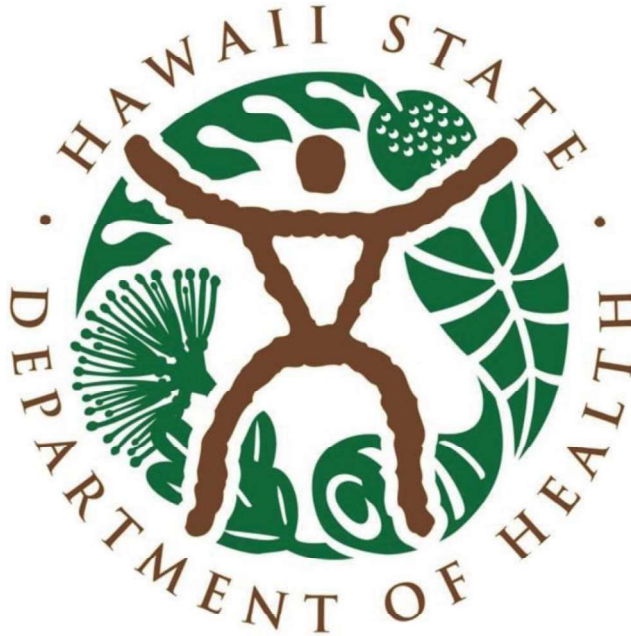


Clean Air Branch Air Monitoring Program Quality Assurance Project Plan



**State of Hawaii
Department of Health
Environmental Management Division
Clean Air Branch**

Document Control Number CABAMP-QAPP-002

July 31, 2023

This *Quality Assurance Project Plan* (QAPP), including all Appendices, *Standard Operating Procedures* (SOPs), Practices, and Procedures, shall be implemented by the *Clean Air Branch Air Monitoring Program* (CABAMP).

Disclaimer


The mention of trade names or commercial products does not constitute a State of Hawaii Department of Health endorsement or recommendation for use.


A. PROJECT MANAGEMENT


A.1 Title and Approval Page


This *Clean Air Branch Air Monitoring Program (CABAMP), Quality Assurance Project Plan (QAPP), CABAMP-QAPP-002* is hereby recommended for approval and commits the State of Hawaii, Department of Health (HDOH) to follow the elements described within.

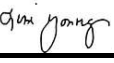
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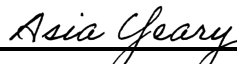
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- <http://www.Time.gov>
- <https://airknowledge.gov/SI/AMBM208-SI.html>
- <http://www.epa.gov/aqs>

Appendices

- I. CAB Standard Operating Procedures
- II. ITS Standard Operating Procedures
- III. HECO QAPP
- IV. PACE QAPP
- V. Chemical Speciation Network QAPP
- VI. 2023 State of Hawaii Ambient Air Quality Network
- VII. State of Hawaii Department of Health Short-Term SO₂ Advisory
- VIII. Measurement Quality Objectives
- IX. QAO TSA Checklist
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Acronyms and Abbreviations

| | |
|------------------|---|
| ADQ | Audits of Data Quality |
| AMTIC | Ambient Monitoring Technology Information Center |
| APTI | Air Pollution Training Institute |
| AQET | Air Quality Electronic Technician |
| AQI | Air Quality Index (EPA) |
| AQS | Air Quality System (EPA) |
| ARM | Approved Regional Method |
| ASC | Aerosol Sample Conditioner |
| ASQ | American Society for Quality |
| AWMA | Air & Waste Management Association |
| BAM | Beta Attenuated Monitor |
| CAA | Clean Air Act (Federal) |
| CAB | Clean Air Branch (HDOH) |
| CABAMP | Clean Air Branch Air Monitoring Program |
| CAN | Corrective Action Notice |
| CAPS | Cavity Attenuated Phase Shift |
| CARB | California Air Resources Board |
| CFR | Code of Federal Regulations |
| CO | Carbon Monoxide |
| CV | Coefficient of Variation |
| DAS | Data Acquisition System |
| DASC | Data Assessment Statistical Calculator |
| DDEH | Deputy Director for Environmental Health (HDOH) |
| DQA | Data Quality Assessment |
| DQI | Data Quality Indicators |
| DQO | Data Quality Objectives |
| DRR | Data Requirement Rule |
| DVP | Data Validation Personnel |
| EDO | Environmental Data Operation |
| EHA | Environmental Health Administration (HDOH) |
| EHASB | Environmental Health Analytical Service Branch ((HDOH) |
| EHS | Environmental Health Specialist (HDOH) |
| EMD | Environmental Management Division (HDOH) |
| EMSU | Electronic Maintenance Support Unit |
| Envista ARM | Air Resources Manager (Envista) |
| EPA | United States Environmental Protection Agency |
| FEM | Federal Equivalent Methods |
| FPA | Filter Processing Area (CAB) |
| FRM | Federal Reference Methods |
| FT | Filter |
| GIS | Geographical Information Systems |
| HAMP | Hawaii Air Monitoring Program SharePoint |
| HDOH | Hawaii Department of Health |
| HECO | Hawaiian Electric Company |
| HISO | Health Information System Office (HDOH) |
| H ₂ S | Hydrogen Sulfide |
| IEC | International Electronic Commission |
| ISA | Internal Systems Audits |
| ISO | International Organization for Standardization |
| ITS | Information Technology Specialist (assigned to CAB from HISO) |
| LDL | Lower Detection Limit |

| | |
|--------------------|--|
| MA | Monitoring & Analysis Section (CAB) |
| MDL | Minimum Detection Limit (EPA) |
| MQO | Measurement Quality Objectives |
| MSA | Metropolitan Statistical Area |
| NAAQS | National Ambient Air Quality Standards |
| NCORE | National Core Multi-Pollutant Monitoring Station |
| NIST | National Institute of Standards and Technology |
| NO ₂ | Nitrogen Dioxide |
| NO/NO _y | Nitrogen Oxide/Oxides of Nitrogen |
| NPAP | National Performance Audit Program (EPA) |
| NPEP | National Performance Evaluation Program (EPA) |
| O ₃ | Ozone |
| OAQPS | Office of Air Quality Planning and Standards (EPA) |
| OMB | Office of Management and Budget (Federal) |
| PAMS | Photochemical Assessment Monitoring Stations |
| PASS | Planning & Administrative Support Staff |
| Pb | Lead |
| PE | Performance Evaluation |
| PM _{2.5} | Particulate matter less than or equal to 2.5 micrometers in diameter |
| PM ₁₀ | Particulate matter less than or equal to 10 micrometers in diameter |
| PPM | Parts Per Million |
| PQAO | Primary Quality Assurance Organization |
| PRP | Peer Review Personnel |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| QMP | Quality Management Plan |
| RH | Relative Humidity |
| SIP | State Implementation Plan |
| SLAMS | State and Local Air Monitoring Station |
| SLD | State Laboratories Division |
| SO ₂ | Sulfur Dioxide |
| SOP | Standard Operating Procedure |
| SPMS | Special Purpose Monitoring Station |
| SRP | Standard Reference Photometers |
| STP | Standard Temperature & Pressure |
| TAD | Technical Assistance Documents |
| TAPI | Teledyne Air Pollution Instruments |
| TSA | Technical Systems Audit |
| TSP | Total Suspended Particulates |
| µg/m ³ | micrograms per cubic meter |
| WESTAR | Western States Air Resources Council |
| WD | Wind Direction |
| WS | Wind Speed |

A.3 Distribution List

The following individuals should receive a hardcopy or electronic version of this approved *Quality Assurance Project Plan* (QAPP) as well as any future revisions. An electronic version will be available on the Department of Health, *Hawaii Air Monitoring Program* (HAMP) SharePoint site:

<http://www.doh.hawaii.gov/sites/eha/emd/CAB/HAMP/default.aspx>

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Further, in addition to this QAPP, as *Standard Operating Procedures* (SOP) are created and revised all *Clean Air Branch Air Monitoring Program* (CABAMP) personnel listed on this distribution list shall be notified via email that these documents are available for viewing on both the *HAMP* and *Clean Air Branch* (CAB) *Operations* SharePoint sites.

A.4 Project/Task Organization

This document is the *Quality Assurance Project Plan* (QAPP) for the *Clean Air Branch Air Monitoring Program* (CABAMP) implemented by the State of Hawaii. The QAPP is the secondary planning and guidance document for the CAB and consistent with the *Quality Management Plan* (QMP)^[1] (expected completion is December 2023). This project plan incorporates all the requirements of the *United States Environmental Protection Agency* (EPA) QA/R-5, *EPA Requirements for Quality Assurance Project Plans (2001)*. Additionally, EPA-454/B-13-003, *Quality Assurance Handbook for Air Pollution Measurement Systems Volume II Ambient Air Quality Monitoring Program (January 2017)* serves as the quality reference document for the collection and use of criteria pollutant and NCore ambient air quality data. This QAPP supersedes the previous QAPP, dated September 15, 2015, located on the *Hawaii Air Monitoring Program* (HAMP) SharePoint:

<http://www.doh.hawaii.gov/sites/eha/emd/CAB/HAMP/default.aspx>

The *State of Hawaii Department of Health* (HDOH) is the *Primary Quality Assurance Organization* (PQAO) for the CABAMP. Under the HDOH, is the *Environmental Health Administration* (EHA), *Environmental Management Division* (EMD). EMD manages six different *Branches*, including the CAB, which is the program charged with implementing the CABAMP (*Figure A-1*).

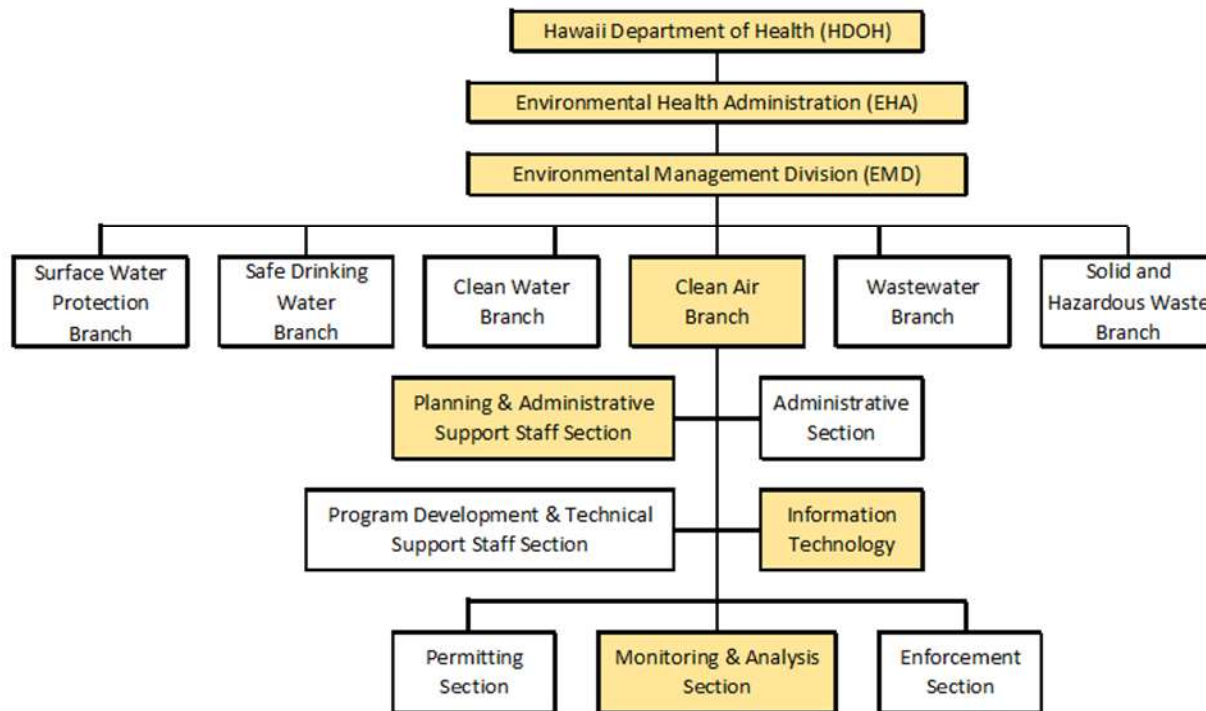
The Monitoring and Analysis (MA) Section in the CAB establishes and maintains the ambient air monitoring network including special air monitoring studies. The MA tasks include station siting and operations, data collection, data validation, and conducting audits.

Quality assurance oversight of the air program is the responsibility of the CAB *Quality*

^[1] The Quality Management Plan (QMP) describes an organization's Quality Program. It also documents how the organization structures its Quality Program including descriptions of its internal quality procedures for implementing and assessing the effectiveness of the program; criteria for and areas of application; and roles, responsibilities, and authorities. The QMP must also document all technical activities to be performed under the Quality Program and how the program will integrate quality assurance (QA), quality control (QC), and Quality Assurance Project Plans (QAPP) into all its environmental information operations.

Assurance Officer (QAO) who resides in the *Planning & Administrative Support Staff* (PASS) Section. The QAO is organizationally independent of the data generation activities. (Figure A-1).

Figure A-1: Hawaii Department of Health CAB Organizational Chart



CAB MA is responsible for all data generation activities which includes the following:

- Plans, establishes, and reviews the ambient air monitoring network.
- Plans and reviews special studies on air pollutants and air toxics.
- Selects and procures approvals for new and/or relocated monitoring stations.
- Installs, operates, and maintains air monitoring stations and associated equipment per EPA requirements.
- Procures scientific instruments and equipment needed for the air program.
- Maintains an inventory of all equipment and instruments.
- Reviews, analyzes, and compiles air quality data for various reports to the public and the EPA.
- Ensures that all sampling, analytical, and data handling procedures performed are consistent with QAPP requirements and EPA mandates and that they are properly documented, and adequately reviewed.
- Prepares, implements, and updates all required *Standard Operating Procedures* (SOP).
- Maintains and archives all data as specified in this QAPP.
- Performs contract management with outside laboratories.
- Verifies data and performs *Quality Assurance and Quality Control* (QA/QC) activities specified in this QAPP and EPA requirements as part of the normal data collection process.
- Performs Data Validations and generates reports on collected data.
- Enters final valid data into the EPA *Air Quality System* (AQS).

CAB QAO is responsible for quality assurance oversight of the CAB air monitoring program which includes:

- Provides quality assurance oversight, conducts data assessments and independent *Technical Systems Audits* (TSA) on data collection activities.
- Verifies that quality system corrective actions are implemented.
- Ensures that a QAPP is generated and updated for all air quality data collection activities.

