or database manager electronically uploads the data to AQS as described in DAQ-15-005.5.

For 1-Point-QC checks for SO_2, every night, a Precision, Zero, Span runs to determine if the SO2 Analyzer is running within specifications. Each month, the RCO statistician generates an excel file that contains the PZS checks for each site for the previous month. The RCO chemist will then use this file to validate the PZS checks, use Envista ARM to add any missing PZS checks, add null codes where appropriate, and add comments where appropriate. Once the RCO chemist finishes validating the PZS checks, the RCO statistician creates transaction files from the excel spreadsheet using macros and transfers the transaction files to the database manager to electronically upload to AQS. See DAQ-15-005.5 for additional details.

When DAQ establishes a new site, the coordinator and ECB electronics technicians collect metadata for the site. The database manager enters the metadata into AQS. The regional monitoring technician and coordinator review the metadata annually during the network review and the database manager updates it in AQS as needed.

19.3 Data Transmittal and Transformation

Data transmittal is accomplished using wireless communication to access a site modem. Downloading collected data does not delete data from the DAS. The Envidas Ultimate software removes data from the site computer by overwriting data on a first-in, first-out basis. This configuration requires the Envista ARM software to extract data from the site computer on a regular basis to prevent any data loss (hourly for minute data and hourly data, and the following hour after the data are collected for nightly checks). If communications problems arise, the Envista ARM software retrieves the data from the Envidas Ultimate system when it can once again communicate with the site. The regional monitoring technicians must make a site visit if the database manager or ECB electronics technician informs them that he or she cannot correct the communications problems in a timely fashion.

For the SO_2 monitors, the DAS reads instantaneous SO_2 values from the monitor and averages each 60-second interval to create a one-minute average. The DAS stores each minute average, and this average acts as the base unit for all measurements taken by the SO_2 monitors within the DAQ background monitoring network. The data are reviewed daily by RCO chemists as well as regional monitoring technicians. There exists a dynamic ongoing open communication with the monitoring staff to discuss anomalies, missed data, or observed errant issues with respect to the daily data. In addition, at least once a month, the statistician downloads the instantaneous data for at least one hour for three different

days from at least one of the network monitors and compares the values to the data captured in Envista ARM to verify the data for accuracy. The monitors, themselves, as well as the Envidas Ultimate system, averages the stored 1-minute averages to form averaged hourly and 5-minute values (for SO_2). The database manager submits hourly SO_2 values as well as 5-minute maximum SO_2 values for each valid hour to the EPA. Envidas Ultimate transmits all these values to Envista ARM for retention. The DAQ uses the daily hourly maximum 99^{th} percentiles for SO_2 calculated by AQS to determine the background concentrations for PSD modeling.

For the PM_{10} monitor, the DAS reads hourly PM values from the continuous PM monitor. The DAS stores each hour and this acts as the base unit for all measurements taken by the continuous PM monitors within the DAQ background monitoring network. The PM monitor measures and stores hourly averages. The monitors, as well as the Envidas Ultimate system, average the stored hourly averages to form averaged 24-hour values. Envidas Ultimate transmits all these values to Envista ARM database for retention. The database manager submits only the 1-hour ambient PM concentrations to the EPA AQS database for the continuous PM monitors. The AQS database also averages the submitted hourly averages to form averaged 24-hour values. The regional monitoring technician downloads data directly from the continuous PM monitor to a universal serial bus (USB) flash drive, personal computer (PC) or laptop or via Comet software in the field twice a month. These data downloads serve as a backup. The DAQ uses the 24-hour values calculated by AQS to determine background concentrations for PSD modeling.

19.4 Data Verification and Validation

Data verification and validation is an important routine process that involves several steps to ensure the regional monitoring technicians and coordinators and RCO chemists have correctly carried out the field and data processing operations. The verification and validation process will identify data with errors, biases and physically unrealistic values before DAQ or the EPA uses them for determining background for PSD modeling. Once the regional offices or RCO have identified these problems, the regional monitoring technicians and coordinators and RCO chemists can correct, flag or invalidate the data. If necessary, the regional monitoring and ECB electronics technicians can take corrective actions. Section 23.0 Verification and Validation Methods contains additional information on data verification and validation.

Each of the network's analytical instruments employed to measure the ambient concentrations of the criteria pollutants undergoes periodic audits, one-point QC checks (SO_2) or monthly flow rate verifications (PM_{10}) and calibrations. SOPs DAQ-12-001.1, DAQ-12-001.2, 2.37.1, 2.37.2 and 2.47.2 (see Table 11.2 for SOP titles) outline these procedures. Audits and verification checks ascertain the accuracy, precision and repeatability of each instrument in performing its required function.

The instrument-generated data are stored on site in the DAS. When Envista ARM accesses the data through the wireless modems, it downloads the data into its database where the data undergo verification, reduction and analysis (level 0). The regional monitoring technician using Envista ARM performs data verification electronically by searching the data for status flags and comparing reported

values to acceptable range criteria (Level 1). After the regional monitoring technician flags data as questionable, level 2 (preliminary) and 3 (final) reviewers evaluate the flagged data to identify underlying causes and decide whether the data are valid. If the data are invalid, DAQ does not use them to calculate background concentrations. If the data are valid, but flagged due to some extenuating circumstance, then DAQ may use the data to calculate background concentrations, accompanied by a comment documenting the situation.

DAQ 15-005.5 and 2.63.4 contain further details on the verification and validation procedures.

19.5 Data Reduction and Analysis

As described in the subsections above, data reduction activities take place throughout the entire data management process. The on-site DAS gathers data from the monitors at each site each hour and transmits them to the Envista ARM database. The data are gathered and transmitted in response to a poll via the wireless modem. The SO_2 data do not require special aggregation. The Envista ARM system can aggregate hourly PM_{10} data into the 24-hour averages, as appropriate, to calculate the background concentrations; once validated, the database manager uploads the data into the AQS database. The background concentrations are provided to private consultants and the permit modelers who use them to do and evaluate the PSD modeling.

The regulations, at 40 CFR Part 50, define the quantity of valid data points required within a data set. For most pollutants, the EPA requires a minimum data capture of 75 percent of the interval – hour, day, quarter – for the EPA to consider the interval valid for use in NAAQS comparisons. Ambient Monitoring Guidelines for Prevention of Significant Deterioration defines the quantity of valid data points required within a dataset for use in PSD determinations. The EPA requires a minimum data capture of 80 percent of the data possible during the PSD monitoring effort, which is a minimum of 12 months. Tables 7.2 through 7.4 summarize these completeness requirements as well as provide specific references to the CFR.

The DAQ analyzes data periodically throughout the data collection and validation process. For example, the regional monitoring and ECB electronics technicians, coordinators, RCO chemists, audit chemist and statistician can download data from Envidas Ultimate directly into Microsoft Excel spreadsheets. The regional monitoring technicians, coordinator, RCO chemists and statistician use Microsoft Excel spreadsheets solely for data analysis and in-depth study of the data. For example, each business day the statistician prepares a tabulation of the raw hourly data from the previous day, evaluating it for missing data, trends and data higher or lower than Tukey's fences for that day to ensure it is within specifications. The RCO chemist and statistician also review all validated data looking for trends, data outside of three times the interquartile range, etc. to establish the reasonableness of the data sets. The RCO chemist and statistician accomplish these tasks by retrieving several reports from the AQS database, such as the AMP256, AMP430, AMP450 and AMP600, and analyzing the results.

19.6 Data Submission

After the regional monitoring technicians and coordinators and RCO chemists complete all three levels of verification and validation for a month of data, as described in Section 23.0 Verification and

Validation Methods, the database manager or statistician uploads the data to the AQS database. In addition to hourly data, the database manager also uploads to AQS hourly 5-minute maximum SO_2 data, internal performance evaluations, and one-point-QC checks. This submittal must occur no later than 90 days following the close of each calendar quarter, as specified in 40 CFR Section 58.16.

The RCO chemist assigned to this task shall certify to the chief that the data are complete to the best of his or her knowledge. The quarterly data submittal shall contain the following summary data:

- The AQS site code, monitoring method code, and parameter occurrence code;
- The results of all valid precision, bias and accuracy tests performed for PM_{10} and SO_2 during the quarter; and
- All ambient air quality data obtained for PM_{10} and SO_2 (including maximum hourly 5-minute block averages for each valid hour).

At the end of each quarter, an RCO chemist runs the AMP251, AMP256, AMP350, AMP430 and AMP600 (for regulatory monitors) reports in AQS and verifies that the database manager and statistician successfully entered all hourly data, internal performance evaluation, 1-point QC check, monthly flow rate verification and semi-annual flow rate audit data. The DAQ will also notify the EPA if a monitor does not meet the completeness requirements summarized in Tables 7.2 through 7.4.

Every year before the annual data certification due date, the chief reviews the data from the EPA AQS summary reports, along with internal performance evaluation and audit reports to confirm the data meet the required criteria. The RCO chemists address any concerns with the data.

DAQ shall submit to the EPA an annual AMP600 summary report of all the background monitoring data from all background monitoring stations that meet criteria in Appendix A as well as Appendix B, in accordance with 40 CFR Section 58.15. DAQ will also submit a signed certification letter on DAQ agency letterhead signed by the chief. The chief will submit the report by May 1 of each year for the data collected from Jan. 1 through Dec. 31 of the previous year. The chief, or designee, must certify the report as accurate to the best of his or her knowledge. The chief will base this certification on the various assessments and reports performed by DAQ, including the AMP600 report.

19.7 Data Storage and Retrieval

Once collected, data are stored in a variety of ways and for varying periods. Initially, data are stored in the monitor and/or the station-specific DAS. The monitors keep an unalterable record of instrument measurements for a period of days to weeks, depending on the amount of information stored. The on-site DAS also keeps an unalterable record of instrument measurements for a period of months to years depending on the number of monitors operated at the site. The RCO Envista ARM database system automatically accesses data stored in the on-site Envidas Ultimate system.

Because of the DAQ archiving system, the DAQ can store and retrieve the air quality monitoring data. Backup and recovery procedures exist to ensure the regional monitoring and ECB electronics technicians and database manager can recover data in the event of a catastrophic failure. The database manager manually executes a backup of the full database every Friday. Due to the lack of a second structured

query language (SQL) database in which to import the backup files, the database manager has not routinely tested procedures for using the backup files; however, he has used backup files to import data into the virtual server's database. The use of backup files worked as expected. The DAQ has recently established a backup computer with SQL software installed to continue the data polling operation in the event of a catastrophic failure of the server. When storage space limits the amount of data that DAQ can keep in the database, procedures exist for moving the data into an archive database. Presently, the database manager backs up data weekly using Zip File. The database manager keeps the most recent copy available on SharePoint. Envidas Ultimate polls data older than one week old directly from the site computer. DAQ keeps all data in real time.

Note: The monitoring technicians also download data directly from instruments to USB flash drives, PC or laptops in the field for continuous PM_{10} twice a month; these data downloads serve as a backup, as they are uploaded to the regional office SharePoint page for archival. The monitoring technicians also download backup site temperature data and store it on the regional office SharePoint page for archival purposes.

The DAQ retains all supporting electronic and written information, such as logbooks, maintenance logs, certifications and diagnostic information worksheets for a minimum period of four years, unless any litigation, claim, negotiation, audit or other action involving the records started before the expiration of the four-year period. When this type of situation occurs, the DAQ will retain the records until completion of the action and resolution of all issues that arise from it, or until the end of the regular four-year period, whichever occurs later. The DAQ shall store the data on electronic media or in hard copy, whichever format proves most advantageous. Envitech software updates have no impact on data accessibility. After the storage period has passed, the database manager may dispose of the storage media or recycle it. However, the database manager uploads the validated dataset to the EPA AQS for long-term storage.

20.0 Assessments and Response Actions

An assessment is the process used to measure the performance or effectiveness of the quality system, the background monitoring network, its sites, the pertinent QAPP and various measurement phases of the data operation. The DAQ also uses assessments to determine whether the monitoring staff has implemented the ambient-air quality monitoring program in accordance with the approved QAPP. Although not all of these assessments are required for PSD monitoring by Appendix B to 40 CFR Part 58, the DAQ has designated these monitors as SPM and reports the data to AQS and thereby follows 40 CFR Part 58.20, which calls for network plans as well as some of the other assessments listed here. In addition to implementing the more stringent QA requirements of Appendix B, the DAQ also evaluates these monitors according to the requirements in Appendix A to 40 CFR Part 58. Thus, to ensure the adequate performance of the quality system, DAQ will perform the following assessments:

- Network reviews and assessments
- External performance evaluations
- Internal performance evaluations
- Semi-annual flow rate audits
- Quarterly completeness assessments
- Annual data certification
- Data quality audits
- Data quality assessments
- Internal systems audits

Table 6.1 provides information on the parties implementing assessments and their frequency.

20.1 Network Reviews and Assessments

Conformance with network requirements of the background monitoring network as set forth in 40 CFR Part 58, Appendices B, C, D and E are determined through annual network reviews of the ambient air quality monitoring systems, as required by 40 CFR Section 58.10(a). The chief uses the network review to determine if the background-monitoring network collects adequate, representative and useful data in pursuit of its air monitoring objectives. Additionally, the annual network review may identify possible network modifications to enhance the system or correct deficiencies in attaining network objectives.

Before implementing an annual network review, the regional monitoring technician compiles and evaluates significant data and information pertaining to the background sites and network. Such information might include:

- Network files (including metadata, updated site information and site photographs);
- AQS reports, especially the AMP380 and AMP390 reports;
- Network monitors' five-year air quality summaries;
- Local area emissions trend reports;

- Traffic data; and
- National Weather Service or State Climate Office meteorological summaries from stations nearby the monitoring network area.

Upon receiving the information, the regional monitoring technician will check it to ensure it is current. The regional monitoring technician will note any discrepancies and resolve them during the review. The regional monitoring technician will also identify and update files and photographs that need updating during the review. The DAQ emphasizes certain categories of information during the network review, such as the monitor location, nearby pollution sources, potential changes to nearby pollution sources, population density, changes in nearby land use and other pertinent information.

During the annual network review, the regional monitoring technician will reconfirm the stated objective for the monitoring site and reverify the location's spatial scale. If the site location does not support the stated objectives or the designated spatial scale, the regional monitoring technician will propose changes to rectify the discrepancy. The regional offices and RCO monitoring staff will then act to correct the information in AQS, relocate the monitors or site, or move the site to a more suitable location, if needed. Although proposed additions and discontinuations of SLAMS monitors are subject to EPA approval in accordance with 40 CFR Section 58.14, special purpose monitors are not subject to EPA approval for discontinuation or relocation. However, the chief informs EPA Region 4 of any changes to special purpose monitors.

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, and
- Other issues such as proposed regulations and funding.

20.1.1 Background Monitoring Sites Annual Network Reviews

The regional monitoring technicians complete an annual network review of the background sites and submit a network review form to the RCO every year. EPA regions are also required to perform these reviews. The regional monitoring technicians consider the following criteria during the review:

- Date of last review;
- Areas where attainment/nonattainment redesignations are likely to take place, or did take place;
- Results of special studies, saturation sampling, point source oriented ambient monitoring, etc.; and
- Proposed network modifications since the last network review.

The chief in consultation with the director and permit modelers determine the number of background monitors required, depending upon projected PSD applications and the locations of the facilities projected to submit PSD applications.

Once the annual network plan is updated based on the annual network review, projected PSD applications, the locations of the facilities projected to submit PSD applications and other pertinent information, the network plan is posted on the DAQ website for a 30-day public comment period. The plan is prepared by DAQ and submitted to EPA Region 4 by July 1 each year.

20.1.2 Five Year Network Assessment

The five-year network assessment is a more extensive evaluation of the air monitoring network. This assessment is prepared by the chief with assistance by the PPB supervisor or his/her designee(s). The assessment determines at a minimum:

- If the background network meets the monitoring objectives defined in 40 CFR Part 58, Appendix D,
- Whether DAQ must add other sites,
- Whether an existing site is no longer needed and can be terminated, and
- Whether new technologies are appropriate for incorporation into the ambient air monitoring network.

During the 5-year network assessment, the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals, for example, children with asthma, as well as the potential impact any sites proposed for discontinuance may have on other data users is considered. As part of the 5-year network assessment, DAQ requests renewals and provides additional information related to applicable waivers for the background monitoring network sites in the network plan submitted with the 5-year network assessment. The DAQ submits a copy of the five-year network assessment, along with a revised annual network plan, to the EPA Region 4. These assessments began in 2010 for the background monitoring program and are due to EPA every five years on July 1.

For more information about the five-year network assessment requirements, please see 40 CFR 58.10(d). For more information about the background monitoring locations, please see the annual network plan at: https://deq.nc.gov/about/divisions/air-quality/air-quality-data/annual-network-plan.

20.2 External Performance Evaluations

DAQ participates in EPA's Ambient Air Protocol Gas Verification Program when it is available. See Section 17.0 of this QAPP and 40 CFR Part 58, Appendix B, Section 2.6.1 for more information.

20.3 Performance Evaluations

For the SO_2 monitors, the ECB electronics technicians, who do not operate the monitors, conduct performance evaluations at least once each monitoring quarter and every 90 days. They challenge the SO_2 monitors with known concentrations of gas using an independent, NIST traceable, calibrator and

gas standard. The ECB electronics technicians certify the audit system and the monitor's calibration system using the same primary standard for both. Likewise, the ECB purchases the gas standards for the audit system and monitor's calibration system from the same vendor at the same time, so both come from the same lot of gas. The ECB electronics technicians follow the audit procedures in SOP DAQ-12-001.1. They document the results of these audits on the Continuous Monitor Performance Audit Report AQ-121 form. Acceptance criteria applicable to SO_2 monitor performance evaluations may be found in Table 7.2. If a monitor does not pass the evaluation, the regional monitoring and ECB electronics technicians will take appropriate action to identify why the monitor failed the evaluation and to correct the situation. See 40 CFR Part 58, Appendix B, Sec 3.1.2 for more information regarding performance audits.