Figure A-2 shows the organizational structure and data flow for the CABAMP. The CAB is required to operate under the quality assurance practices established by the CABAMP *Quality Management Plan* (QMP). This document describes policies and procedures that ensure the work performed satisfies the expectations and specifications required for a quality organization. The CAB reviews and approves the protocols and procedures outlined in this QAPP, to certify that the documented practices are consistent with the CABAMP's established objectives and Federal regulations.

Hawaiian Electric Company (HECO) is included in Figure A-2 as they have established *Sulfur Dioxide* (SO₂) *Data Requirement Rule* (DRR) sites. HECO, is a private company that is required to install, operate, and maintain SO₂ ambient monitoring stations, which were selected by CAB to meet the following rule as stated from HECO's QAPP:

"In August 2015, the U.S. Environmental Protection Agency (EPA) published its final requirements rule on the one-hour SO₂ standard.^[2] This rule requires all air quality agencies under its jurisdiction to adequately characterize the air quality in the vicinity of sources that emit 2,000 tons of SO₂ (or more) per year. On the island of Oahu, the following facilities fall into this category:

1. Waiau Generating Station
2. Kahe Generation Station
3. AES Hawaii Generation Plant
4. Kalaeloa Cogeneration Plant

The State of Hawaii Department of Health, Clean Air Branch (DOH) is collaborating with Hawaiian Electric to comply with the requirements in this rule and have chosen to perform the characterization by means of installing and operating an ambient air monitoring station near the Kahe Generating Station and another ambient air monitoring station near the Waiau Generating Station. It is intended that the Kahe monitoring station also cover any impacts from the AES Hawaii and Kalaeloa facilities. "

The operation and maintenance of the stations must comply with all applicable federal regulations and guidance documents for ambient air monitoring and quality assurance. CAB has reviewed HECO's QAPP and had found it be satisfactory in meeting EPA/CAB requirements where HECO ensures validations are performed by an independent Data Validation Contractor.

^[2] "40 CFR Part 51, Data Requirements for the 2010 1-Hour Sulfur Dioxide (SO₂) Primary National Ambient Air Quality Standard (NAAQS), Final Rule, Federal Register Vol. 80, No. 162, August 21, 2015

Figure A-2 CABAMP Organizational and Data Flow Chart

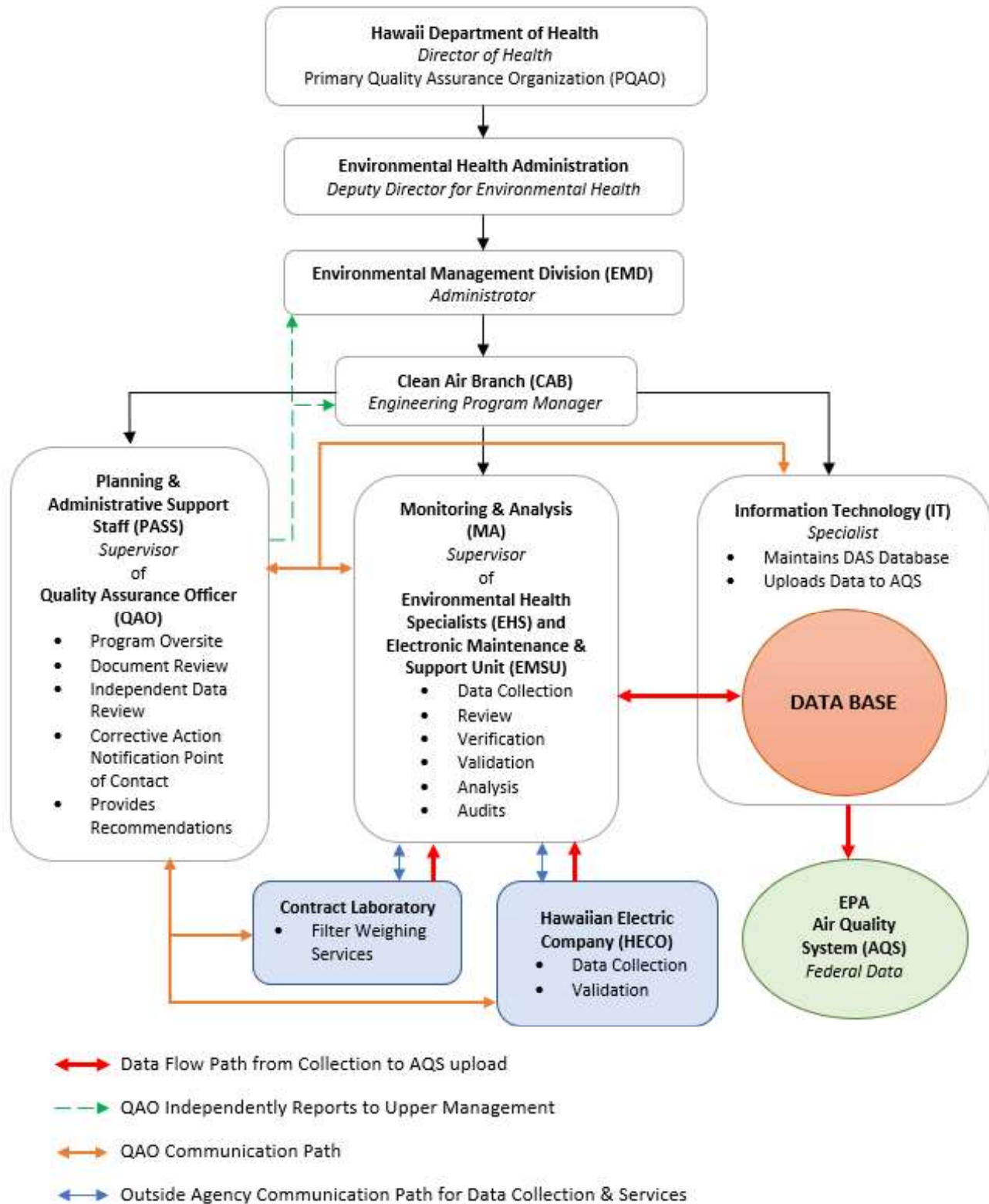


Figure A-3 CAB Organizational Structure

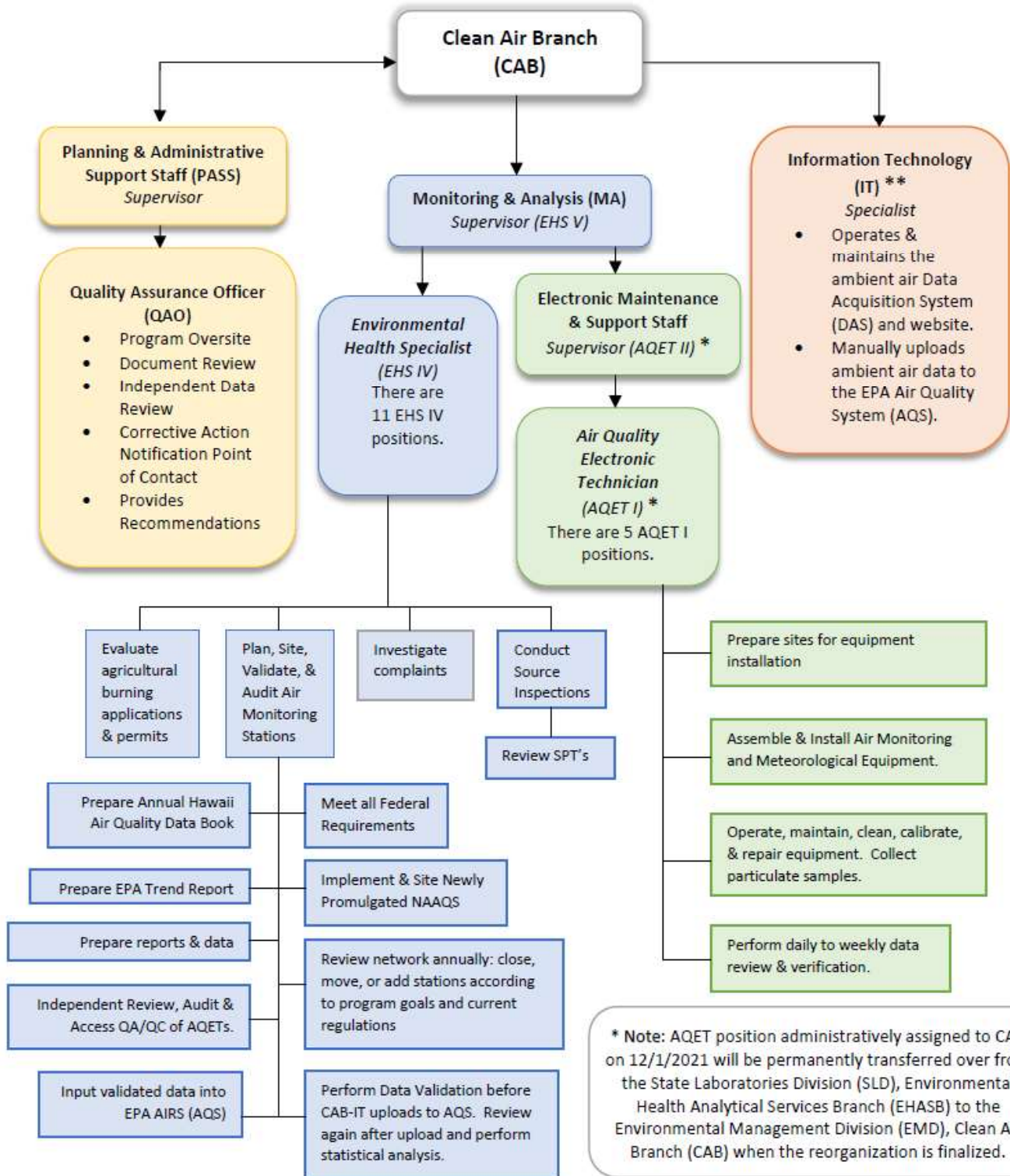


Table A-1 CABAMP Roles and Responsibilities

| Title | Roles and Responsibilities |
|--|---|
| Engineering Program Manager | <p>Program Manager for the CAB. Responsibilities include:</p> <ul style="list-style-type: none"> • Manages the statewide Clean Air Program. • Manages the CAB budget. • Certifies the annual data submitted to AQS. • Oversees the planning, implementation, and maintenance of the statewide Clean Air Branch/Program. |
| Program Specialist V Supervisor, Planning and Administrative Support Staff (PASS) | <p>Supervisor for the PASS, in CAB. This section is administratively separate from the MA section. Primary responsibilities include:</p> <ul style="list-style-type: none"> • Supervises the QAO for the CABAMP. • Manages federal grants utilized by the air monitoring program. • As part of grants management tracks, funding for the 3-year equipment Replacement Plan. • Provides guidance to staff responsible for the procurement of equipment and supplies for the air program. • Reviews and manages contracts, grants, and any other agreements for Branch. |
| EHS IV Quality Assurance Officer (QAO), PASS | <p>Quality Assurance Officer for the CABAMP. Responsibilities include:</p> <ul style="list-style-type: none"> • Provides overall quality assurance oversight for the CABAMP. • Conducts independent assessments of the data collection, verification, and validation processes. • Provides guidance and technical assistance on QA/QC procedures and the latest EPA requirements. • Issues quality assurance/quality control guidance as needed to ensure data integrity is maintained. • Conducts data reviews and independent assessments, and reviews annual data certification reports prior to data being uploaded to AQS. • Assists the PASS Supervisor by reviewing the QA requirement portions of contracts, grants, and agreements pursued by the Branch. • Participates in and observes performance audits, which are conducted by MA and EPA (e.g. NPEP, NPAP). • Participates in EPA Technical Systems Audits (TSA). • Conducts CABAMP <i>Internal Systems Audit</i> (ISA) of all monitoring stations and data collection activities in alternating years EPA conducts TSA. • Verifies that quality system corrective actions are implemented and ensures they are tracked to satisfactory completion. Works with staff to resolve all EPA issued TSA findings under internal corrective actions. • Ensures that QA documents, including but not limited to QMPs, QAPPs, and SOPs are generated and updated for air quality data collection activities. • Reviews and provides comments, recommendations, and approvals for all QA documents to ensure EPA guidance and QA/QC requirements are fulfilled. • Reviews and approves SOPs prepared by those performing activity. • Archives documents on the HAMP SharePoint and CAB Operations SharePoint site, which include but are not limited to audit reports, CANs, SOPs, QAPPs, QMPs, and all other data reports. • Monitors and provides oversight over data from collection through all validation levels to ensure completion prior to upload to AQS. |

| Title | Roles and Responsibilities |
|--|--|
| EHS IV, QAO PASS (continued) | <ul style="list-style-type: none"> Reviews and/or conducts training to ensure adequate and appropriate QA training is provided for the MA staff. Participates in the annual network review, five-year network assessment, selection, siting of new or relocated stations, and annual site surveillance. Has the authority to initiate "Stop Work" emergency meetings to address immediate concerns that could affect data completeness from issues that are causing significant data loss. |
| EHS V Supervisor, Monitoring and Analysis Section (MA) | <p>Supervisor for the Monitoring and Analysis Section. Responsibilities include:</p> <ul style="list-style-type: none"> Supervises the Monitoring and Analysis Section's staff which includes the Environmental Health Specialists and the Air Quality Electronic Technicians. Directs, reviews, and implements the monitoring and QA activities and processes for the CABAMP. Oversees the monitoring network design and review process. Ensures that MA staff implement the QA process. Ensures that CAB assessments, reviews, validations, and audits are scheduled, completed, and reported as required. Provides, documents, and administers the training program to ensure adequate and appropriate training of the MA staff. Ensures that staff responsible for QA is kept abreast of current and revised SOPs, QAPPs, regulation, and EPA guidance documents (such as, QA Guidance Document 2.12, Monitoring PM2.5 in Ambient Air Using Designated Reference or Class I Equivalent Methods, EPA-454/B-16-001, January 2016). Acts as the designated records custodian for the DHOH, CABAMP. Assigns appropriate staff to train and mentor new hires on the elements and requirements of the quality system. Participates in EPA TSAs. Participates in the annual network review, five-year network assessment, selection, and siting of new or relocated stations, and the annual site surveillance. Oversees the 3-year equipment Replacement Plan. Completes Level 4 Data Validations and approves data for upload to AQS. Has the authority to initiate "Stop Work" emergency meetings to address immediate concerns that could affect data completeness from issues that are causing significant data loss. When absent, an acting supervisor will perform this function. Receives reports and validated data from contracted laboratories and <i>Hawaiian Electric Company</i> (HECO) and assigns appropriate MA staff to review and archive. Oversees Contract Laboratory and HECO quality assurance functions to ensure their proficiency to perform expected task. |
| EHS IV Environmental Health Specialists (EHS), MA | <p>MA EHS staff establishes and maintains Hawaii's ambient air quality network. Responsibilities include:</p> <ul style="list-style-type: none"> Conducts daily data review of all monitoring stations on a rotational basis with other MA EHS to check for NAAQS exceedances and general station operations. Maintains familiarity with CAB QAPP, SOPs, and EPA's Quality Assurance Handbooks and Validation Templates Conducts performance audits of all SLAMS, SPM, and NCORE stations as required by <i>40 CFR Part 58, Appendix A</i>, and on HECO and PGV air sites. |

| Title | Roles and Responsibilities |
|--|--|
| EHS IV (continued) | <ul style="list-style-type: none"> • Some EHS are designated as Data Validation Personnel who complete Level 2 Data Validations for data collected from SLAMS, SPM, and NCORE ambient air monitoring stations prior to data being uploaded to AQS. • Some EHS are designated as Peer Review Personnel who complete Level 3 Data Validations by reviewing Level 2 data validations • Conducts site surveillance of all SLAMS, SPM, and NCORE monitoring stations. • Selects sites for new or relocated stations. • Reviews QA reports and if indicated, submits a Corrective Action Notice to the MA supervisor on QA activity requiring CAB attention, correction, or clarification. • Documents problems and unsatisfactory results, operation or maintenance of ambient monitoring stations and equipment to the MA supervisor. • Conducts data assessments and statistical analyses. • Prepares required reports such as Hawaii Air Quality Data Books, annual trends, permitting, annual network plan, five-year network assessment report and other requested reports for the public, legislature, EPA, and other stakeholders. • Writes pertinent CAB MA SOPs, reviews internally annually, updates as necessary, and provides MA supervisor and CABAMP QAO for review. • Maintains and updates all station files including annual data trend analyses and statistics. • Participates in EPA technical systems audits. • Assists in providing the PASS section with information they need to procure equipment, goods, and services for the CABAMP. • Manages and tracks the certification of all equipment and standards used for performance audits. • Assists with the performances of site operation which includes routine maintenance and Level 1 data verification. • Receives validated data from HECO, then reviews and notifies CAB MA Supervisor if data is okay, Supervisor approves data for upload to AQS by ITS. |
| AQET II Air Quality Electronic Technician (AQET) II, Supervisor Electronic Maintenance & Support Unit (EMSU) | Supervisor for the EMSU staff in the MA Section. Responsibilities include: <ul style="list-style-type: none"> • Supervises the Air Quality Electronic Technician I staff. • Oversees the site preparation and installation of air monitoring stations. • Creates technical specifications for the purchase of equipment and supplies, then provides this information to the PASS section to procure. • Works with management and MA section supervisor to create the 3-year equipment Replacement Plan • Oversees acceptance testing of equipment and gas standards by AQET I personnel. • Manages and tracks the certification of standards and equipment used for site operations. • Participates in writing and updating SOPs for air monitors and accessories. • Maintains accurate inventory records for air monitoring equipment and supplies. • Ensures that the air quality objectives for the CABAMP are properly performed by the AQET staff. • Performs and oversees the design, development, troubleshooting, and repair of electronic equipment. • Guides EMSU staff on field and site issues, provides corrective action recommendations. |

| Title | Roles and Responsibilities |
|--|---|
| AQET II (continued) | <ul style="list-style-type: none"> Monitors quality control activities at air sites, initiates corrective actions as needed. Participates in Technical Systems and Performance Audits conducted by the EPA contractor (NPAP/NPEP). Track service/software contracts and warranties to ensure that they are current or need to be renewed. Ensures that the AQET staff is up to date with QA activities, new regulations, EPA guidance documents, revised SOPs, and the QAPP. Ensures that AQET personnel are up to date with logbooks, QC logs, calibration reports, and maintenance logs on the CAB Operations SharePoint site. Has the authority to initiate "Stop Work" emergency meetings to address immediate concerns that could affect data completeness from issues that are causing significant data loss. When absent, an acting supervisor will perform this function. Oversees CAB <i>Filter Processing Area</i> (FPA) as the intermediate sample custodian where PM_{2.5} filters are received, processed, and mailed by AQET I personnel. Oversees corrective actions for the FPA and AQET I filter handling in the field, per CAB SOPs and this QAPP. Trains AQET I personnel in QA Guidance, Document 2.12, Monitoring PM_{2.5} in Ambient Air Using Designated Reference or Class I Equivalent Methods. |
| AQET I Air Quality Electronic Technicians (AQET) I | <p>AQET staff is part of the EMSU staff in the MA Section. Responsibilities include:</p> <ul style="list-style-type: none"> Installs air monitoring stations at locations specified by CAB MA Supervisor. Installs, operates, maintains, troubleshoots, and repairs equipment that includes, but is not limited to analyzers, calibrators, meteorological sensors, computers, and telecommunication devices. Performs quality control activities at stations, takes corrective actions when necessary. Performs Level 1 data verifications as site operator. Reviews data generated on a daily to weekly basis, verifies that collected data meets the QC criteria defined in the EPA, <i>QA Handbook for Air Pollution Measurements, Volume II, Appendix D</i>. Conducts site preparation for new or relocated monitoring stations, including but not limited to groundwork, meteorological tower installation, security enclosures for monitors, and power/communication cable setups for equipment. Maintains stations in a sanitary, orderly, safe manner and in accordance with any lease or license agreement. Maintains accurate documents and records, such as logbooks, calibration reports, QC logs, and maintenance logs on the CAB Operations SharePoint site. Informs EMSU and CAB MA supervisor of any changes, downtime, or possible impacts to the monitoring stations, such as equipment malfunctions, replacement schedules, and anticipated shutdowns due to repairs. Performs acceptance testing of equipment that is new, repaired, or recertified and gas standards. Maintains familiarity with CAB QAPP, SOPs and EPA's Quality Assurance Handbooks and Validation Templates. Operates the CAB FPA where PM_{2.5} filters used in the FRM monitors are received, processed, and mailed back to contracted laboratories. The FPA is also where COCs, logs, shipping forms, and filter relinquish document are archived. |

| Title | QA Roles and Responsibilities |
|---|--|
| AQET I (continued) | <ul style="list-style-type: none"> Receives exposed filters from the contract laboratory after being archived in cold storage for one year at the contract facility. Continues to store exposed filters, in non-chilled conditions, for an additional four at the CAB FPA. |
| Information Technology Specialist (ITS) | <p>Manages the CABAMP Data Base and uploads to the federal AQS. Responsibilities include:</p> <ul style="list-style-type: none"> Operates and maintains the ambient air <i>Data Acquisition System</i> (DAS) and the Hawaii Ambient Air Quality Data website for collected data. Develops CAB data management SOP. Ensures that information management activities are developed within reasonable time frames for review and approval. Downloads and archives analyzer data for continuous particulate monitors. Follows good, automated data processes including but not limited to, <i>Envista Air Resource Manager</i> (ARM) database maintenance, backups, and data restoration. Coordinates the development of the information management system with data users. Ensures the development of data standards for data structure, entry, transfer, and archiving. Ensures the adherence to CAB QAPP and SOPs, where applicable. Ensures access to data for timely reporting and interpretation. Ensures the development of database structures and user guidance documents. Ensures timely delivery of all required data to EPA's AQS. Communicates with HDOH staff on any AQS reporting errors (e.g. typos, entries in wrong columns, out of range values, completeness of required fields, wrong null codes or flags assigned, and date/time consistency with Time.gov). Assists with maintenance of SharePoint sites under CAB. Tracks software updates needed to maintain the DAS and the Hawaii Ambient Air Quality Data websites. Performs software acceptance testing after initial installation and software updates (works with MA to test calculations for QC tests conducted). Maintains a list of recoveries performed, including the data and software used. Track service/software contracts and warranties to ensure that they are current or need to be renewed. |
| Hawaiian Electric Company (HECO) | <p>Monitor SO₂ emissions for compliance with the EPA SO₂ Data Requirements Rule and provide quality assured data to the CABAMP. Responsibilities include:</p> <ul style="list-style-type: none"> Installs and operates SO₂ SLAMs stations. Collects data on HECO database that is separate from the CAB database. Ensures collected data is consistent with and follows EPA requirements. Reviews, verifies, and validates collected data. Provides validated data and reports to CAB for review and upload to AQS. Manages and tracks the certification of standards and equipment used for HECO site operations. Data is validated by an independent Data Validation Contractor hired by HECO, who validates data prior to release to HDOH CAB. Submits monthly data packages to the HDOH CAB with validated data in a format ready for upload to AQS. |

| Title | QA Roles and Responsibilities |
|------------------------------|---|
| Contract Laboratory: PACE | <p>CAB has a contract with PACE Laboratory. Responsibilities include:</p> <ul style="list-style-type: none"> • Supplies, conditions, and weighs particulate filters for the CABAMP. • Provides gravimetric analysis pre- and post- exposure for PM_{2.5} per 40 CFR 50, 53, and 58. • Serves as the sample custodian of exposed filters once received from CAB. • Archives exposed filters for a minimum of one year at which time CAB is notified and consulted on the disposition of exposed filters. • Approves release of contract laboratory data package to CAB. Data package shall include laboratory QA/QC documentation. • Oversees corrective actions pertaining to contract laboratory activities per PACE QAPP. • Provides analytical results in electronic format (records conditioning humidity, and temperature, notifies of elevated concentrations, and generates results in AQS format). • Generates and delivers data package reports to CAB. • Adheres to PM_{2.5} Filter Based Local Conditions Validation Template, <i>Appendix D, QA Handbook for Air Pollution Measurement Systems, Volume II: Ambient Air Quality Monitoring Program, EPA 454/B-17-001, January 2017</i> (QA Handbook). • Provides shipping containers, chilling agents, and packing material. |

The MA supervisor and QAO are notified in writing of any problems, disputes or other conflicts identified as resulting from QA reviews or audits. Initial notification is in the form of a *Corrective Action Notification* (CAN) which is outlined in *Section C.1.9* of this QAPP. If a CAN is unresolved, the matter is communicated to the CAB Engineering Program Manager, who is the initial mediator. If the issue is still unresolved, the matter is advanced to the *Environmental Management Division* (EMD) Administrator, who is the immediate mediator. For more difficult situations, the final arbitrator in the line of dispute resolution is the Environmental Health Administration, *Deputy Director of Environmental Health* (DDEH).

A.5 Problem Definition/Background and Objectives

In 1970, the federal *Clean Air Act* (CAA) was promulgated as a comprehensive response to address air pollution and created the EPA as the agency responsible for carrying out the law. In 1990, the CAA amendments expanded EPA's authority to implement and enforce air pollution regulation, Title 40 of the *Code of Federal Regulations* (CFR) Part 50 required the EPA to set *National Ambient Air Quality Standards* (NAAQS) for pollutants considered harmful to public health and welfare. This amendment identified six principal pollutants, which are called criteria air pollutants: *particulate matter* (PM), *sulfur dioxide* (SO₂), *carbon monoxide* (CO), *nitrogen dioxide* (NO₂), *ozone* (O₃), and *lead* (Pb). Particulate matter is further broken down into fine and coarse particulates with an aerodynamic diameter of 2.5 (PM_{2.5}) and 10 (PM₁₀) microns, respectively. Additionally, the CAA NAAQS defined two types of standards:

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

The current NAAQS standards listed in *Table A-2* are reviewed periodically and are subject to revision.

40 CFR Part 58 requires that states establish and operate active ambient air quality surveillance systems in a manner that assures the most applicable data of the highest quality is collected. *Appendix A* of *40 CFR Part 58* provides the quality assurance requirements that each monitoring organization must implement to ensure that the data produced will be of the type and quality needed and expected by the data user. The data is used, in part, to support regulatory, research and health decisions and to provide air quality information to the general public.

The ambient air monitoring network is designed for the following purposes:

1. To determine compliance with the NAAQS.
2. To provide the public with timely air quality information.
3. To develop emissions control strategies.
4. To support air pollution research.
5. To prevent or alleviate air pollution episodes by activating emergency control procedures.
6. To track pollution trends throughout the region, including non-urban areas.

For the monitoring network to support the purposes outlined, it is designed with a variety of monitoring site types. The six general monitoring objectives described in *40 CFR Part 58* are to determine:

1. The highest pollutant concentrations to occur in the area covered by the network.
2. Typical concentrations in areas of high population densities.
3. The impact of significant sources or source categories on air quality.
4. General background concentrations.
5. The extent of regional pollutant transport between populated areas.
6. Pollution impacts on visibility, vegetation, crops, animals, and buildings.

Table A-2 National Ambient Air Quality Standards

| Pollutant | | Primary/ Secondary | Averaging Time | Level | Form |
|--|-------------------|-----------------------|-------------------------|-------------------------|---|
| Carbon Monoxide (CO) | | primary | 8 hours | 9 ppm | not to be exceeded more than once per year |
| | | | 1 hour | 35 ppm | |
| Lead (Pb) * | | primary and secondary | Rolling 3-month average | 0.015 µg/m ³ | not to be exceeded * |
| Nitrogen Dioxide (NO ₂) | | primary | 1 hour | 100 ppb | 98 th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| | | primary and secondary | 1 year | 53 ppb | annual mean |
| Ozone (O ₃) | | primary and secondary | 8 hours | 0.070 ppm | annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years |
| Particle Pollution (PM) | PM _{2.5} | primary | 1 year | 12.0 µg/m ³ | annual mean, averaged over 3 years |
| | | secondary | 1 year | 15.0 µg/m ³ | annual mean, averaged over 3 years |
| | | primary and secondary | 24 hours | 35 µg/m ³ | 98 th percentile, averaged over 3 years |
| | PM ₁₀ | primary and secondary | 24 hours | 150 µg/m ³ | not to be exceeded more than once per year on average over 3 years |
| Sulfur Dioxide (SO ₂) | | primary | 1 hour | 75 ppb | 99 th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| | | secondary | 3 hours | 0.5 ppm | not to be exceeded more than once per year |

* The CABAMP no longer monitors for Pb

The State of Hawaii's monitoring network consists of three major categories of monitoring stations, described below:

1. The *State and Local Air Monitoring Stations (SLAMS)* network consists of monitoring stations with the primary purpose of comparison to the NAAQS. They also serve other purposes such as providing real-time air pollution data for the general public, for regulatory decision making and compliance.
2. The *National Core (NCore)* Multi-Pollutant Monitoring Station consists of only one site located in Kapolei. Gas monitors at this site are more sensitive than the standard monitors used at the other sites. Concentrations measured are well below NAAQS but are important in the formation of ozone and particulate matter. As a supplement to NCore, this site also includes *Chemical Speciation Network (CSN)* monitoring. The CSN QAPP, EPA documents *EPA-454/B-19-003 June 2012* and addendum dated *5/15/2014*, have been adopted by the CAB. Details from the CSN QAPP will not be covered extensively in this QAPP, see *Appendix V*.
3. The *Special Purpose Monitoring Stations (SPMS)* network provides data to the State for specific objectives and interests needed to determine air quality trends for selected locations and for responding to public concerns. These are not always permanently established and can be adjusted to accommodate changing needs and priorities.