20.4 Semi-annual Flow Rate Audits

An auditor, who is not involved with the routine operation of the PM_{10} monitor, completes a minimum of three flow rate audits on the monitor. These flow rate audits must not be more than 182 days apart and two must be between 5 and 7 months apart. Preferably the auditor will complete a flow rate audit once every quarter or 91 days. The auditor uses different, NIST traceable, equipment to conduct the audit than the equipment used to calibrate the monitor and do the monthly or semimonthly flow verification checks. The auditor follows the audit procedures in SOP 2.37.2 or 2.47.2. The auditor documents the semi-annual flow rate audits in the e-log. Acceptance criteria applicable to PM_{10} flow rate audits may be found in Tables 7.3 and 7.4. If a monitor does not pass the evaluation, the appropriate DAQ regional office monitoring staff will take appropriate action to identify why the monitor failed the evaluation and to correct the situation. See CFR 40 Part 58, Appendix B, Sec. 3.3.2 for more information regarding required PM_{10} flow rate audits.

20.5 Quarterly Completeness Assessment

After the database manager uploads to AQS the data for a quarter, an RCO chemist assesses the data to ensure all data made it through the upload process and into AQS. The RCO chemist accomplishes the quarterly completeness assessment by running the AMP430 Completeness Report, the AMP350 Raw Data Report and the AMP251 QA Data Report. The RCO chemist compares the data in AQS with the data that should be in AQS based on the monitoring schedule. When the RCO chemist identifies missing data or some other problem, he or she informs the Level 3 reviewer and database manager who act to resolve the issue. The RCO chemist archives the AMP251, AMP350 and AMP430 reports used for the quarterly completeness review in the Laserfiche Ambient Monitoring Module. If the monitor does not meet the 75 percent completeness requirements in the grant commitment, the chief contacts EPA Region 4, providing information on what occurred and what actions DAQ plans to take to keep the event from reoccurring.

20.6 Annual Data Certifications

Because the data are reported to AQS and the monitors used to collect the data are SPMs, the DAQ certifies the data annually. In accordance with 40 CFR Section 58.15, an annual air monitoring data certification letter is required to certify that the data from Jan. 1 to Dec. 31 of the previous year collected by the FRM and FEM monitors at the background sites meet criteria in 40 CFR Part 58,

Appendix A as well as Appendix B. Along with the certification letter, the chief must submit to EPA an annual summary report of all the ambient air quality data collected by the monitors, as well as a summary of the precision and accuracy data, for the previous year.

Data certification is the final process of assessing the background data for the previous calendar year. The DAQ verifies and validates data monthly, as discussed in Section 23.0 Verification and Validation Methods. Additionally, an RCO chemist assesses data on a quarterly basis when he or she generates specific AQS reports to assess the DQIs as discussed in Section 20.8 Data Quality Assessments. With these assessments ongoing throughout the year, annual data certification, then, serves as the last assessment of the data – looking at it from an all-inclusive, annual perspective – to see if any unidentified anomalies or trends exist in the data that the review process did not previously identify. The annual data certification process starts with running and reviewing AMP reports contained in AQS. The reports typically queried include the following:

- AMP350 Raw Data
- AMP251 QA Data
- AMP430 Data Completeness
- AMP600 Certification Evaluation
- AMP256 Data Quality Indicator
- AMP504 Extract QA Data
- AMP450 Quicklook Criteria Parameters
- AMP450NC Quicklook All Parameters

An RCO chemist and the PPB supervisor review these reports and confirm everything is complete and accurate. The RCO chemist and PPB supervisor also review the reports to ensure the statistical results indicate the monitoring data were in control over the course of the entire year and met the DQOs. If they identify problems, the RCO chemist investigates them in accordance with Section 24.0 Reconciliation with Data Quality Objectives. Ultimately, this process verifies that the background monitoring data submitted to AQS are correct and complete. Once the RCO chemists, statistician and database manager have completed any necessary corrections, additions or deletions in AQS and the RCO chemists and PPB supervisor have finalized the dataset, the chief officially recommends the data for certification to EPA Region 4. The data certification package provided to EPA includes a signed copy of the AMP600 report, along with a letter signed by the chief, certifying that the ambient concentration and QA data in AQS are complete and accurate, taking into consideration the QA findings, to the best of his or her knowledge.

The annual data certification package is due to EPA Region 4 by May 1 of each year.

20.7 Audit of Data Quality

An RCO chemist who does not validate the data conducts the audit of data quality, or ADQ, which reveals how the level 1 to 3 reviewers handled data, what judgments they made and whether they made uncorrected mistakes and records exist to support the decisions made. An ADQ can often identify the means to correct systematic data reduction errors. Sufficient time and effort will be devoted to this

activity so that the RCO chemist has a clear understanding and complete documentation of data flow. The RCO chemist shall perform this assessment quarterly in accordance with the quarterly data review described in SOP 2.39.4. The DAQ ensures the level 1 to 3 reviewers maintain data collection and handling integrity via the quarterly data review. If the RCO Chemist finds a problem during the ADQ, the RCO Chemist will work with the level 1 to 3 reviewers to correct the situation and modify the procedures to ensure the problem does not reoccur. See Section 23.0 Verification and Validation Methods of this document for more information related to the data review process which occurs monthly and/or quarterly.

20.8 Data Quality Assessments

A DQA is the statistical analysis of environmental data to determine whether the data meet the assumptions under which the DQOs and data collection design were developed and whether the total error in the data is tolerable. Calculations for DQA activities shall follow the requirements and equations identified in 40 CFR Part 58, Appendix B, Section 4. The regulations at 40 CFR Part 58, Appendix B provide terminology associated with measurement uncertainty.

An RCO chemist will evaluate the data quality on a quarterly basis using the AQS AMP256 and AMP600 reports. The DAQ evaluates the data quality from background monitors by comparing them with the data from the SLAMS network monitors. The DQAs will be sent to the QAM via email, for information and to allow corrective action to be taken. Copies of the AQS AMP256 and AMP600 files in PDF format are provided upon request. For the annual data certification, the background sites are combined with monitors from other DAQ-supported networks to determine an estimate of data quality for the agency or PQAO overall. The chief reports the individual results of these tests for each method or analyzer to the EPA annually as part of the AQS AMP600 report.

Level 1 data reviewers use the BAM flow rate control chart in the e-log semimonthly to identify unusual variations in the flow rate. The Level 1 data reviewers must take corrective action when the control chart shows the flow rate reaching the action level. The RCO chemists review control charts of the daily auto zero, span and 1-point-QC check for SO_2 every business day. When the control chart indicates the zero, span or 1-point-QC check has drifted out of range, the RCO chemist contacts the regional monitoring technicians and asks them to take corrective action as specified in each monitor's SOP. (Table 11.2 lists associated SOPs.) In addition, box and whisker plots are viewed at least twice a year for the 1-point-QC checks.

20.9 Internal Technical Systems Audits

At the time of this QAPP revision, the DAQ is beginning to implement internal technical systems audits on the background monitoring network. Ideally, an RCO chemist or team of chemists perform an internal, technical systems audit on the background program, which may include activities linked to the DAQ regional offices, ECB and the RCO. Audit checklists are detailed in SOP DAQ-15-004.5, currently under development. Assigned RCO chemists will be responsible for conducting the systems audits.

20.10 Reporting and Resolution of Issues

The communication process regarding necessary corrective actions within DAQ's background monitoring program because of the previously mentioned assessments is detailed in SOP DAQ-15-002. The NC DAQ AMS – Hurricane Readiness Task List provides emergency/contingency plans that should be implemented when a hurricane or tropical storm is approaching North Carolina.

21.0 Reports to Management

This section describes the quality-related reports and communications to management necessary to support background network operations and the associated data acquisition, validation, assessment, and reporting. Besides the reports discussed in this section, staff meetings occur regularly on either a weekly, biweekly or monthly schedule depending on the part of the organization involved. In addition, DAQ holds as needed meetings with the affected parties to address any additional issues that may arise. See Section 20.0 of this document for additional information regarding the types of reports generated from AQS used to inform management of QA issues. Unless otherwise noted all reports will contain monitoring data for the list of pollutants provided in Table 5.2. Raw data reports may also contain data for shelter temperature.

The reports to management required for the background monitoring program are the same as those for the SLAMS program which are discussed in various sections of 40 CFR Parts 50, 53 and 58. The EPA's Air Quality Assessment Division within the Office of Air Quality Planning and Standards (OAQPS) provides guidance for management report format and content. The following subsections describe the reports to management used by DAQ.