This QAPP focuses on the QA activities of the **SLAMS**, **NCore**, and **SPMS** network and its objectives. One of the main objectives is to show whether the state is in attainment or nonattainment of the seven criteria pollutants and averaging times listed in *Table A-2* through the ambient air quality monitoring network. Non-attainment of any of the NAAQS

may have regulatory consequences addressed through the air permitting program. Historically, Hawaii has been in attainment of the NAAQS. Summarized data is available at the following website:

<http://health.hawaii.gov/cab/hawaii-air-quality-data-books>

To provide the public with timely air quality information, air pollution data from all continuous monitors at the SLAMS and SPMS are exhibited in near real-time on the HDOH public website at:

<https://health.hawaii.gov/cab/hawaii-ambient-air-quality-data>

According to recent census data, Hawaii's population reached one million people, however, the population has recently decreased to under one million in 2023. This recent development prompts the EPA to expect the HDOH CABAMP to initiate supplemental NCore *Photochemical Assessment Monitoring Stations* (PAMS). A PAMS site measures for Speciated Volatile Organic Compounds, Carbonyls, and Meteorological Parameters that include Mixing Layer Height, per EPA document EPA-454/B-19-003. In time CAB will be expected to adopt the associated QAPP for PAMS or request a waiver due to the low levels of ozone measured.

Additionally, continuous PM_{2.5} and O₃ data are provided to the EPA's AIRNow website for use in calculating the *Air Quality Index* (AQI). All raw feeds of real time data posted to these websites are preliminary and are subject to change. Real-time reporting of data into public websites does not allow any data quality review to take place before being posted. There are disclaimers on the website that indicate that the data is raw and unvalidated. CAB also does not maintain the website. Raw data generated from CAB air sites are eventually reviewed, verified, and validated to ensure that the data meets established quality standards. Errors found in the raw data are flagged and validations are performed prior to releasing final data results into the EPA AQS. Data generated from HECO and PGV are stored on their own databases. These organizations also performed their own data validations. CAB reviews and approves validated HECO data for upload to AQS. PGV data is not uploaded to AQS. HECO and PGV data is NOT merged with CAB data on Envista.

The network includes special purpose monitoring for specific objectives of interest to the state such as:

- To determine air quality trends at selected locations and communities.
- In response to public complaints and concerns and to determine if action is required.

For SPMS using *Federal Reference Methods* (FRM), *Federal Equivalent Methods* (FEM), or *Approved Regional Methods* (ARM) that meet the requirements of *40 CFR Part 58 Appendix E* should follow all the quality assurance criteria contained in *40 CFR Part 58 Appendix A* as well as the data quality and measurement quality objectives as detailed in *Section A.7* of this QAPP.

The special interest objectives for Hawaii include ambient monitoring in communities on: (a) the island of Hawaii that are impacted by sulfur dioxide (SO₂) and fine particulate matter (PM_{2.5}) from Kilauea volcano emissions and, (b) the island of Kauai that are impacted by SO₂ from cruise ship emissions.

Establishing monitoring stations on the outer islands poses unique problems since most of the station operators are on Oahu. There are currently more stations on the outer islands of Kauai, Maui, and Hawaii than there are on Oahu. This poses budget and logistical challenges such as incurring travel expenses; scouting for appropriate site locations that meet our objectives and scale; procuring, installing, and establishing electrical, and communication links; servicing equipment during normal operations; and addressing malfunctions as they occur.

The largest source of air pollution in the state continues to be attributed to the Kilauea volcano on Hawaii Island. When erupting, it produces approximately 3,000 to 6,000 tons of SO₂ per day. The activity has significantly slowed since 2018, resulting in much lower emissions. Volcanic activity ebbs and flows unpredictably, with a recurrence in the winter of 2020. Currently sulfur dioxide and particulate matter readings are fluctuating. During the emergency episodes in 2018 and 2021, HDOH installed additional regulatory monitors. For future episodes, CAB will deploy smaller non-regulatory monitors or sensors. Past experiences exposed the difficulty in establishing new regulatory monitors in a timely fashion due to the logistical problems regarding electrical connections, site preparation, and instrument shelters.

In response to the volcanic events in 2008, CAB collaborated with several federal and state agencies to develop a short-term (15-minute) SO₂ advisory to assist individuals who are impacted by the volcano in making health related decisions (*Appendix VII*). A plan for addressing emergency or contingency monitoring by CAB, including collaborative work with Federal and State agencies' work, is being developed with a January 2025 target date for completion. The data collected from Hawaii Island SO₂ monitors are relayed from the Envista ARM server to the EPA's AirNow contractor Sonoma Technology Inc. who manages the short-term advisory web site at:

<http://www.hiso2index.info>

Currently, most of the SO₂ monitors on the island of Hawaii are programmed to operate at a range of 0 to 1 *part per million* (ppm). A second monitoring range of 1 to 10 ppm was initiated after the 2008 eruption but was discontinued after a few years due to decreased volcanic emissions. This second monitoring range is now intended to be initiated only during periods of heightened volcanic activity. Air monitoring stations on the island of Hawaii are equipped with additional gas standards and analyzers that can measure dual ranges. The second range option can be deployed as part of a contingency/emergency plan. Both monitoring ranges require separate calibrations and audits.

A detailed description, including the location, parameter(s) monitored, operating schedule(s), type of monitoring station, spatial scale(s), purpose(s), and objective(s) of each station in the network is included in *Appendix VI*. Monitoring locations are selected based on the requirements of *40 CFR Part 58, Appendix E* and *Sections A.7.1, B.1.1 and B.1.2* of this QAPP.

This QAPP is to be used by all staff and managers responsible for implementing, designing, and coordinating air quality monitoring in the state. The QAPP is a compilation of QA requirements, procedures, and guidelines that are applicable to air

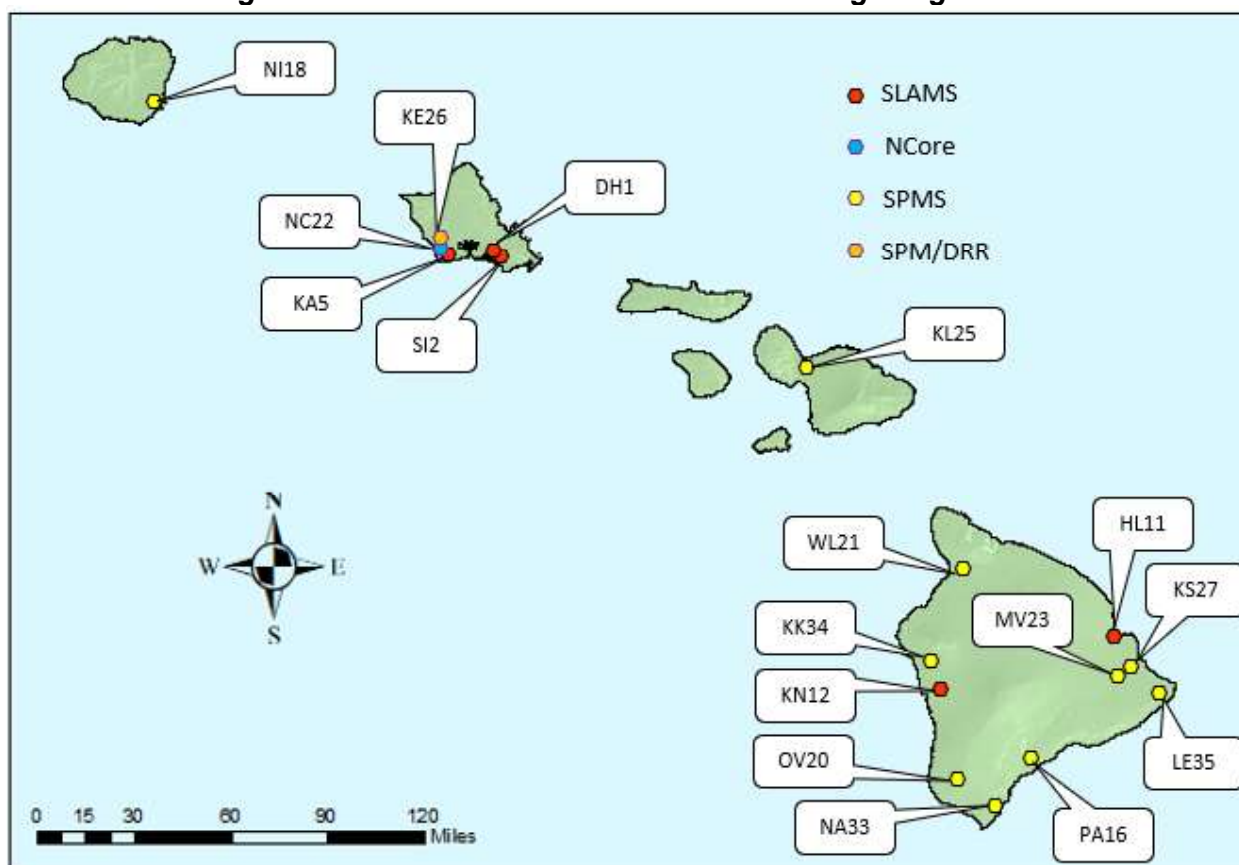
quality measurement systems for the CABAMP. This QAPP is revised every five years or sooner as changes occur (e.g., EPA newly revised policy; monitoring or other equipment change; site additions, etc.). The associated SOPs are reviewed annually for updating by CAB MA personnel. SOPs are written by CAB personnel who are experienced and knowledgeable in procedures. Staff and Supervisors must be in agreement with SOPs prior to implementation.

A.6 Project/Task Description and Schedule

A.6.1 Description of Work Performed

The CABAMP monitors for the criteria pollutants specified in *Section A.5, Table A-2* of this QAPP and for the non-criteria pollutant Hydrogen Sulfide (H₂S). Hawaii's network of air stations consists of three types: *State and Local Monitoring Station (SLAMS)*, *National Core* multipollutant monitoring station (NCore), and *Special Purpose Monitoring Station (SPMS)*. See *Figure A-4* to view stations locations.

Figure A-4 Clean Air Branch Air Monitoring Program Sites



Each station type is described as follows:

- **SLAMS** locations: established primarily to determine compliance with the NAAQS and to meet minimum monitoring requirements set forth in *40 CFR Part 58, Appendix D* but may also serve other data purposes in *Section A.5* of this QAPP. One of the main objectives is to show whether the state is in attainment or non-

attainment of the seven criteria pollutants and averaging times listed in *Table A-2* through the ambient air quality monitoring network. Non-attainment of any of the NAAQS may have regulatory consequences that would have to be addressed through the air permitting program. Historically, Hawaii has been in attainment of the NAAQS. Summarized data is available at:

<https://health.hawaii.gov/cab/hawaii-air-quality-data-books>

- **NCore** location: mandated by the EPA for each state to operate at least one of these sites. This began January 1, 2011. The site in *Kapolei* must measure, at a minimum, PM_{2.5} particle mass (particles with an average aerodynamic diameter of 2.5 micrometers or less) using continuous and integrated/filter-based samplers, speciated PM_{2.5}, PM_{10-2.5} particle mass, SO₂, CO, *Nitrogen Oxide* (NO), reactive *Oxides of Nitrogen* (NO_y), O₃, wind speed, wind direction, relative humidity, and ambient temperature.

On October 17, 2006, as published in the Federal Register, the EPA provided final rule revisions to ambient monitoring regulations as contained in *40 CFR, Parts 53 and 58*. Included in these revised rules are the requirements for establishing NCore sites. These stations are established to support the tracking of long-term trends of criteria and non-criteria pollutants, model evaluation, long-term health and ecosystem assessments, and other scientific and technological studies. The QA requirements for Hawaii's NCore station are covered in this revised QAPP.

- **SPMS** locations: established for specific areas of interest to the state, the results of this monitoring do not count in meeting the minimum monitoring requirements. However, all SPMS use *Federal Reference Methods* (FRM), *Federal Equivalent Methods* (FEM), or Approved Regional Methods (ARM) meet the requirements of *40 CFR Part 58, Appendix E*, and follow all the quality assurance criteria contained in *40 CFR Part 58, Appendix A* as well as the data quality and measurement quality objectives as detailed in *Section A.7*.

There are specific impacts to air quality impacting Hawaii's island communities. Areas of Interest for special purpose monitoring are from sources that are natural and man-made. On the island of Hawaii, SO₂ and PM_{2.5} are monitored due to volcanic emissions, while H₂S is measured due to geothermal activities. The island of Maui established PM monitoring when it was experiencing impacts from agricultural burning caused by the sugar cane industry, however, this practice ended in 2016. Kauai Island started monitoring for NO₂, SO₂, and PM due to concerns with cruise ship emissions.

Several air monitoring stations are privately operated and managed outside the CABAMP network. These private agencies maintain their own records, data validations, and data storage. CAB provides some oversight for some of these agencies by conducting annual performance audits and issuing operating permits. These private agencies include:

- *Hawaiian Electric Company* (HECO) uses a private contractor to measure for SO₂ near their facility in Oahu. CAB-MA audits this site annually. This site is an SPMS/DRR site. See *Section A.4* (page 13), of this QAPP for an explanation of the *Data Rule Requirement* (DRR).

- *Puna Geothermal Venture (PGV)* uses a private contractor to measure for SO₂ & H₂S near their plant in the Puna district, on Hawaii Island. PGV operates under permits issued by CAB and is audited annually by the CAB-MA section.
- *Hawaii Volcano Observatory (HVO)* measure SO₂ and PM emissions in the *Volcanoes National Park*, on Hawaii island. HVO operates independently with no oversight by CAB.

For all three types of monitoring, this QAPP ensures that the CABAMP network has:

- appropriate density, location, and sampling frequency.
- appropriate, accurate and reliable data collecting and recording equipment, procedures, and software.
- acceptable data and report formats, content, management, schedules, and response actions.
- standard operating procedures providing activities and schedules for:
 - equipment operation and preventative maintenance.
 - instrument calibrations, zero/span/precision, and accuracy evaluations.
- a process for establishing assessment criteria and schedules.
- a process for transmitting validated data to the AQS.
- a system to report data to the public in a timely manner.