21.1 Quarterly Data Reports

The DAQ monitoring staff will edit, validate and upload air quality data submitted for each reporting period to AQS using the procedures described in the EPA's AQS User Guide, EPA's *AQS Data Coding Manual*[3] and DAQ's data handling and validation SOPs DAQ-15-005.5 and 2.63.4. The level 1 to 3 reviewers review and validate the concentration data in the Envista ARM database. When a monitor's data capture falls below 75 percent for the quarter or the projected 12-month completeness for a monitor falls below 80 percent, an RCO chemist prepares for the chief a memo explaining why and the corrective action taken. If monitoring completeness is projected to not meet the 80 percent completeness for the 12-month period, monitoring at the site will be extended to ensure completeness requirements are met. Otherwise, the PPB supervisor documents that the quarterly data submittal is complete and that the data meets 75 percent completeness for the quarter and is projected to meet 80 percent completeness for the 12-month period by sending an email to the chief.

Each quarter, DAQ uploads to AQS the results of all valid precision, bias and accuracy tests it carried out during the previous quarter. The database manager submits data to AQS consistent with the data reporting requirements specified for air quality data as set forth in 40 CFR Part 58, Appendix B. DAQ reports the required QA data on the same schedule as quarterly monitoring data submittals. The chief is responsible for ensuring that the level 1 to 3 reviewers use the results of QA data to validate concentration data.

In accordance with 40 CFR Section 58.16(b), DAQ submits data to the AQS database no later than 90 days following the end of the quarter in which DAQ collected the data. Table 21.1 provides the dates by which the DAQ must upload the previous quarter's data. After the database manager uploads all

[3] Available at http://www.epa.gov/ttn/airs/airsaqs/manuals/AQS%20Data%20Coding%20Manual.pdf.

quarterly data to AQS, an RCO chemist retrieves and reviews the following quarterly reports from AQS: the AMP251, AMP256, AMP350, AMP350MX, AMP430 and AMP600. After reviewing the reports, the RCO chemist archives the reports in the Laserfiche Ambient Monitoring Module and sends an email to the Level 3 reviewer summarizing the review and any corrective action needed.

Table 21.1 Required AQS Data Reporting Periods

Quarter	Reporting Period	Last Day to Upload Data to AQS
Q1	Jan. 1 to March 31	June 29
Q2	April 1 to June 30	Sept. 28
Q3	July 1 to Sept. 30	Dec. 29
Q4	Oct. 1 to Dec. 31	March 30 or 31 (of following year)

21.2 Performance Evaluations

The ECB electronics technicians conduct performance evaluations, sometimes referred to as audits, of the background SO_2 monitors at least once each monitoring quarter and every 90 days, using specially designated audit equipment. All gaseous transfer standards used in the air monitoring network must be traceable to a primary standard such as a NIST standard reference material or an EPA/NIST-approved certified reference material.

The ECB electronics technicians document the results of each performance evaluation on the AQ-121 form. After the ECB supervisor reviews and approves the form, he routes the form to the PPB supervisor for review and approval. After the PPB supervisor reviews and approves the form, the PPB supervisor distributes the form to the appropriate DAQ regional office air quality supervisors, coordinators and RCO chemists.

The RRO monitoring technician conducts flow rate audits, sometimes referred to as audits, of the $PM_{2.5}$ monitors at least once each quarter, using designated audit equipment that was not used to calibrate the monitors or do the flow rate verifications. All transfer standards used in the air-monitoring network must be traceable to a primary standard such as a NIST standard.

The RRO monitoring technician documents the results of each flow rate audit in the monitor e-log. After the coordinator reviews and approves the e-log, the coordinator transfers the e-log to the PM chemist for review and approval. After the PM chemist reviews and approves the e-log, the PM chemist converts the audit information into a transaction file and submits it to the database manager who uploads it to AQS.

21.3 Annual Network Review

By Oct. 31 of each calendar year, the regional monitoring technicians conduct an annual network review of each active site in the background monitoring program, documenting the information requested on the annual site review forms, which is part of DAQ's overall annual network review. SOP 2.43.2 describes

this process. The network review determines if the monitoring site and probe locations meet the siting requirements and monitoring objectives defined in 40 CFR Part 58, Appendices B, D and E. The review identifies any needed modifications to the site and network including termination or relocation of unnecessary stations or monitors or establishment of new stations or monitors. The regional monitoring technician completes the annual network review form described in SOP 2.43.2. The appropriate regional monitoring coordinator reviews the form and submits it to the RCO by Dec. 31. The PPB supervisor or a designee archives the network review forms in the Laserfiche Ambient Monitoring Module and provides them to the public and the EPA as appendices to the annual network monitoring plan.

21.4 Annual Data Certification

By May 1 of each year, the chief will prepare for his signature a data certification package, which is submitted to the Director, ARD, US EPA Region 4. The report will consist of a letter, for signature, along with AQS generated summaries of background concentration data collected during the previous year, and all applicable QA data. The Office of Air Quality Planning and Standards, or OAQPS, and EPA Region 4 specify the exact AQS reports for the chief to submit. Generally, the chief submits an AMP600 and AMP450NC report.

21.5 Annual Network Monitoring Plan

Following the requirements in 40 CFR Section 58.10(a) DAQ prepares and submits to the EPA Region 4 regional administrator an annual monitoring network plan by July 1 of each year. The plan is reviewed and submitted by the chief. It is composed by the regional air quality supervisors and coordinators, RCO chemists, the AMS supervisors and the chief. The plan provides for the establishment and maintenance of an air-quality surveillance system consisting of a network of SLAMS and special purpose monitoring stations. The plan includes: (1) a statement of purpose for each monitor and (2) evidence that siting and operation of each monitor meets the requirements of appendices B, C, D and E of 40 CFR Part 58, where applicable. Before submitting the plan to the EPA, the DAQ makes the annual monitoring network plan available for public inspection for at least 30 days

As required by 40 CFR Part 58, Appendix A, Section 5.1, DAQ provides a list of all monitoring sites and their AQS site identification codes to EPA Region 4 each year in the network plan. DAQ keeps AQS up-to-date by creating site data records with the date DAQ established a site and other pertinent info. DAQ also sends any appropriate data to AirNow-Tech. Whenever there is a change in this list of monitoring sites or in a reporting organization between network plans, DAQ reports this change to EPA Region 4 via electronic mail and to AQS and AirNow-Tech by updating the appropriate site records.

21.6 Five-Year Network Assessment

The DAQ conducts and submits to the EPA regional administrator an assessment of the air-quality surveillance system every 5 years, which is due on July 1. At a minimum, this assessment determines if the network meets the monitoring objectives defined in 40 CFR Part 58, Appendix D, whether DAQ needs to add new sites, whether DAQ no longer needs existing sites and can terminate them, and whether new technologies are appropriate for incorporation into the ambient air monitoring network.

In the network assessment for PSD monitoring, DAQ considers the ability of existing and proposed sites to support air quality characterization for PSD modeling throughout the state by considering where industrial expansion is likely to occur and what type of pollutants will be involved. The DAQ evaluates the network to ensure that background monitors are distributed throughout the state and are particularly located in areas where DAQ expects to receive permit applications. For any sites that DAQ proposes for discontinuance, DAQ also considers the effect on users of the data, other than the agency itself, such as nearby states and tribes or permitted facilities. The chief submits a copy of this 5-year assessment, along with a revised annual network plan, to the EPA regional administrator.

21.7 Internal Systems Audit Reports

At this time, DAQ is developing an internal systems audit program so DAQ has not yet completed regularly scheduled internal systems audits at the background-monitoring sites. An RCO auditor or audit team will perform an internal systems audit when the monitor is operational to verify that the background-monitoring program meets the data MQOs outlined in Section 7.2. When completed, the RCO auditor or audit team will distribute copies of the systems audit report to the DAQ regional office air quality supervisor, RCO chemist, ECB supervisor, the PPB supervisor and the chief.

21.8 Response/ Corrective Action Report

Currently, regional monitoring technicians document any corrective action taken at the site in an e-log. The regional monitoring technicians do not send these e-logs to management but the regional monitoring coordinator and RCO chemists review them. When the corrective action needed is beyond what the regional monitoring technician can handle at the site, the regional monitoring technician contacts the regional monitoring coordinator and ECB electronics technicians. The ECB electronics technicians document all corrective actions taken on an Air Quality Section Maintenance Order or AQ-109 Form which the ECB and PPB supervisors review. When the level 1, 2 or 3 reviewers need to correct data reported to AQS, they document the changes on a data correction form (see DAQ-15-005.5 Appendix A). If the corrective action affects several days or a month or more of data, involves systemic issues, or endangers meeting completeness, an RCO chemist documents the corrective action in a memo to the chief and carbon copies the DAQ regional office air quality supervisor. SOP DAQ-15-002, describes when a need exists for a formal corrective action preventative action (CAPA) process that documents the root cause analysis, investigates solutions, and confirms that the solution was effective.

22.0 Data Validation and Usability

Data review is the in-house examination to ensure that the data has been recorded, transmitted and processed correctly. It includes completeness checks to determine if there are any deficiencies such as missing data or lost integrity. The level one through three reviewers should compare the data under evaluation to actual events, as per guidance (Guidance on Environmental Data Verification and Data Validation (EPA QA/G-8)). In addition, DAQ expects that some of the QC checks will indicate that the data fail to meet the acceptance criteria. The level one to three reviewers shall flag or void data identified as suspect, or does not meet the acceptance criteria, with AQS codes prior to upload to AQS.

Data verification is the process for evaluating the completeness, correctness, and conformance/ compliance of the data set against method, procedural and contractual specifications. Verification can be further defined as confirmation, through provision of objective evidence, that the data has fulfilled all of the specified requirements for that type of data.

Data validation is a routine process designed to ensure that reported values meet the quality goals of the environmental data operations. Data validation is further defined as examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. The primary intended use for the background data set is to provide background data for PSD modeling. A progressive, systematic approach to data validation must be used to ensure and assess the quality of the data. Data validation includes the review of the DAQ background data sets against the individual pollutant MQOs listed in Tables 7.2 – 7.4. Reviewing data long-term (over a monthly or quarterly period) provides information about the structure of the data and may identify patterns, relationships or potential anomalies. If the RCO chemists find a problem or discrepancy, he or she will conduct further investigations to find the source of the error and then correct it. Deviations from operational procedures or QA requirements that do not result in data invalidation may require that data be qualified with QA qualifier flags prior to upload to AQS.

22.1 Sampling Design

The EPA must approve sampling network and monitoring site selection for SLAMS monitors. The background monitors are special purpose monitors so the EPA does not have to approve the monitoring site selections. However, the DAQ includes the background monitors in the network plan so the EPA approves the monitoring site selections when the EPA approves the network plan. In selecting the locations of the various sites, DAQ must comply with, and EPA must verify that DAQ has complied with the following:

- 40 CFR Part 58, Appendix B - Quality Assurance Requirements for Prevention of Significant Deterioration (PSD) Air Monitors
- 40 CFR Part 58, Appendix D- Network design criteria for Ambient Air Quality Monitoring
- 40 CFR Part 58, Appendix E - Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring

- Ambient Monitoring Guidelines for Prevention of Significant Deterioration, EPA-450/4-87-007, May 1987 *Guidance on Choosing a Sampling Design for Environmental Data Collection* (EPA QA/G-5S)[4] provides additional guidance.

The regional monitoring technician shall thoroughly document any deviations from the minimum siting criteria (e.g., shelter location, probe placement and/or monitor sight path requirements) in the site's QC documentation. Examples of deviations include, but are not limited to, insufficient distance from roadways (i.e., marginal terrain criteria) and insufficient distance from influencing objects (e.g., dripline of an adjacent tree or a cell phone tower installed after establishment of the monitoring site).

22.2 Data Collection Procedures

Section 11.0 Sampling Methods Requirements outlines data collection procedures for the FRMs and FEMs used in the background monitoring network. The Envidas Ultimate DAS routinely identifies potentially unacceptable data points in the database through electronic application of Envidas-Ultimate applied status flags. The database manager has associated each instrument-specific flag with a unique error. The level 1, 2 and 3 reviewers routinely review these Envidas-Ultimate applied status flags as part of the data validation process. This activity assists in identifying suspect or potentially bad data points that could invalidate the resulting averaging periods. Table 22.1 presents a compilation of the AQS error flags and null codes (as of September 15, 2021). A current list of AQS error flags and null codes can be found at EPA's AQS webpage.

The regional monitoring technician must document any deviation from the established data collection plan in the appropriate logbook. Accurate and complete documentation of any data collection deviations will assist in any subsequent investigations or evaluations. Investigations and evaluations may be necessary to determine whether the data obtained from a site may qualify as a baseline or indicator for other sites.

Table 22.1 AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
IA	African Dust	Informational Only	To provide information on events that influenced the measured values.
IB	Asian Dust	Informational Only	
IC	Chem. Spills and Industrial Accidents	Informational Only	
ID	Cleanup After a Major Disaster	Informational Only	
IE	Demolition	Informational Only	
IF	Fire - Canadian	Informational Only	
IG	Fire - Mexico/Central America	Informational Only	
IH	Fireworks	Informational Only	
II	High Pollen Count	Informational Only	
IJ	High Winds	Informational Only	

[4] Available at: https://www.epa.gov/sites/production/files/2015-08/documents/g9r-final.pdf

Table 22.1 AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
IK	Infrequent Large Gatherings	Informational Only	To provide information on events that influenced the measured values.
IL	Other	Informational Only	
IM	Prescribed Fire	Informational Only	
IN	Seismic Activity	Informational Only	
IO	Stratospheric Ozone Intrusion	Informational Only	
IP	Structural Fire	Informational Only	
IQ	Terrorist Act	Informational Only	
IR	Unique Traffic Disruption	Informational Only	
IS	Volcanic Eruptions	Informational Only	
IT	Wildfire-U. S.	Informational Only	
J	Construction	Informational Only	
1C	A 1-Point-QC check exceeds acceptance criteria but there is compelling evidence that the analyzer data are valid	Missing QA/QC Audit	Void the data and submit the code in its place.
1F	No 1 Point QC but need to count for completeness	Missing QA/QC Audit	
AA	Sample Pressure out of Limits	Null Data Qualifier	
AB	Technician Unavailable	Null Data Qualifier	
AC	Construction/Repairs in Area	Null Data Qualifier	
AD	Shelter Storm Damage	Null Data Qualifier	
AE	Shelter Temperature Outside Limits	Null Data Qualifier	
AF	Scheduled but not Collected	Null Data Qualifier	
AG	Sample Time out of Limits	Null Data Qualifier	
AH	Sample Flow Rate out of Limits	Null Data Qualifier	
AI	Insufficient Data (cannot calculate)	Null Data Qualifier	
AJ	Filter Damage	Null Data Qualifier	
AK	Filter Leak	Null Data Qualifier	
AL	Voided by Operator	Null Data Qualifier	
AM	Miscellaneous Void	Null Data Qualifier	
AN	Machine Malfunction	Null Data Qualifier	
AO	Bad Weather	Null Data Qualifier	
AP	Vandalism	Null Data Qualifier	
AQ	Collection Error	Null Data Qualifier	
AR	Lab Error	Null Data Qualifier	
AS	Poor Quality Assurance Results	Null Data Qualifier	
AT	Calibration	Null Data Qualifier	

Table 22.1 AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
AU	Monitoring Waived	Null Data Qualifier	
AV	Power Failure	Null Data Qualifier	
AW	Wildlife Damage	Null Data Qualifier	
AX	Precision Check	Null Data Qualifier	Void the data and submit the code in its place.
AY	QC Control Points (zero/span)	Null Data Qualifier	
AZ	QC Audit	Null Data Qualifier	
BA	Maintenance/Routine Repairs	Null Data Qualifier	
BB	Unable to Reach Site	Null Data Qualifier	
BC	Multi-point Calibration	Null Data Qualifier	
BD	Auto Calibration	Null Data Qualifier	
BE	Building/Site Repair	Null Data Qualifier	
BF	Precision/Zero/Span	Null Data Qualifier	
BG	Missing ozone data not likely to exceed level of standard	Null Data Qualifier	
BH	Interference/co-elution/misidentification	Null Data Qualifier	
BI	Lost or damaged in transit	Null Data Qualifier	
BJ	Operator Error	Null Data Qualifier	
BK	Site computer/data logger down	Null Data Qualifier	
BL	QA Audit	Null Data Qualifier	
BM	Accuracy check	Null Data Qualifier	
BN	Sample Value Exceeds Media Limit	Null Data Qualifier	
BR	Sample Value Below Acceptable Range	Null Data Qualifier	
CS	Laboratory Calibration Standard	Null Data Qualifier	
DA	Aberrant Data (Corrupt Files, Aberrant Chromatography, Spikes, Shifts)	Null Data Qualifier	
DL	Detection Limit Analyses	Null Data Qualifier	
EC	Exceeds Critical Criteria	Null Data Qualifier	
FI	Filter Inspection Flag	Null Data Qualifier	
MB	Method Blank (Analytical)	Null Data Qualifier	
MC	Module End Cap Missing	Null Data Qualifier	
QV	Quality Control Multi-Point Verification	Null Data Qualifier	
SA	Storm Approaching	Null Data Qualifier	
SC	Sampler Contamination	Null Data Qualifier	
ST	Calibration Verification Standard	Null Data Qualifier	
SV	Sample Volume out of limits	Null Data Qualifier	