All continuous ambient air quality data from SLAMS, SPMS, and NCore are displayed on a near real-time basis on the HDOH public website. A disclaimer on the website states that the data is preliminary and unofficial. Since it takes time to poll the monitoring stations, data is normally displayed within one hour after collection. The data may be flagged or invalidated after undergoing the review, verification, and validation process. The HDOH makes every effort to affirm the validity and integrity of the near real-time data, but data can be affected by equipment malfunctions, technical difficulties, and other unforeseen circumstances. This near real-time data is also made available to the EPA AIRNow website for the purpose of calculating the *Air Quality Index (AQI)* for PM_{2.5} and O₃.

A.6.2 Field Activities

The *Electronic Maintenance & Support Unit (EMSU)* personnel are assigned to perform field activities which include installing instruments; conducting QC checks (e.g., one point QC, zero/span for gases, converter efficiency; flow, leak checks for PM); and calibrating, operating, maintaining, troubleshooting, and repairing air monitoring equipment at stations located across the State. This document describes field activities, as well as the roles and responsibilities for specific CAB personnel. The SOPs for these activities are included in *Appendix I* of this QAPP. See *Section A.4* and *Table A-1* for details on tasks performed by CAB-MA personnel.

A.6.3 Laboratory Activities

Laboratory activities for PM_{2.5} FRM filters are currently contracted to PACE Labs, an outside laboratory that prepares and analyzes particulate filters. Filters are received, processed, and mailed back by the CAB at the FPA in Pearl City. The FPA is overseen by the AQET II supervisor and operated by AQET I personnel. CAB station operators are responsible for picking up filters from the FPA, and for installing and retrieving filters at air station(s).

Upon receipt of filters from PACE Labs, *Chain of Custody* (COC) forms are created for each filter. Exposed filters are sent back to the contract laboratory with a *Filter Relinquish & Receipt* Form. Shipment containers are secured with signed and dated custody seals.

A.6.4 Network Description

The ambient air monitoring network for the State of Hawaii is established according to the requirements of *40 CFR 58 Appendix D*. The CAB MA is responsible for ensuring that the network meets or exceeds the minimum EPA monitoring requirements and locates stations to adequately address the purposes and objectives described in *Section A.5*. The criteria, non-criteria, and NCore, pollutants covered in this document; CO, NO₂, O₃, SO₂, PM₁₀, PM_{2.5}, and H₂S are currently monitored at sixteen (16) stations statewide. Monitors in use are as follows:

- CO: one (1) SLAMS and one (1) NCore
- NO₂: one (1) SLAMS
- NO/NO_y: one (1) NCore
- O₃: one (1) SLAMS and one (1) NCore
- SO₂: four (4) SLAMS, seven (7) SPMS, and one (1) NCore
- H₂S: one (1) SPMS
- PM₁₀: two (2) SLAMS
- PM_{2.5}: two (2) SLAMS, nine (9) SPMS, and two (2) NCore

Although Pb is a criteria pollutant, monitoring was discontinued and is no longer part of the CABAMP. Per a letter dated October 29, 2018, EPA approved the discontinuation of the Pb monitoring at the Kapolei NCore station. Pb monitoring was discontinued on December 31, 2018.

Details of the network design, objectives, spatial scales, and specific site locations are described in *Section B.1* of this QAPP.

A.6.5 Project Assessment Techniques

An assessment is an evaluation process to measure the performance or effectiveness of a system and its elements. As used in this document, assessment represents:

- technical systems audits.
- equipment performance audits.
- network reviews and assessments.
- data quality audits, reviews, and assessments.
- inspection or surveillance.

Table A-3 summarizes the assessment schedules and documentation of critical records. The table isolates the required assessments into categories, identifies the responsible agencies, and frequency of tasks. Details of each assessment activity and the specific roles and responsibilities are described in *Section C* of this QAPP.

A.6.6 Project Records

The HDOH maintains procedures for the timely preparation, review, approval, issuance, use, control, revision, and archiving of documents and records. The types of records and documents which are applicable to document control for ambient air quality information are presented in *Table A-3*.

Table A-3 Assessment Schedule and Critical Documents/Records

| Category | Document or Record Type | Responsible Agency | Frequency | Location of Document |
|-------------------------------|--|--------------------|------------------------|--|
| Management and Organization | State implementation plan | CAB | Annually | CAB-Pearl City ³ |
| | Organizational structure | CAB | Annually | CAB-Pearl City ³ |
| | Personnel qualifications, training, and certifications | CAB | Annually | CAB-Pearl City ³ |
| | Applicable EPA regulation | CAB | Annually | CAB-Pearl City ³ |
| | Grant allocations | CAB | Annually | CAB-Pearl City ³ |
| | Contracts | CAB | Annually | CAB-Pearl City ³ |
| | Clean Air Branch Air Monitoring Program, Quality Management Plan (QMP) | CAB | Every 5 years | CAB-Pearl City ³ |
| Site Information | Network descriptions | CAB | Annually | CAB-Pearl City ³ |
| | Site files, maps, descriptions, photos, leases, traffic counts, data trends and statistics | CAB | Annually | CAB-Pearl City ³ |
| Environmental Data Operations | Quality Assurance Project Plans (QAPP) | CAB | Every 5 years | CAB HAMP SharePoint ⁵ |
| | Standard Operating Procedures (SOPs), reviews | CAB | Annually | CAB Operations SharePoint ⁴ |
| | Field logs and laboratory logbooks | CAB | Ongoing | CAB Operations SharePoint ⁴ |
| | Sample handling / Chain of custody records | CAB | Ongoing | CAB Pearl City ³ and CAB Operations SharePoint ⁴ |
| | Inspection / maintenance / repair records / pertinent emails | CAB | Ongoing | CAB Operations SharePoint ⁴ |
| Contract Laboratory | Laboratory Filter Data Reports (with lab QA/QC documentation) | PACE/IML | Monthly/Quarterly | CAB Operations SharePoint ⁴ |
| QC Data & Records | All original routine and quality control data | CAB | Ongoing | CAB Operations SharePoint ⁴ and Dr. DAS backup |
| | Data entry forms | CAB | Ongoing | |
| Raw Data | Primary data logger | CAB | Ongoing | Dr. DAS backup |
| Data Reporting | Data Qualifiers & Null Codes | CAB | Annually | CAB Operations SharePoint ⁴ |
| | Data Reviews | CAB | Daily/Monthly | CAB-Pearl City ³ |
| | Data Validation Reports | CAB/MA | Quarterly | CAB Operations SharePoint ⁴ |
| | Data Certification and Summary | CAB | Annually | CAB-Pearl City ³ |
| | Air Quality Data Book (original & public) | CAB | Annually | CAB-Pearl City ³ |
| | Network Plan (original & public) | CAB | Annually | CAB-Pearl City ³ |
| | Network Assessment (original & public) | CAB | Every 5 years | CAB-Pearl City ³ |
| | Exceptional Events Document (original & public) | CAB | Annually | CAB HAMP SharePoint ⁵ |
| | Annual Reports on Campbell Industrial Park | CAB | Annually | CAB-Pearl City ³ |
| Data Management | Data Management Records | CAB | Annually | CAB HAMP SharePoint ⁵ |
| | Air Monitoring Data and Algorithms | CAB | Per Software Updates | CAB HAMP SharePoint ⁵ |
| Quality Assurance | Control Charts | CAB | Annually | CAB-Pearl City ³ |
| | Network Reviews | CAB | Annually | CAB-Pearl City ³ |
| | Data Quality Assessments | CAB | Annually | CAB-Pearl City ³ |
| | Technical System Audits | EPA Region 9 | Every 3 years | CAB HAMP SharePoint ⁵ |
| | Independent System Audits | CAB | Every 18 months | CAB HAMP SharePoint ⁵ |
| | National Performance Audits ^{1,2} | EPA Region 9 | Annually | CAB HAMP SharePoint ⁵ |
| | Performance Audits (in house) | CAB | Bi-Annually & Annually | CAB HAMP SharePoint ⁵ |
| | Site Surveillance Reports | CAB | Annually | CAB HAMP SharePoint ⁵ |
| | Data Quality Audits | EPA Region 9 | Every 3 years | CAB HAMP SharePoint ⁵ |
| | Corrective Action Reports | CAB | Ongoing | CAB HAMP SharePoint ⁵ |

¹ EPA's National Performance Audit Program (NPAP) audits 20% of the gaseous pollutant monitors annually such that all monitors are audited every 5-7 years. The PM_{2.5} Performance Evaluation Program (PEP) is required to audit eight sites annually (for Hawaii).

² Three (3) years of data are needed to determine compliance with NAAQS

³ CAB-Pearl City located documents are hardcopies that become available electronically over time.

⁴ CAB Operations SharePoint: <https://www.doh.hawaii.gov/sites/eha/sld/air/default.aspx>

⁵ CAB HAMP (Hawaii Air Monitoring Program) SharePoint: <http://www.doh.hawaii.gov/sites/eha/emd/CAB/HAMP/default.aspx>

A.7 Quality Objectives and Criteria for Measurement Data

A.7.1 Data Quality Objectives

Data collected in the CABAMP may be used for decision-making purposes that could have an economic impact on the area represented by the data.

Data Quality Objectives (DQO) are qualitative and quantitative statements that:

- clarify the intended use of the data.
- define the type of data needed.
- determine the most appropriate conditions to collect the information.
- specify the tolerable limits on the probability of making a decision error due to uncertainty in the data.

The DQOs ensure that the type, quantity, and quality of collected data meet the objectives of the network as stated in Section A of this QAPP.

In general, the goal of the CABAMP is to:

- determine the highest concentration expected to occur in the area covered by the network.
- determine representative concentrations in areas of high population density.
- determine the impact on ambient pollution levels of significant sources or source categories.
- determine the general background concentration levels.
- determine the extent of regional pollutant transport among populated areas, and in support of secondary standards.
- determine the welfare-related impacts in rural and remote areas, such as visibility impairment and effects on vegetation.

A.7.1.1 Intended Uses of Data

Data collected is used to:

- establish baseline concentrations of natural and anthropogenic air pollutants.
- monitor the current concentrations of these air pollutants and provide near real-time reporting of data to the public.
- evaluate compliance with the NAAQS.
- activate emergency control procedures that prevent or alleviate air pollution episodes.
- provide short-term SO₂ health advisory levels for Hawaii Island.
- provide data upon which long term control strategies can be reliably developed.
- track pollution trends throughout the state.
- provide background concentrations in air models to determine if a proposed source being permitted would operate in compliance with the NAAQS.
- provide a database for researching and evaluating effects of air pollution.
- provide near real-time reporting of data to the public at the following website:

<https://health.hawaii.gov/cab/hawaii-ambient-air-quality-data>

(Data presented on this website is preliminary and subject to change after validation and verification).

- provide near real-time short term (15-minute) SO₂ advisory levels to inform the public of possible health implications from exposure to volcanic emissions at the following website:

<http://www.hiso2index.info>

A.7.1.2 Type of Data Needed

The data compiled is a combination of meteorological and pollutant data. The criteria pollutants, established by EPA, are particulate matter (PM_{2.5} and PM₁₀), SO₂, CO, NO₂, and O₃, are monitored at designated SLAMS and SPM sites. The pollutant concentrations to be measured and meteorological parameters monitored at our NCore station is required by EPA and includes PM_{2.5} particulate mass using continuous and filter-based samplers, speciated PM_{2.5}, PM_{10-2.5} particulate mass, SO₂, CO, nitrogen oxides NO/NO_y, O₃, wind speed, wind direction, relative humidity, and ambient temperature. Additionally, Hawaii has a *State Ambient Air Quality Standard* for H₂S. Specific information on the sampling design including identifying appropriate locations for each pollutant is presented in *Section B* of this QAPP.

A.7.1.3 Tolerable Error Limits

EPA document QA/G-4, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, specifies tolerable limits on the probability to make decision errors due to uncertainty in the data. Particularly, limits on the probability of false positive or false negative errors. A false positive error is encountered when the data indicates that a standard has been exceeded when in fact, due to errors in data, it has not been exceeded. Alternately, a false negative error is encountered when the data indicates that no standard has been exceeded when in fact, due to errors in data, a standard has been exceeded. Utilizing the DQO process, the HDOH can determine the objectives regarding the quality of the ambient air measurement system to control precision and bias to reduce the probability of decision errors.

A.7.1.4 General Data Quality Objectives

The following are DQOs that apply to all data collected in the CABAMP:

- All data shall be traceable to a *National Institute of Science and Technology* (NIST) primary standard. Traceable standards are used to verify monitoring equipment. Standards used are purchased and recertified by vendors with accredited NIST-traceable calibration processes. There are two levels of standards: *Primary* (Level 1) and *Transfer* (Level 2). The calibration certificates for these standard levels are retained as part of the quality control documentation process. When transfer standards are received from vendors, they are verified against CAB standards. Verification results are archived for QC tracking and to document standard performance history. Standard types used include the following:
 - Level 2 Ozone generator/calibrator: certified annually by NIST traceable/certified using Level 1 Ozone standard.
 - Temperature, pressure, and flow standard: certified annually by vendors that provide certificates of traceability for NIST standards.
- All data shall be of a known and documented quality. Two major measurements used to define quality are precision and bias. Audits and Calibrations are conducted using *Primary* standards. Precision and bias goals

are met by performing *Quality Control* (QC) checks, which are performed in between audits and calibrations.

- All data shall be comparable by producing data in a similar and scientific manner by using standard FRM, FEM, ARM and EPA accepted analytical methods for sampling, calibrating, analysis, auditing, etc. (see *Table 4*).

Table A-4: CABAMP Criteria, NCore, & Non-Criteria Pollutant Network of Analyzers

| Pollutant | Analyzer | EPA Reference or Equivalent | Type | Method Code | MDL ¹ |
|------------------------------|------------------------|-----------------------------|--------------|-------------|-------------------------|
| Nitrogen Dioxide | TAPI: T500U | FEM, EQNA-0514-212 | Criteria | 212 | 0.04 ppb |
| Oxides of Nitrogen | TEI: 42i-Y | FRM, RFNA-1289-074 | NCore | 574 | 0.05 ppb |
| Ozone | TEI: 49i, 49iQ | FEM, EQOA-0880-047 | Criteria | 047 | 5.0 ppb |
| Sulfur Dioxide | TEI: 43i, 43iQ | FEM, EQSA-0486-060 | Criteria | 060 | 2 ppb |
| | TEI: 43i TLE, 43iQ TLE | FEM, EQSA-0486-060 | NCore | 560 | 0.2 ppb |
| Carbon Monoxide | TAPI: T300 | FRM, RFCA-1093-093 | Criteria | 093 | 0.5 ppm |
| | TAPI: M300EU | FRM, RFCA-1093-093 | NCore | 593 | 0.02 ppm |
| | TEI: 48iQTL | FRM, RFCA-0981-054 | NCore | 554 | 0.02 ppm |
| Hydrogen Sulfide | TEI: 450iQ | n/a | Non-Criteria | n/a | 2 ppb |
| *PM ₁₀ | TAPI: T640X | FRM, EQPM-0516-239 | NCore | 239 | 0.1 µg/m ³ |
| **PM _{2.5} | Met One: BAM 1022 | FEM, EQPM-1013-209 | Criteria | 209 | 5 µg/m ³ |
| | TAPI: T640 | FEM, EQPM-0516-236 | NCore | 236/545 | 0.1 µg/m ³ |
| | TAPI: T640X | FEM, EQPM-0516-238 | NCore | 238/545 | 0.1 µg/m ³ |
| | BGI: PQ200 | FRM, RFPS-0498-116 | Criteria | 116 | 2 µg/m ³ |
| | Met One: E-SEQ-FRM | EQPM, RFPS-0717-245 | NCore | 245/545 | 2 µg/m ³ |
| **PM _{10-2.5} | TAPI: T640X | FEM, EQPM-0516-240 | NCore | 540 | 0.1 µg/m ³ |
| PM _{2.5} speciation | Met One: Super SASS | n/a, non-criteria pollutant | NCore/CSN | 811/812 | n/a |
| | URG: 3000N | n/a, non-criteria pollutant | NCore/CSN | 838 | 0.002 µg/m ³ |

* Reported in standard temperature and pressure

** Reported in ambient conditions

¹ Multiply MDL by 2 or 3 times to calculate Audit Levels.

- All data shall be representative of the parameters being measured with respect to time, location, and the conditions from which the data are obtained. See DQOs for parameters (*40 CFR Part 58, Appendix A, Section 2.3*).
- For PM_{2.5} and PM₁₀, the measurement uncertainty for automated and manual methods is defined for precision as an upper 90 percent confidence limit for the *coefficient of variation* (CV) of 10 percent and +/-10 percent total bias. Additionally, PM_{2.5} results are reported in ambient conditions, while PM₁₀ is in standard, temperature, and pressure.
- For SO₂ and CO, the acceptable measurement uncertainty for precision is defined as an upper ninety (90) percent confidence limit for the CV of ten (10) percent and for bias as an upper ninety-five (95) percent confidence limit for the absolute bias of ten (10) percent.
- For O₃, the acceptable measurement uncertainty is defined for precision as an upper ninety (90) percent confidence limit for the CV of seven (7) percent and for bias as an upper ninety-five (95) percent confidence limit for the absolute bias of seven (7) percent.
- For NO₂, the acceptable measurement uncertainty is defined for precision as an upper ninety (90) percent confidence limit for the CV of fifteen (15) percent and for bias as an upper ninety-five (95) percent confidence limit for the absolute bias of fifteen (15) percent.

- For NCore, the site must measure, at minimum, PM_{2.5} using continuous and filter-based samplers, speciated PM_{2.5}, PM_{10-2.5}, O₃, SO₂, CO, NO/NO_y, WS, WD, RH, and ambient temperature. These parameters will follow the same measurement uncertainties specified for the respective standard parameters.
- For H₂S (state standard), the measurement uncertainty shall follow what is specified for SO₂. This is a non-criteria pollutant that is being monitored by CAB to ensure permit compliance by PGV on Hawaii Island.
- This QAPP must be dynamic and updated to continue to achieve its stated goals as techniques, systems, concepts, and project goals change.

A.7.2 Measurement Quality Objectives

The quality of the data is evaluated and controlled to ensure that it is maintained within the established acceptance criteria and meets the DQOs. *Measurement Quality Objectives* (MQOs) are designed to evaluate and control various phases of the measurement process (e.g., sampling, transportation, preparation, and analysis) to ensure that total measurement uncertainty is within the range prescribed by the DQOs.

MQOs are defined in terms of *Data Quality Indicators* (DQIs). DQIs describe the framework for ensuring that data are of known quality and available in a timely manner to meet the DQOs. The DQIs are precision, bias, comparability, representativeness, completeness, and sensitivity. The MQOs are defined in terms of the following DQIs:

- Precision: According to *EPA QA/G-5, Appendix D*, “Precision is a measure of agreement between two replicate measurements of the same property, under prescribed similar conditions. This agreement is calculated as either the range or as the standard deviation.” This is the random component of error.
- Bias: According to *EPA QA/G-5, Appendix D*, “Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction.” Bias is determined by estimating the positive and negative deviation from the true value as a percentage of the true value.
- Comparability: According to *EPA QA/G-5, Appendix D*, “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, in regard, to the measurement of a specific variable or groups of variables.”
- Representativeness: According to *EPA QA/G-5, Appendix D*, “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 should be evaluated to determine whether in situ or other measurements are made and physical samples collected in such a manner that the resulting data appropriately reflect the media and phenomenon measured or studied.”

- Completeness: Completeness is a metric quantifying the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct, normal conditions. Completeness can be expressed as a ratio or a percentage. Data completeness requirements are included in the reference methods in *40 CFR Part 50*.
- Sensitivity: Sensitivity is the capability of a method or instrument to discriminate between small differences in analyte concentration with a defined degree of confidence. The sensitivity indicators of primary interest relate to the limits of detection and quantitation because they describe the inherent limitations of the data being reported by the field and laboratory instruments. This QAPP provides sensitivity requirements for each field and laboratory instrument.

For each of these indicators, acceptance criteria have been developed using various parts of 40 CFR 50 and 58 and EPA guidance documents. Detailed descriptions are included in each of the CAB SOPs (*Appendix I*). MQO tables for the criteria and NCore pollutants, described in *Tables A-5 to A-15* of this QAPP and included in *Appendix VIII* are now known as validation templates.

In June 1998, a workgroup of QA personnel from the monitoring organizations, EPA Regional Offices, and EPA's *Office of Air Quality Planning and Standards* (OAQPS) was formed to develop a procedure that could be used by all monitoring organizations to ensure consistent use of MQOs and the validation of the criteria pollutants across the country. The workgroup developed three tables of criteria which are now incorporated into the validation templates shown in *Appendix VIII*.

- Critical Criteria Table: These criteria are deemed *must meet* and are critical to maintaining the integrity of a sample, group of samples, or ambient air concentration value. Observations that do not meet each and every criterion on the critical table are invalidated unless there are compelling reasons and justifications for not doing so. Basically, the sample, group of samples, or value(s) for which one or more of these criteria are not met is invalid until proven otherwise.
- Operational Criteria Table: These are criteria indicating there *might* be a problem with data quality and if any criterion is not met it may be cause for invalidation. The data validators in CAB consider operational quality control information that may or may not indicate whether the samples or values are acceptable. Therefore, the data for which one or more of these criteria are not met is suspect unless other quality control information demonstrates otherwise. The reason for not meeting the criteria is investigated, mitigated, or justified.
- Systemic Criteria Table: These are criteria which are important for correct interpretation of the data but do not necessarily impact the validity of a sample or value. DQOs are included in this table and if they are not met it does not invalidate the sample or value but may indicate a systematic problem with the data collection activity that may in turn impact the ability to make appropriate decisions based on the data.

The following *Tables A-5 through A-15* follow the criteria outlined in the *QA Handbook, Volume II*, for *Ambient Air Quality Monitoring Program, Appendix D*.

Table A-5: DQI and MQO for CO, Criteria and NCore Trace

| Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|--|---|---|--|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | 40 CFR Part 58, App D |
| Completeness | 8- hour standard | 75% of hourly averages for the 8-hour period | 1) 40 CFR Part 50.8 (c) 2) 40 CFR Part 50.8 (a- 2) 3) 40 CFR Part 50.8 (c) |
| Comparability | All data | Use of FRM/FEM instrumentation and NPAP audits | 40 CFR Part 58, App A |
| Sensitivity Lower Detectable Limit | Every 365 days and 1/calendar year | ≤ 0.4 ppm (standard range) ≤ 0.2 ppm (lower range) | 1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1 |
| Precision and Bias One point QC Check Single Analyzer | Every 14 days | $< \pm 10.1\%$ (percent difference) | 1 and 2) 40 CFR Part 58, App A., Sec 3.1 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec. 2.3.1. QC Check range 0.5 – 5 ppm |
| Zero/Span Check | Every 14 days | <ul style="list-style-type: none"> Zero drift $< \pm 0.41$ ppm (24 hour) Zero drift $< \pm 0.61$ ppm (> 24 hr.- 14 days) Span Drift $\leq \pm 10.1\%$ | 1 and 2) <u>QA Handbook Volume 2</u> Sec. 12.3 3) Recommendation |
| Analyzer Calibration Multi-point Calibration (at least 5 points) | <ul style="list-style-type: none"> Upon receipt / adjustment / repair / installation / moving Every 182 days and 2/calendar year if manual zero/span performed biweekly Every 365 days and 1/calendar year if continuous zero/span performed daily | <ul style="list-style-type: none"> All points $< \pm 2.1\%$ or $\leq \pm 0.03$ ppm difference of best fit straight line, whichever is greater and Slope $1.0 \pm .05$ | 1) 40 CFR Part 50, Appendix C, Section 4 2 and 3) Recommendation See details about CO2 sensitive instruments multi-point calibration. (0 and 4 upscale points) Slope criteria is a recommendation |
| Bias Annual Performance Evaluation Single analyzer | Every site every 365 days 1/calendar year | <ul style="list-style-type: none"> Percent difference of audit levels 3-10 $\leq \pm 15.1\%$ Audit levels 1 & 2 $< \pm 0.031$ ppm difference or $\pm 15.1\%$ | 1 and 2) 40 CFR Part 58, App A, Sec. 3.1.2 3) Recommendation- 3-audit concentrations not including zero. <u>AMTIC Technical Memo</u> |
| Bias Audits (NPAP) | 20% of sites audited in a calendar year | <ul style="list-style-type: none"> Audit levels 1&2 ± 0.031 ppm difference All other levels percent difference $< \pm 15.1\%$ | 1 and 2) 40 CFR Part 58, App. A, Sec/ 3.1.3 3) NPAP QAPP/SOP |

Table A-6: DQI and MQO for NO₂, NO_x, NO

| Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|--|--|--|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | 40 CFR Part 58, App D |
| Completeness | Annual Standard | ≥75% hours in year | 1) 40 CFR Part 50 App S Sec. 3.1(b) 2) 40 CFR Part 50 App S Sec. 3.1(a) 3) 40 CFR Part 50 App S Sec. 3.1(b) |
| | 1-hour standard | <ul style="list-style-type: none"> • 3 consecutive calendar years of complete data • 4 quarters complete each year. • ≥75% sampling days in quarter • ≥75% of hours in a day | 1) 40 CFR Part 50 App S Sec. 3.2(b) 2) 40 CFR Part 50 App S Sec. 3.2(a) 3) 40 CFR Part 50 App S Sec. 3.2(b) More details in 40 CFR Part 50 App S |
| Comparability | All data | Use of FRM/FEM instrumentation and NPAP audits | 40 CFR Part 58, App A |
| Sensitivity Lower Detectable Limit | Every 365 days and 1/calendar year | ≤ 0.01 ppm | 1) Part 53.23 (c) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1 |
| Precision and Bias One point QC Check Single Analyzer | Every 14 days | < ±15.1% (percent difference) or < ±1.5 ppb difference whichever is greater | 1 and 2) <u>40 CFR Part 58 App A, Sec 3.1.1</u> 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec 2.3.1.5 QC Check Conc range 0.005 – 0.08 ppm and 05/05/2016 <u>Technical Note on AMTIC</u> |
| Zero/Span Check | Every 14 days | Zero drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24 hr-14 day) Span Drift < ±10.1% | 1 and 2) <u>QA Handbook Volume 2 Sec. 12.3</u> 3) Recommendation and related to DQO |
| Converter Efficiency NO _y (non-CAPS analyzer, Oxides of Nitrogen, TEI 42i-y, FRM, RFNA-1289-74) | During multi-point calibrations, span, and audit. Every 14 days | (≥ 96%) 96% - 104.1 % | 1) 40 CFR Part 50 App F Sec. 1.5.10 and 2.4.10 2) Recommendation 3) 40 CFR Part 50 App F Sec. 1.5.10 and 2.4.10 Regulation states ≥ 96%, 96 - 104.1% is a recommendation |
| Analyzer Calibration Multi-point Calibration (at least 5 points) | <ul style="list-style-type: none"> • Upon receipt/ adjustment/ repair/ installation/ moving • Every 182 days and 2/calendar year if manual zero/span performed biweekly. • Every 365 days and 1/calendar year if continuous zero/span performed daily | <ul style="list-style-type: none"> • Instrument residence time ≤ 2 min • Dynamic parameters ≥ 2.75 ppm-min • All points within < ± 2.1% or ≤ ± 1.5 ppb difference of best fit straight line whichever is greater and slope = 1.0 ± .05 | 1) 40 CFR Part 50 App F 2 and 3) Recommendation Multi-point calibration (0 and 4 upscale points) Slope criteria is a recommendation |
| Bias Annual Performance Evaluation Single Analyzer | Every site every 365 days and 1/calendar year | <ul style="list-style-type: none"> • Percent difference of audit levels 3-10 < ± 15.1% • Audit levels 1&2 < ±1.5 ppb difference or < ±15.1% | 1) 40 CFR Part 58 App A Sec 3.1.2 2) 40 CFR Part 58 App A sec 3.1.2 3) Recommendation – 3-audit concentrations not including zero. <u>AMTIC Technical Memo</u> |
| Bias Audits (NPAP) | 20% of sites audited in calendar year | <ul style="list-style-type: none"> • Audit levels 1&2 < ±1.5 ppb difference • all other levels percent difference < ±15.1% | 1&2) 40 CFR Part 58 App A Sec 3.1.3 3) NPAP QAPP/SOP |