Table 22.1 AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
TC	Component Check and Retention Time Standard	Null Data Qualifier	
TS	Holding Time or Transport Temperature Is Out of Specs.	Null Data Qualifier	
XX	Experimental Data	Null Data Qualifier	
1	Deviation from a CFR/Critical Criteria Requirement	Quality Assurance Qualifier	Flag indicating the quality of the data In some cases, the data may not meet all the criteria but is still valid.
1V	Data Reviewed and Validated	Quality Assurance Qualifier	
2	Operational Deviation	Quality Assurance Qualifier	
3	Field Issue	Quality Assurance Qualifier	
4	Lab Issue	Quality Assurance Qualifier	
5	Outlier	Quality Assurance Qualifier	
6	QAPP Issue	Quality Assurance Qualifier	
7	Below Lowest Calibration Level	Quality Assurance Qualifier	
9	Negative value detected - zero reported	Quality Assurance Qualifier	
CB	Values have been Blank Corrected	Quality Assurance Qualifier	
CL	Surrogate Recoveries Outside Control Limits	Quality Assurance Qualifier	
DI	Sample was diluted for analysis	Quality Assurance Qualifier	
EH	Estimated; Exceeds Upper Range	Quality Assurance Qualifier	
FB	Field Blank Value Above Acceptable Limit	Quality Assurance Qualifier	
FX	Filter Integrity Issue	Quality Assurance Qualifier	
HT	Sample pick-up hold time exceeded	Quality Assurance Qualifier	
LB	Lab blank value above acceptable limit	Quality Assurance Qualifier	
LJ	Identification of Analyte is Acceptable; Reported Value Is an Estimate	Quality Assurance Qualifier	
LK	Analyte Identified; Reported Value May Be Biased High	Quality Assurance Qualifier	
LL	Analyte Identified; Reported Value May Be Biased Low	Quality Assurance Qualifier	
MD	Value less than MDL	Quality Assurance Qualifier	
MS	Value reported is 1/2 MDL substituted.	Quality Assurance Qualifier	
MX	Matrix Effect	Quality Assurance Qualifier	
ND	No Value Detected, Zero Reported	Quality Assurance Qualifier	
NS	Influenced by nearby source	Quality Assurance Qualifier	
QX	Does not meet QC criteria	Quality Assurance Qualifier	
SQ	Values Between SQL and MDL	Quality Assurance Qualifier	

Table 22.1 AQS Qualifier Code Description and Type

Flag	Flag Description	Flag Qualifier Type	Purpose
SS	Value substituted from secondary monitor	Quality Assurance Qualifier	Flag indicating the quality of the data. In some cases, the data may not meet all the criteria but is still valid.
SX	Does Not Meet Siting Criteria	Quality Assurance Qualifier	
TB	Trip Blank Value Above Acceptable Limit	Quality Assurance Qualifier	
TT	Transport Temperature is Out of Specs.	Quality Assurance Qualifier	
V	Validated Value	Quality Assurance Qualifier	
VB	Value below normal; no reason to invalidate	Quality Assurance Qualifier	
W	Flow Rate Average out of Spec.	Quality Assurance Qualifier	
X	Filter Temperature Difference or Average out of Spec.	Quality Assurance Qualifier	
Y	Elapsed Sample Time out of Spec.	Quality Assurance Qualifier	

Data collection procedures must adhere to those procedures documented in the SOPs listed in Table 11.2. Any time the regional monitoring technician or coordinator uses a code to void or flag data, he or she should document the reason for using the code in the appropriate logbook and must document any deviation from the established data collection plan in the appropriate logbook. Accurate and complete documentation of any flagged or voided data will assist in any subsequent investigations or evaluations.

22.3 Quality Control

Section 14.0 Quality Control Requirements and Procedures specifies the QC checks that regional monitoring technicians must perform when initially setting up a monitor and periodically throughout the period while the monitor is operating, during data collection and analysis. These include the analysis of daily one-point-QC checks, and monthly or semimonthly flow rate verifications, which provide indications of the quality of data produced by specified components of the measurement process. SOPs DAQ-12-001.2, 2.37.2 and 2.47.2 (see Table 11.2 for SOP titles) specify the procedure, acceptance criteria and corrective action (and changes) for each QC check. Data validation should document the corrective actions taken, affected sampling days or hours and the potential effect of the actions on the validity of the data. The level 1, 2 and 3 data reviewers will:

- Code missing PM_{10} and SO_2 data with appropriate AQS null codes,
- Invalidate hourly and hourly 5-minute maximum SO_2 data if less than 45 minutes of valid data are collected within the hour,
- Invalidate SO_2 and PM_{10} data when the FEM shelter temperature requirements are not met,
- Bracket valid SO_2 data with valid, 1-point QC checks that meet the MQOs and control limits,
- Invalidate SO_2 data back to the most recent valid, passing 1-point QC check and forward to the completion of appropriate corrective actions and calibration when a valid 1-point QC check exceeds critical criteria,

- Report all valid QA/QC data to AQS, with valid 1-point QC checks that exceed acceptance criteria reported with the "1F" null code and invalid 1-point QC checks reported with the "1C" null code,
- Bracket valid PM_{10} data with valid, flow rate verification checks that meet the MQOs and control limits, and
- Invalidate PM_{10} data back to the most recent valid, passing flow rate verification check and forward to the completion of appropriate corrective actions and calibration when a valid flow rate verification check exceeds critical criteria.

Tables 7.2 – 7.4, along with SOPs DAQ-12-001.2, 2.37.2 and 2.47.2 provide further information about 1-point-QC checks and monthly flow rate verifications.

22.4 Calibration

Section 14.0 (Quality Control Requirements and Procedures) addresses the calibration of the monitors, along with the information regional monitoring technicians should present to demonstrate they performed the calibrations correctly and the results are acceptable. When a level 1 to 3 reviewer identifies calibration problems, a level 1 to 3 data reviewer should flag or void any data produced between the suspect calibration event and any subsequent recalibration to alert data users. SOPs DAQ-12-001.2, 2.37.2 and 2.47.2 (see Table 11.2 for SOP titles) provide further information about calibrations.

22.5 Data Reduction and Processing

As mentioned in the above sections, the DAQ will perform internal system audits to ensure the level 1 to 3 data reviewers follow the data reduction and processing activities mentioned in the QAPP. The level 1 to 3 data reviewers will review data monthly to ensure that associated flags or any other data qualifiers have been appropriately associated with the data. An RCO chemist not involved in data collection and processing will review the data quarterly to ensure that regional monitoring technicians and coordinators, ECB electronics technicians and other RCO chemists doing the level 3 review took appropriate corrective actions.

22.6 Exceptional Events

Although 40 CFR Section 50.14 allows the EPA Administrator to exclude certain data from use for determinations of exceedances and violations of a NAAQS, if a state or local agency demonstrates to the EPA Administrator's satisfaction that an "exceptional event" caused the exceedance or violation, this exclusion is not necessary for data used for PSD determinations. However, background data affected by an exceptional event can be considered on a case by case basis for exclusion from use in PSD

applications. As a result, DAQ will flag any data affected by an exceptional event with an informational flag. Title 40 CFR Section 50.1 defines an exceptional event" as an event or events, in which:

- The resulting emissions affect air quality in such a way that there exists a clear causal relationship between the specific event(s) and the monitored exceedance(s) or violation(s)
- The event(s) is not reasonably controllable or preventable; and
- The event(s) is caused by a human activity that is unlikely to recur at that location or is a natural event(s).

An exceptional event does not include:

- Air pollution relating to source noncompliance;
- Stagnation of air masses or meteorological inversions; and
- Meteorological events involving high temperatures or lack of precipitation.

Conditions involving high temperatures, or a lack of precipitation may promote occurrences of some types of exceptional events, such as wildfires or high wind events, which do directly cause emissions. Natural events such as a volcanic eruption or an unlikely to recur human activity such as a train derailment may also lead to exceedances which satisfy 40 CFR Section 50.1 and for which the administrator could grant an exception.

The EPA does not consider data impacted by an exceptional event "representative" of air quality for NAAQS comparison purposes or calculation of certain summary statistics. The RCO chemist should flag all concentration data impacted by an exceptional event with an AQS information code linked within AQS to an event description. The RCO chemist should add exceptional event codes and descriptions to AQS during the monthly data review or as soon thereafter as possible, but no later than the schedule established by federal rulemaking.

It is the responsibility of the RCO chemist with the assistance of the regional office staff and air quality forecasters to analyze the data for potential exceptional events and to add the necessary flags and descriptions into AQS by the applicable regulatory due dates.

To obtain concurrence with an exceptional event the RCO must notify and cooperate with EPA Region 4 Regional Office to prepare a demonstration package for the EPA Administrator. When the chief submits a demonstration package, the RCO chemist working with the database manager will change the informational flags in AQS to request exclusion flags.

Exceptional event data in AQS must receive concurrence from the EPA Administrator. Data that does not receive a concurrence is still eligible for NAAQS comparisons, regardless of the application of request exclusion flags. Examples of exceptional events impacting the background monitoring program might include a natural disaster like a volcanic eruption, or a man-made disaster like a train derailment which releases large quantities of SO_2.

23.0 Verification and Validation Methods

Data verification is the process of evaluating the completeness, correctness, and conformance of a specific data set against the method, procedural, or contractual requirements, as specified in both the SOPs and 40 CFR Part 58. Data validation is a routine process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e. data verification) to ensure that reported values meet the quality goals of the environmental data operations and that the data can be used for its intended purpose.