Table A-7: DQI and MQO for O₃

| Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|--|---|--|--|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | 40 CFR Part 58, App D |
| Completeness | 3- year comparison | ≥ 90% (avg.) daily max available in ozone season with min of 75% in any one year | 1,2,3) 40 CFR Part 50 App. U Sec 4(b) |
| | 8- hour average | ≥ if at least 6 of the hourly concentrations for the 8- hour period is available. | 1) 40 CFR Part 50, App. U 2 and 3) 40 CFR Part 50 App U, Sec 3(b) |
| | Valid Daily Max | ≥ If valid 8- hour averages are available for at least 13 of the 17 consecutive 8- hour periods stating from 7:00 a.m. to 11:00 p.m. | 1) 40 CFR Part 50 App U 2 and 3) 40 CFR Part U Sec 3(d) |
| Comparability | All data | Use of FRM/FEM instrumentation and NPAP audits | 40 CFR Part 58, App A |
| Sensitivity Lower Detectable Limit | Every 365 days and 1/calendar year | ≤ 0.005 ppm (standard range) ≤ 0.002 ppm (lower range) | 1) 40 CFR Part 53.23 (b) (definition & procedure) 2) Recommendation 3) 40 CFR Part 53.20 Table B-1 |
| Precision and Bias One point QC check Single Analyzer | Every 14 days | < ± 7.1% (percent diff.) or < ± 1.5 ppb difference whichever is greater | 1 and 2) <u>40 CFR Part 58 App A, Sec 3.1</u> 2) Recommendation based on DQO in 40 CFR Part 58 App A, Sec 2.3.1.2 QC Check Conc. range 0.005 – 0.08 ppm and 05/05/2016 <u>Technical Note on AMTIC</u> |
| Zero/Span Check | Every 14 days | Zero drift < ± 3.1 ppb (24 hr) < ± 5.1 ppb (>24 hr-14 day) Span Drift < ± 7.1% | 1 and 2) <u>QA Handbook Volume 2 Sec 12.3</u> 3) recommendation and related to DQO |
| Analyzer Calibration Multipoint Calibration (at least 5 points) | <ul style="list-style-type: none"> • Upon receipt/adjustment /repair/installation/ moving and repair and recalibration of standard of higher level • Every 182 days and 2/calendar year if manual zero/span performed biweekly. • Every 365 days and 1/calendar year if continuous zero/span performed daily | All points < ± 2.1% or < ± 1.5 ppb difference of best fit straight line whichever is greater and slope 1 ± .05 | 1) 40 CFR Part 50 App D 2) Recommendation 3) 40 CFR Part 50 App D, Sec 4.5.5.6 Multi-point calibration (0 and 4 upscale point) Slope criteria is a recommendation |
| Bias Annual Performance Evaluation Single Analyzer | Every site every 365 days and 1/calendar year within period of monitor operation | <ul style="list-style-type: none"> • Percent difference of audit levels 3-10 < ± 15.1% • Audit levels 1 & 2 < ± 1.5 ppb difference or < ± 15.1% | 1 and 2) Part 58, App. A Sec. 3.1.2 3) Recommendation- 3-audit concentrations not including zero. AMTIC guidance 2/17/2011 <u>AMTIC Technical Memo</u> |

Table A-7 (continued) Data Quality Indicators and Measurement Quality Objectives, O₃

| Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|---|---|---|--|
| Bias Audits (NPAP) | 20% of sites audited in calendar year | <ul style="list-style-type: none"> Audit levels 1&2 < ± 1.5 ppb difference all other levels percent difference < $\pm 10.1\%$ | 1 and 2) 40 CFR Part 58, App A Sec 3.1.3 3) NPAP QAPP/SOP |
| Calibration & Audit Standards Standard Reference Photometer (Level 1) | Every 365 days and 1/calendar year | Single point difference < $\pm 3.1\%$ | 1) 40 CFR Part 50 APP D Sec 5.4 2 and 3) Transfer Standard for Calibration of Air Monitoring Analyzers for Ozone. <i>Technical Assistance Documents</i> (TAD), October 2013, EPA-454/B-13-004 Level 2 standard (formerly called primary standard) usually transported to EPA Regions SRP for comparison) |
| Level 2 and Greater Transfer Standard Precision | Every 365 days and 1/calendar year | Standard deviation less than 0.005 ppm or 3.0% whichever is greater | 1) 40 CFR Part 50 Appendix D Sec 3.1 2) Recommendation, part of verification 3) 40 CFR Part 5 Appendix D Sec 3.1 |
| (If recertified via a transfer standard) | Every 365 days and 1/calendar year | Regression slopes = 1.00 ± 0.03 and two intercepts are 0 ± 3 ppb | 1, 2 & 3) Transfer Standard Guidance EPA-545/B-10-001 |
| Ozone Transfer Standard (Level 3 and greater) | | | |
| Qualification | Upon receipt of transfer standard | < $\pm 4.1\%$ or < ± 4 ppb (whichever greater) | 1, 2 and 3) Transfer Standard Guidance EPA-545/B-10-001 |
| Certification | After qualification and upon receipt / adjustment / repair | RSD of six slopes ≤ 3.7 Std. Dev. of 6 intercepts ≤ 1.5 | 1, 2 and 3) Transfer Standard Guidance EPA-545/B-10-001 1 |
| Recertification to higher level standard | Beginning and end of O ₃ season or every 182 days and 2/calendar year whichever less | New slope = ± 0.05 of previous and RSD of six slopes $\leq 3.7\%$ Std. Dev. of 6 intercepts ≤ 1.5 | 1, 2 and 3) Transfer Standard Guidance EPA-545/B-10-001 recertification test that then gets added to the most recent 5 tests. If does not meet acceptability certification fails |

Table A-8: DQI and MQO for SO₂, Criteria and NCore Trace

| Requirement | Frequency | Acceptance Criteria | Reference |
|--|---|--|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | 40 CFR Part 58, App D |
| Completeness | 1 hour standard | Hour – 75% of hour | 1,2 and 3) 40 CFR Part 50 App T Sec 3 (b), (c) More details in CFR on acceptable completeness 5-min values or 5-min max values (40 CFR part 58.16 (g)) only reported for the valid portions of the hour reported. If the hour is incomplete no 5-min or 5-min max reported. |
| | | Day – 75% of hourly concentration | |
| | | Quarter – 75% complete days | |
| | | Years – 4 complete quarters | |
| | | 5 min value reported only for valid hours | |
| Comparability | All data | Use of FRM/FEM instrumentation and NPAP audits | 40 CFR Part 58, App A |
| Sensitivity Lower Detectable Limit | Every 365 days and 1/calendar year | ≤ 0.002 ppm (standard range) ≤ 0.001 ppm (lower range) | 1) 40 CFR Part 53.23 (c) (definition & procedure) 2) Recommendation- info can be obtained from LDL 3) 40 CFR Part 53.20 Table B-1 |
| Precision and Bias One point QC check Single Analyzer | Every 14 days | < ± 10.1% (percent difference) or < ± 1.5 ppb difference whichever is greater | 1 and 2) <u>40 CFR Part 58 App A Sec 3.1.1</u> 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec 2.3.1.2 QC Check Conc. range 0.005 - 0.08 ppm and 05/05/2016 <u>Technical Note on AMTIC</u> |
| Zero/Span Check | Every 14 days | Zero drift < ± 3.1 ppb (24 hour) < ± 5.1 ppb (>24 hour- 14 days) Span drift < ± 10.1% | 1 and 2) <u>QA Handbook Volume 2</u> Sec 12.3 3) Recommendation and related to DQO |
| Analyzer Calibration Multi-point Calibration (at least 5 points) | <ul style="list-style-type: none"> Upon receipt/adjustment/repair/installation/moving Every 182 days and 2/calendar year if manual zero/span performed biweekly Every 365 days and 1/calendar year if continuous zero/span performed daily | All points < ± 2.1% or < ± 1.5 ppb difference of best fit straight line whichever is greater and slope 1 ± .05 | 1) 40 CFR Part 50 App A-1 Sec 4 2 and 3) Recommendation Multi-point calibration (0 and 4 upscale point) Slope criteria is a recommendation |
| Bias Annual Performance Evaluation Single Analyzer | Every site every 365 days and 1/calendar year | <ul style="list-style-type: none"> Percent difference of audit levels 3-10 < ± 15% Audit levels 1&2 < ± 1.5 ppb difference or < ± 15.1% | 1 and 2) 40 CFR 58 App A, Sec 3.1.2 3) Recommendation- 3-audit concentrations not including zero <u>AMTIC Technical Memo</u> |
| Bias Audits (NPAP) | 20% of sites audited in calendar year | <ul style="list-style-type: none"> Audit levels 1&2 < ± 1.5 ppb difference all other levels percent difference < ± 15% | 1 and 2) 40 CFR Part 58 App A Sec 3.1.3 3) NPAP QAPP/SOP |

Table A-9: DQI and MQO for PM_{2.5} Continuous

| Requirement | Frequency | Acceptance Criteria | Reference |
|--|---|---|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | 40 CFR Part 58, App D |
| Completeness (FB & Continuous) | <ul style="list-style-type: none"> Annual Standard 24-hour Standard | ≥ 75% scheduled sampling days in each quarter | 1,2 and 3) 40 CFR Part 50 App N Sec 4.1 (b) and 4.2 (a) |
| Comparability | All data | Use of FEM instrumentation and PEP audits | 40 CFR Part 58, App A |
| Sensitivity Lower Detection Limit | All data | ≤ 2 µg/m ³ | 40 CFR Part 50, App L, Sec 3.1 |
| Precision Collocated Samples (FB) | Every 12 days for 15% of sites by method designation (CAB will conduct 1 in 3 rather than 1 in 12) | CV < 10.1% of samples ≥ 3.0 µg/m ³ | 1 and 2) 40 CFR Part 58 App A Sec 3.2.3 3) Recommendation based DQO in 40 CFR Part 58 App A Sec 2.3.1.1 |
| Bias One Point Flow Rate Verification | Every 30 days each separated by 14 days | <ul style="list-style-type: none"> < ± 4.1% of transfer standard < ± 5.1% of flow rate design value | 1.2 and 3) 40 CFR Part 50 App L Sec 9.2.5 and 40 CFR Part 58 App A Sec 3.2.3 & 3.3.2 |
| Flow-Rate Multi-point Verification/Calibration (FB & Continuous) | Electromechanical maintenance or transport or every 365 days and 1/calendar year | < ± 2.1% of transfer standard | 1) 40 CFR Part 50 App L Sec 9.2 2) 40 CFR Part 50 App L Sec 9.1.3 Method 2.12 Sec 6.3 & Table 6-1 3) Recommendation |
| Bias Semi-Annual Flow Rate Audit (FB & Continuous) | Twice a calendar year and between 5-7 months apart | <ul style="list-style-type: none"> ±4% of transfer standard ±5% of design flow rate | 1 and 2) Part 58, App A Sec 3.3.3 3) Method 2.12 Sec 11.2.1 |
| Bias Audits (PEP) | For PQAOs: <ul style="list-style-type: none"> 5 Audits for ≤ 5 sites 8 Audits for > 5 sites | < ± 10.1% for value > 3 µg/m ³ | 1, 2 and 3) 40 CFR Part 58 App A Sec 3.2.7, 4.3.2 and 2.3.1.1 |

Table A-10: DQI and MQO for PM₁₀ Continuous STP¹ Conditions

| Requirement | Frequency | Acceptance Criteria | Reference |
|--|---|--|--|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | 40 CFR Part 58, App D |
| Completeness | 24-hour Quarterly | ≥ 75% | 1,2 and 3) 40 CFR Part 50 App K Sec 2.3 (b & c) |
| Comparability | All data | Use of FRM/FEM instrumentation | 40 CFR Part 58, App A |
| Sensitivity Lower Detection Limit | All data | ≤ 2 µg/m ³ | 40 CFR Part 50, App N, Sec 3.0(b) |
| Bias One Point Flow Rate Verification | Every 30 days each separated by 14 days | < ± 7.1% of transfer standard | 1 and 2) 40 CFR Part 58 App A Sec 3.3 3) Method 2.10 Table 3-1 |
| Flow-Rate Multi-point Verification/ Calibration | Every 365 days and once a calendar year | 3 of 4 cal. points within < ± 10.1% of design | 1) 40 CFR Part 50, App J Sec 8.0 2 and 3) Method 2.10 Section 2.2.4 |
| Bias Semi-Annual Flow Rate Audit | Twice a calendar year and 5- 7 months apart | < ± 10.1% of audit standard | 1 and 2) Part 58, App A, Sec 3.3.3 3) Method 2.10 Sec 7.1.5 |

¹ Standard Temperature & Pressure

Table A-11: DQI and MQO for PM_{2.5} Filter Based (FB)* **

| Requirement | Frequency | Acceptance Criteria | Reference |
|---|---|---|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | 40 CFR Part 58, App D |
| Completeness (FB & Continuous) | <ul style="list-style-type: none"> Annual Standard 24-hour Standard | ≥ 75% scheduled sampling days in each quarter | 1,2 and 3) 40 CFR Part 50 App N Sec 4.1 (b) and 4.2 (a) |
| Comparability | All data | Use of FRM instrumentation and PEP audits | 40 CFR Part 58, App A |
| Sensitivity Lower Detection Limit | All data | ≤ 2 µg/m ³ | 40 CFR Part 50, App L, Sec 3.1 |
| Precision Collocated Samples (FB) | Every 12 days for 15% of sites by method designation (CAB conducts 1 in 3) | CV < 10.1% of samples ≥ 3.0 µg/m ³ | 1 and 2) 40 CFR Part 58 App A Sec 3.2.3 3) Recommendation based DQO in 40 CFR Part 58 App A Sec 2.3.1.1 |
| Bias One Point Flow Rate Verification | Every 30 days each separated by 14 days | <ul style="list-style-type: none"> < ± 4.1% of transfer standard < ± 5.1% of flow rate design value | 1.2 and 3) 40 CFR Part 50 App L Sec 9.2.5 and 7.4.3.1 and 40 CFR Part 58 App A Sec 3.2.1 |
| Flow-Rate Multi-point Verification/Calibration | Electromechanical maintenance or transport or every 365 days and 1/calendar year | < ± 2.1% of transfer standard | 1) 40 CFR Part 50 App L Sec 9.2 2) 40 CFR Part 50 App L Sec 9.1.3 Method 2.12 Sec 6.3 & Table 6-1 3) Recommendation |
| Bias Semi-Annual Flow Rate Audit | Twice a calendar year and between 5-7 months apart | ±4% of transfer standard ±5% of design flow rate | 1 and 2) Part 58, App A Sec 3.2.2 3) Method 2.12 Sec 11.2.1 |
| Bias Audits (PEP) | For PQAOs: <ul style="list-style-type: none"> 5 Audits for ≤ 5 sites 8 Audits for > 5 sites | < ± 10.1% for value > 3 µg/m ³ | 1, 2 and 3) 40 CFR Part 58 App A Sec 3.2.7, 4.3.2 and 2.3.1.1 |

* See Table D-5 in Section D of this QAPP for more information specific to contract laboratory tasks like conditioning/weighing.