The DAQ uses the validation templates provided in Tables 7.2 through 7.4 for the weight of evidence approach afforded to PQAOs within 40 CFR Part 58, Appendix B. The DAQ follows the guidance in the QA Handbook regarding the use of these templates and handles the criteria as follows:

- Critical criteria are criteria deemed critical to maintaining the integrity of an ambient air concentration value or group of values. The level 1 to 3 reviewers should invalidate observations that do not meet each criterion on the critical table unless there are compelling reasons and justification for not doing so. Basically, the concentration value or group of concentration values that do not meet one or more of these criteria is invalid until proven otherwise. In most cases, the CFR dictates the requirement, the implementation frequency of the criteria and the acceptance criteria so these criteria are therefore regulatory in nature.
- Operational criteria are situations where violations of a criterion or criteria may be cause for invalidation of the data. The level 1 to 3 reviewers should consider other QC information that may or may not indicate the data are acceptable for the parameter they want to control. Therefore, the data, which do not meet one or more of these criteria, are suspect, unless other QC information demonstrates otherwise, and the reviewers have adequate documentation of that information. The level 1 to 3 reviewers should investigate, mitigate or justify the reason for not meeting the criteria.
- Systematic criteria include those criteria which are important for the correct interpretation of the data, but do not usually change the validity of a datum or data. An example criterion is that at least 80 percent of the days for each quarter should collect 18 or more valid hours. The DQOs are also included in this table. If the data do not meet the DQOs, this does not invalidate any of the data, but it may reduce the confidence in the PSD modeling decision.
- The designation of QC checks as operational or systematic does not imply that the regional monitoring and ECB electronics technicians do not need to perform these QC checks. Not performing an operational or systematic QC check required by regulation can be a basis for invalidation of all associated data. The DAQ applies the validation templates only to small datasets of single values or a few weeks of information and does not allow a criterion to be in non-conformance simply because it is operational or systematic.

23.1 Validating and Verifying Data

The validation and verification procedures that DAQ will employ for this operation shall conform to the validation SOPs listed in Table 11.2. *Guidance on Environmental Data Verification and Data Validation,*

(EPA QA/G-8) discusses verification and validation issues at length. The regional monitoring technicians and coordinators shall perform all verification activities. The RCO chemists shall provide additional support through a final review of all data reconciling any anomalies through discussions with the regional offices. Following the final review, the RCO chemists will provide a final validation of all data. The RCO chemists will also provide other QA/QC support.

The level 1 to 3 data reviewers should compare data under evaluation to actual events as specified in the applicable SOPs. However, significant or unusual field events may occur, and field activities may negatively affect the integrity of the data. In addition, the DAQ expects some of the QC checks will indicate the data fail to meet the acceptance criteria listed in Tables 7.2 through 7.4. The level 1 to 3 data reviewers shall void, or flag data identified as suspect, or which does not meet the acceptance criteria, using the null codes and flags in Table 22.1.

The DAQ verifies and validates the routine and the associated QC data monthly. Presently monthly review is the most efficient period for these verification and validation activities. The DAQ finds that if DAQ can control the measurement uncertainty each month, then DAQ will maintain the overall measurement uncertainty for the PSD-monitoring period within the precision and bias DQOs.

23.2 Verification

After the previous month of data is available, the level 1 and 2 reviewers conduct a thorough review of the data for completeness and accuracy. Once the database manager enters the data into the Envista ARM database, the regional monitoring technician will review the data for routine data outliers and conformance to acceptance criteria. The regional monitoring technician will void or flag appropriately unacceptable or questionable data. The coordinator will verify all voided and flagged data again to ensure the regional monitoring technician entered the flags and voids correctly and that the remaining data are acceptable for use. The level 1 and 2 reviewers document their review in Envista ARM along with their data review decisions.

23.3 Validation

Validation of continuously obtained data requires two stages, one at the measurement value level and another after the previous month of data becomes available. The Envista ARM database retains records of all invalid data. Information shall include a summary of why the level 1 to 3 reviewers invalidated the measurement along with the associated null codes. Logbook notes shall have more detailed information regarding the reason a reviewer voided or flagged a measurement.

The DAQ brackets all SO_2 data by one-point-QC checks or manual calibration checks before and after any invalidated period. This requirement helps to ensure that the SO_2 monitors were in proper operating condition before and after the incident. When a monitor fails, the level 1, 2 and 3 reviewers invalidate any data after the last passing 1-point-QC check. The requirement to bracket the data helps to ensure that the SO_2 monitors were in proper operating condition before and after the incident. In the same way, the DAQ brackets PM data by flow rate verifications or a calibration before and after any invalidated period.

Data validation occurs monthly. DAQ does not use EPA's Data Assessment Statistical Calculator (DASC) tool to evaluate data. The subsections below outline the review, verification and validation processes. The organizational chart in Figure 4.1 labels the specific roles for review level 1 through 3 within the organization.

Level 0 Review - The Envidas Ultimate DAS does the level 0 review.

- Acquire minute averages from instantaneous data and five-minute and hourly averages from minute averages.
- Flag missing and irregular data with preprogrammed, user-defined status flags.

Level 1 Review - The regional monitoring technician does the level 1 review

- Review daily for anomalies and completeness and acquire missing data if available.
- Verify that all daily precision checks fall within acceptable ranges.
- Invalidate data collected during an hour where the shelter temperature was not within the acceptable range.
- Evaluate automated nightly zero/precision/span checks and take appropriate corrective action if necessary.
- Review minute data as needed when completing the level 1 review procedures.
- Verify maximum daily values for validity and take appropriate action if necessary.
- Review the hourly values for any exceedances and take appropriate action if necessary.
- Assess data for values or outliers outside of the acceptable ranges.
- Apply necessary AQS codes from Table 22.1 for hours in which maintenance or calibrations were occurring.
- Flag data as necessary for further investigation.

Level 2 Review (Verification) - The regional monitoring coordinator does the level 2 review

- Review site records (regional monitoring technician logbook, site logbook).
- Review regional monitoring technician checks (leak checks, filter changes, monthly flow verifications, maintenance).
- Assess data for values or outliers outside of the acceptable ranges.
- Review minute data as needed when completing the level 2 review procedures
- Determine if source specific emissions caused any irregularities.
- Flag data as necessary for further investigation.
- Ensure level 1 reviewers used consistent reasons for data invalidation throughout the monitoring period to indicate calibrations, audits, etc.
- Resolve any inconsistencies, anomalies or systemic issues.
- Verify that all daily precision checks fall within acceptable ranges.

Level 3 Review (Validation) - The RCO chemist does the level 3 review.

- Ensure the regional monitoring technician and coordinator used the proper null codes.
- Ensure the regional monitoring technician and coordinator bracketed all valid data with the appropriate null codes indicating valid checks of analyzer accuracy.
- Ensure only valid 5-minute SO_2 hourly maximum values are reported and only for valid SO_2 hours.
- Ensure all data falls within the acceptable ranges as stated in the MQOs in Tables 7.2 through 7.4.
- Ensure all data are acceptable and can be used for the intended purpose.
- Review minute data to confirm that 45 minutes of data are available within an hour.
- Add informational AQS flags (from Table 22.1) to describe data that are out of the ordinary but may be considered “valid.”
- Provide final validation signature.

The DAQ uses a weight of evidence approach in validating data. After level 1 and 2 verifications, the independent level 3 reviewer determines the validity of the data by reviewing:

- The one minute and hourly values,
- Daily automatic and 14-day 1-point-QC checks, flow verifications and any additional manual checks,
- Leak checks after in-line PM filter and probe changes,
- e-logs and the information documented therein,
- Correspondence with the regional monitoring and ECB electronics technicians and coordinator,
- SO_2 concentrations from nearby monitors, and
- The results of DAQ and EPA performance evaluations and semimonthly flow rate audits.

The level 3 reviewer compares all the available information to the specifications in Tables 7.2 through 7.4. The weight the reviewer should give to the available evidence depends on factors such as the quality of the data, consistency of results, nature and severity of effects, and relevance of the information. The weight of evidence approach requires use of scientific judgment and, therefore, it is essential to provide adequate and reliable documentation.

As a general principle, the more information the regional monitoring technician provides, the stronger the weight of evidence is. The regional monitoring technician and coordinator and RCO chemist should present the information in a structured and organized way and the data validator should consider the robustness and reliability of the different data sources to support any justification for validating or invalidating data.

The Envidas Ultimate software completes the level 0 review daily. The regional monitoring technicians and coordinator will complete the level 1 and 2 reviews within 20 calendar days from the end of the monitoring month (example: The month ends on February 28th. The Level 1 and 2 Reviews must be complete by the 20th day of March.). The RCO chemist will complete the level 3 review 20 calendar days after the level 2 review is completed. (Using the prior example, the Level 3 review must be complete by

April 10th.) When the level 3 reviewers sign off on the data in Envista ARM, their signature indicates the files are accurate and ready for the database manager to upload to AQS.

An independent RCO chemist will complete a review of the validated data after the database manager uploads it to AQS and within 40 calendar days after completion of the level 3 review.

As discussed earlier, the EPA and DAQ have developed certain criteria based upon federal requirements and regional monitoring technician judgment that the level 1 to 3 reviewers will use to invalidate a datum or measurement. The level 1 to 3 reviewers shall use the null data codes listed in Table 22.1 to indicate they have invalidated individual measurements, or groups of measurements from an instrument.

24.0 Reconciliation with Data Quality Objectives

Sections 6.0 Project/Task Description and 10.0 Network Description describe the objectives of the background monitoring program. Section 7.0 Quality Objectives and Criteria for Measurement Data describe the DQO's for the background monitoring program.

The AQS AMP256 and AMP600 reports are automated reports based on data uploaded to AQS. These reports provide summary statistics for the background monitoring program data collected. The DAQ uses warning limits that are more stringent than EPA's control limits for its PM_{10} and SO_2 data and implements EPA's critical criteria for all monitoring. Thus, the DAQ should not have to directly calculate confidence intervals annually because all data should statistically meet the DQOs.

An RCO chemist will analyze the results of both the AQS AMP256 and AMP600 reports on a quarterly (Section 20.8 Data Quality Assessments) and calendar year basis to ensure that all monitoring stations are meeting the required DQO's. This RCO chemist documents the review by archiving the AMP256 and AMP600 reports in the Laserfiche Ambient Monitoring Module. If the data from at least one of the background monitors violates the DQI bias and/or precision limits, then the RCO chemist will investigate to uncover the cause of the violation. Depending on the severity of the violation and weight of evidence, the level 3 reviewer will either void or flag the data in AQS. If all the monitors in the network of a similar type or pollutant violate the DQI, the cause may be at the agency level (regional monitoring technician training) or higher (problems with method designation). If only one monitor or site violates the DQI, the cause is more likely specific to the site (regional monitoring technician, problem with the site). Tools for determining the cause include reviewing:

- Data from a local or tribal program or nearby reporting organization
- Data from performance audits (DAQ)
- QC trends.

Once DAQ has identified a cause, DAQ will implement an appropriate corrective action. Some courses of action include:

- Determining the level of aggregation at which DAQ violated the DQOs: Results of the DQA process tell which monitors have problems since the EPA developed the DQOs at the monitor level. To determine the level at which to take corrective action, the DAQ must determine whether the violations of the DQOs are unique to one site, multiple sites or a network of similar monitors, or caused by a broader problem. The AQS generates QA reports summarizing bias and precision statistics at the national and reporting organization levels by method designation. Examination of these reports may assist in determining the level at which the DQOs are being violated.
- Communicating with EPA Region 4: If DAQ finds a violation of the bias and precision DQOs, the chief will remain in close contact with EPA for both assistance and for communication.
- Routinely reviewing control charts, daily, every other week or monthly, to ensure DAQ achieves the DQOs: The RCO chemists will continue to review extensively the control charts

for the monitors until the DAQ attains the bias and precision limits during the time the rotating monitors are operational.

- Reviewing quarterly data: Quarterly QA reports address each monitor's progress toward meeting established DQOs. In the event that a deviation from established goals is noted, a corrective action plan is formulated and enacted at that time. The monitor in question, or if systematic, the entire suite of monitors in the program, is/are thereafter evaluated on a regular basis to determine if the corrective actions have been successful or if additional measures are necessary. The continuing evaluations will include the review of all available DQIs including daily or 14-day QC checks, daily site and monitor electronic readouts, including instrument diagnostic data, additional site audits and increased operator site visits. The evaluations continue until DQOs for bias and precision are brought back within norms. Prior to any decision to shut down a monitor, data from the site is first reviewed to ensure that all DQOs have been met. In the event that DQOs have not been met, the monitor will continue in operation until the required goals have been achieved.
- Updating QAPPs, SOPs and MQOs: When necessary to eliminate future problems, the chief will direct the RCO chemists to update the QAPP, its associated SOPs and the MQOs for the project. Should staff not be readily available to make these updates in a timely fashion, the chief or PPB supervisor will assign staff to make a QA Bulletin addressing the change until such time that the documents associated with this QAPP can be updated.
- Adding additional monitoring stations: If the DQOs indicate a need for additional monitoring stations, the chief will work with the director and regional monitoring coordinator to determine the number of additional stations needed and their location.

When DAQ has collected at least 12 months of data, DAQ will compare the data collected to the DQIs to determine if the data meet the requirements for PSD modeling, etc. If the data are acceptable, they will be released to the DAQ permit modelers, facilities and facility consultants for use in PSD modeling.

Ultimately specifying tolerable error limits reduces the probability of making an error in a decision due to uncertainty in the data. Decision makers, such as the EPA administrator and the director, need to determine if the data collected within the background monitoring network is useful for PSD modeling applications and other monitoring objectives listed in Section 6.0. The annual data certification process and reports generated as part of the certification provide a quantitative assessment of the measurement uncertainty within the DAQ criteria pollutant data set. By controlling uncertainty in the data to the extent prescribed by the DQOs, decision makers can use DAQ's ambient air monitoring data with confidence.

Revision History

The background monitoring program was included as part of the criteria pollutant monitoring QAPP and was submitted as its own separate QAPP in 2020.

In 2020, the QAPP was updated to follow EPA's August 2018 guidance document: Guide to Writing Quality Assurance Project Plans for Ambient Air Monitoring Networks; EPA-454/B-18-006, August 2018.

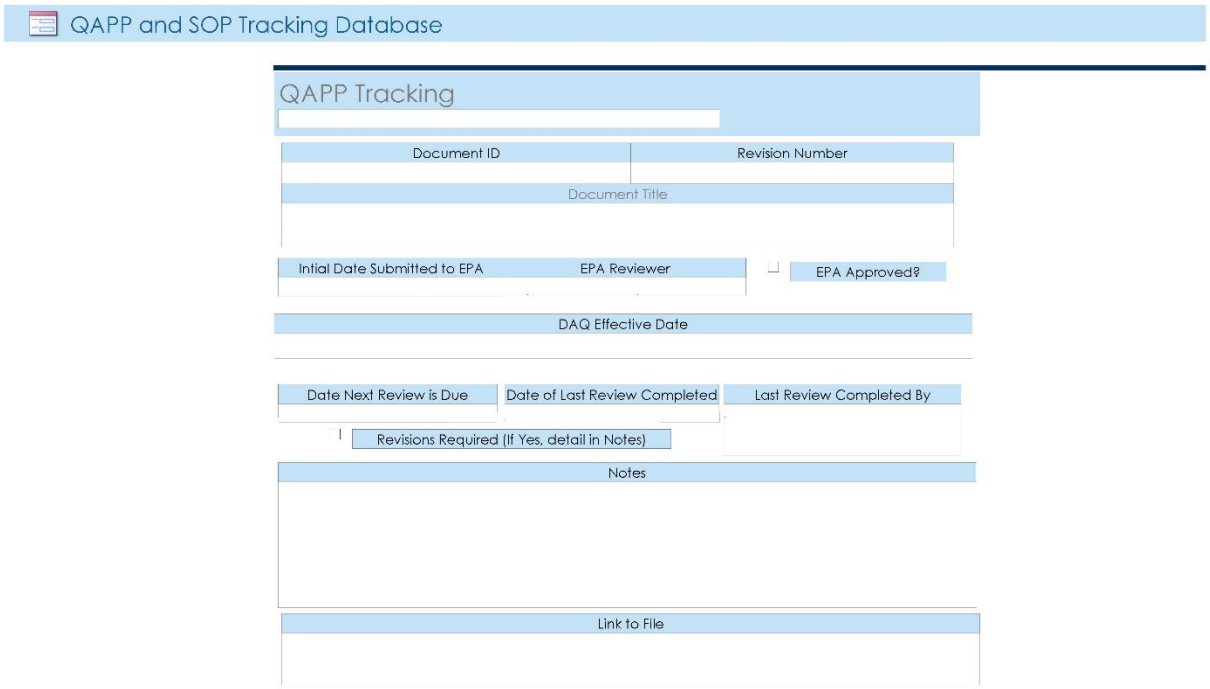
The QAPP was also updated to include EPA's new validation templates and new QA guidance.

Other updates in the QAPP include a new DAS, agency reorganization and new distribution of responsibilities, changes to how data are verified and validated, and different QC criteria for some pollutants.

The QAPP was also updated in 2020 to add the CAPS NO_2 monitor at Rockwell and the T640X PM monitor at Castle Hayne to the background monitoring program, to reference the SO_2 operator's SOP with the new calibration verification procedures, and to reassign flow rate audit responsibilities for the PM_{10} monitors to the ECB electronics technicians.

In November of 2022 the QAPP was updated to remove the CAPS NO_2 monitor at Rockwell and the reassignment of flow rate audit responsibilities for the PM_{10} monitors to the regional monitoring technicians.

QAPP Annual Review Documentation



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