** Table is applicable for the Teledyne T640 PM_{2.5} criteria.

Table A-12: DQI and MQO for NCore Temperature Meteorological Measurements

| Requirement | Frequency | Acceptance Criteria | Reference |
|---------------------------|------------------|---|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | QA Handbook for Air Pollution Measurement systems, Vol IV: Meteorological Measurements 2.0 (final). |
| Completeness | Quarterly Hourly | 75 % of hourly averages for the quarter 75 % of minute averages for the hour | 1, 2 and 3) QA Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final), Table 0-3 NCore Meteorological Measurement Quality Objectives |
| Comparability | All data | Meets requirements listed in QA Handbook | QA Handbook for Air Pollution Measurement systems, Vol IV: Meteorological Measurements 2.0 (final). |
| Resolution | At Purchase | 0.1°C | 1, 2 and 3) QA Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-3 NCore Meteorological MQO. |

Table A-12 (continued): DQI and MQO for NCore Temperature Meteorological Measurements

| Requirement | Frequency | Acceptance Criteria | Reference |
|---|--|---|---|
| Temperature Verification/Calibration | Upon receipt/adjustment/repair/ installation/moving 1/6 months | 3 pt. Water Bath with NIST traceable thermistor or thermometer. All points within $\pm 0.5^{\circ}\text{C}$ of standard. | 1, 2 & 3) QA Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Ver. 2.0 (Final) Table 0-4 NCore Calibration & Accuracy Criteria |
| Bias Annual Accuracy / Performance Evaluation | Purchase, recertify 1/year or per NIST/ASTM certification frequency | Measurement range -50°C to $+40^{\circ}\text{C}$ Accuracy $\leq \pm 0.2^{\circ}\text{C}$ NIST Traceable certified over -30°C to $+30^{\circ}\text{C}$ and Resolution $\leq + 0.1^{\circ}\text{C}$ | 1, 2 & 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Ver. 2.0 (Final) Section 3, Section 0, Table 0-3, 0-4, 0-5, 0-6 |

Table A-13: DQI and MQO for NCore Relative Humidity Meteorological Measurements

| Requirement | Frequency | Acceptance Criteria | Reference |
|---|---|--|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | QA Handbook for Air Pollution Measurement systems, Vol IV: Meteorological Measurements 2.0 (final). |
| Completeness | Quarterly Hourly | 75 % of hourly averages for the quarter 75 % of minute averages for the hour | 1, 2 and 3) QA Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final), Table 0-3 NCore Meteorological Measurement Quality Objectives |
| Comparability | All data | Meets requirements listed in QA Handbook | QA Handbook for Air Pollution Measurement systems, Vol IV: Meteorological Measurements 2.0 (final). |
| Resolution | At Purchase | 0.5% | 1, 2 and 3) QA Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-3 NCore Meteorological MQO. |
| Temperature Verification/Calibration | Upon receipt/adjustment/repair/ installation/moving 1/6 months | NIST traceable Psychrometer or standards solution. $< \pm 7\% \text{ RH}$ | 1, 2 & 3) QA Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Ver. 2.0 (Final) Table 0-4 NCore Calibration & Accuracy Criteria |
| Bias Annual Accuracy / Performance Evaluation | Purchase, recertify 1/year or per NIST traceable certification frequency | RH meter: NIST Traceable Standard $\pm 2\% \text{ RH}$ Assman Style Psychrometer: With matched pair NIST Traceable/ASTM Thermometers with measurement Resolution 0.1°C each and appropriate temperature range. No Sling Psychrometer Acceptable | 1, 2 & 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements, Ver. 2.0 (Final) Section 5 and Section 0, Tables 0-3, 0-4, 0-5, 0-6 |

Table A-14: DQI and MQO for NCore Wind Speed Meteorological Measurements

| Requirement | Frequency | Acceptance Criteria | Reference |
|---|--|--|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | QA Handbook for Air Pollution Measurement systems, Vol IV: Meteorological Measurements 2.0 (final). |
| Completeness | Quarterly Hourly | 75 % of hourly averages for the quarter 75 % of minute averages for the hour | 1, 2 and 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-3 NCore Meteorological Measurement Quality Objectives |
| Comparability | All data | Meets requirements listed in QA Handbook | QA Handbook for Air Pollution Measurement systems, Vol IV: Meteorological Measurements 2.0 (final). |
| Resolution | At purchase | 0.1 meters per second | 1, 2 and 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-3 NCore Meteorological Measurement Quality Objectives |
| Wind Speed Verification/Calibration | Upon receipt/adjustment/repair/installation/moving 1/6 months | NIST-traceable Synchronous Motor, CTS method. Zero plus 4 to 5 evenly spaced points between 0.5 and 50 m/s. $\pm 0.25 \text{ m/s} \leq 5 \text{ m/s}$; 5 % > 2 m/s not to exceed 2.5 m/s. | 1, 2 and 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-4 NCore Calibration and Accuracy Criteria |
| Bias Annual Accuracy / Performance Evaluation | Every site 1/year | NIST-traceable Synchronous Motor. At least 4 to 5 points between 0.5 and 50 m/s. $\pm 0.25 \text{ m/s} \leq 5 \text{ m/s}$; 5 % > 2 m/s not to exceed 2.5 m/s. | 1, 2 and 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-4 NCore Calibration and Accuracy Criteria |

Table A-15: DQI and MQO for NCore Wind Direction Meteorological Measurements

| Requirement | Frequency | Acceptance Criteria | Reference |
|---------------------------|------------------|---|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | QA Handbook for Air Pollution Measurement systems, Vol IV: Meteorological Measurements 2.0 (final). |
| Completeness | Quarterly Hourly | 75 % of hourly averages for the quarter 75 % of minute averages for the hour | 1, 2 and 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-3 NCore Meteorological Measurement Quality Objectives |
| Comparability | All data | Meets requirements listed in QA Handbook | QA Handbook for Air Pollution Measurement systems, Vol IV: Meteorological Measurements 2.0 (final). |

Table A-15 (continued): DQI and MQO for NCore Wind Direction Meteorological Measurements

| Requirement | Frequency | Acceptance Criteria | Reference |
|--|--|--|---|
| Resolution | At purchase | 1.0 degrees | 1, 2 and 3)) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-3 NCore Meteorological Measurement Quality Objectives |
| Wind Direction Verification/Calibration | Upon receipt/adjustment/repair/installation/moving 1/6 months | Solar Noon, GPS, Magnetic Compass, CTS method. Points every 45 ° between 0 and 360 (540) °. ± 5 degrees; includes orientation error. | 1, 2 and 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-4 NCore Calibration and Accuracy Criteria |
| Bias Annual Accuracy Evaluation | Every site 1/year | Solar Noon, GPS, or Magnetic Compass. At least 4 to 5 between 0 and 360 (540) degrees. ± 5 degrees; includes orientation error. | 1, 2 and 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-4 NCore Calibration and Accuracy Criteria |

Table A-16: DQI and MQO for PM_{2.5} Speciation (Filter Based)

| Requirement | Frequency | Acceptance Criteria | Reference |
|---|---|---|---|
| Representativeness | All data | Section B.1, CAB MA Criteria QAPP 002 | 40 CFR Part 58, App D |
| Completeness | Annual | ≥ 75 % scheduled sampling days in each year | 1, 2 and 3) EPA Quality Assurance Guidance Document, EPA-454/B-12-003, June 2012. Section 14.4.4 |
| | Quarterly | ≥ 75 % scheduled sampling days in each quarter | 1, 2 and 3) EPA Quality Assurance Guidance Document, EPA-454/B-12-003, June 2012. Section 14.4.4 |
| Reporting Units Precision | All filters | µg/m³ at ambient temp/pressure (PM_{2.5}) | 1, 2, and 3) 40 CFR Part 50 App N Sec 3.0 (b) |
| Precision Collocated Samples (FB) | every 12 days for 15 % of sites in the chemical speciation network | CV ≤ 10 % of samples > 3 µg/m ³ | 1) and 2) Part 58 App A Sec 3.2.5 3) Recommendation based on DQO in 40 CFR Part 58 App A Sec 2.3.1.1 |
| Bias One Point Flow Rate Verification | 1/month | ± 10 % of transfer std. ± 10 % of flow rate design value | 1, 2 and 3) EPA Quality Assurance Guidance Document, EPA-454/B-12-003, June 2012. Table 11-2 |
| Flow-Rate Multi-point Verification/Calibration | Electromechanical maintenance or transport or 1/year or if verification/audit indicates drift or failure | ± 2 % of transfer standard at each flow rate | 1, 2 and 3) EPA Quality Assurance Guidance Document, EPA-454/B-12-003, June 2012. Table 16-1 |
| Bias Semi-Annual Flow Rate Audit | Semi-annual unless failed audit then at least quarterly until passes for 2 quarters | ± 5 % of audit Std. ± 5 % of design flow rate | 1, 2 and 3) EPA Quality Assurance Guidance Document, EPA-454/B-12-003, June 2012. Table 16-1 |
| Bias Audits (PEP) | 8 audits for NCore Network | ±10% for values > 3 µg/m³ | 1,2 and 3) 40 CFR Part 58, App A, Sec 3.2.7, 4.3.2 and 2.3.1.1 |

A.8 Special Training and Certification Requirements

A.8.1 Personnel Qualifications

Ambient air monitoring personnel are required to perform numerous functions important to the quality of data. *Table A-17* identifies these functions and provides some of the key activities within each category that require staffing and some level of experience or expertise. Personnel in the CABAMP have educational, work experience, responsibility, personal attributes, and training for their positions. However, not all activities identified in *Table A-17* may be continually performed by staff in the HDOH. An activity might be considered a “one-time” event needing a specific type of expertise or capability and may be contracted out on a case-by-case basis.

The CAB personnel records, including training records, are maintained in the CAB administrative office. Records include information on:

- Personnel qualifications – general and position specific.
- Completed training.
- Certifications.

Table A-17: Monitoring Functions Requiring Staffing and Expertise

| Function | Activities |
|------------------------|---|
| Procurement | <ul style="list-style-type: none"> - Purchasing equipment and consumables - Developing contracts and maintenance agreements - Applying for grants - Contractor oversight |
| Technical | <ul style="list-style-type: none"> - Siting (consistent with EPA, Appendix E, Part 58) - Setting up a monitoring site, electricity, communications, security - Developing standard operating procedures - Selecting, installing, operating, testing, and minor repair of monitoring equipment - Calibrating equipment and performing quality control checks - PM filter handling pre/post sampling (COC and temperature tracking) - Shelter and equipment preventive maintenance - Standard certification maintenance - Residence time and converter efficiency determination - Acceptance testing of new or repaired equipment and certified standards |
| Data Analysis | <ul style="list-style-type: none"> - Understanding population and measurement uncertainty - Developing sampling designs - Developing networks to achieve objectives - Assessing and interpreting data (data quality assessments) |
| Quality Assurance | <ul style="list-style-type: none"> - Developing quality systems, QAPPs - Developing data quality objectives - Implementing technical systems and performance audits - Data verification and validation (levels 1 thru 4) - Corrective action notifications - QA reporting |
| Information Technology | <ul style="list-style-type: none"> - Selecting information technology (computers, software) - Maintaining web page functionality - Developing and testing analyzer outputs to data loggers and transfer to local data base - Transferring data from local database to external data repositories such as the EPA AQS database. Tests transmission to determine consistency. - Testing of DAS (transformation, reduction, and transmittal) - Backing up and restoring data - Security Awareness Training |

A.8.2 Training

Funds for employee training are budgeted into the CABAMP annually. Appropriate training for new staff/assignments, ongoing proficiency, and new skills are made available to all employees commensurate with their duties. These include classroom lectures, workshops, web-based courses, teleconferences, vendor provided and self-instructional courses and on-the-job training. *Table A-18* lists suggested and required training for CAB MA and QA personnel. Additionally, staff are encouraged to identify, request, and attend pertinent courses, seminars, and workshops. This includes any updates to EPA's regulations including CFRs, NAAQS, Handbooks, Guidance Documents, and *Technical Assistance Documents* (TADs).

Organizations that provide these training opportunities include the EPA, the *Air & Waste Management Association* (AWMA), the *American Society for Quality* (ASQ), *Western States Air Resources* (WESTAR) Council, *California Air Resources Board* (CARB), and AirKnowledge:

<https://airknowledge.gov/SI/AMBM208-SI.html>

Upon completion of the appropriate training, a certificate of completion is placed in the employee's file at the CAB office. This certificate documents what training was completed and the date of completion. The CAB supervisors maintain training tracking logs with staff names and training items, which are initialed and dated by CAB staff after completion. Required training items include the review of QAPPs, SOPs, EPA QA *Handbooks Volumes II and IV*, *QA Handbook Appendix D Validation Templates*, *QA Guidance Documents*, *TADs*, and other training courses. The CAB training track sheet as well as the certificates of completion in the employee files are kept indefinitely.

All CAB employees involved in network planning, site selection, data analysis and quality assurance are required to review this QAPP annually and whenever changes are made as well as review and become knowledgeable with the applicable CAB SOPs. These reviews are initialed and dated by CAB staff. The CAB MA supervisor assigns experienced EHS staff to train and mentor new hires in the MA section on the elements and requirements of planning and implementing a quality system. This training is ongoing, as available. Suggested training that will be required for new CAB MA hires include:

- AMBM103-SI – Introduction to Ambient Air Monitoring for Criteria Pollutants.
- MODL102-SI – Basic Air Pollution Meteorology.
- AMBM206-SI – Network Design and Site Selection for Monitoring PM_{2.5} and PM₁₀ in Ambient Air.
- AMBM207-SI – Site Selection for Monitoring SO₂ and PM₁₀ in Ambient Air.

The proficiency and development of CAB employees is assessed by more experienced personnel systematically after initial training.

- Employees are observed while performing new tasks.
- Work is screened and corrections are recommended.
- Staff eventually work independently with minimal oversight.
- Final proficiency is achieved when personnel can train others.

Contractors hired to conduct air monitoring or audits will be required to provide quality assurance documentation and/or a QAPP that demonstrates competency and proficiency in performance of contract services. Contracted services must meet the requirements of this QAPP as evaluated by CAB.

Monitoring stations already installed by HECO serve CAB's monitoring network needs. HECO's QAPP has been reviewed and is found to be satisfactory in meeting EPA/CAB requirements. HECO has demonstrated competency and proficiency in performing their monitoring responsibilities.

Table A-18 Suggested and Required Training for the CAB Staff

R= Required

S=Suggested

| Course | Course Title (SI = Self Instructional) | Field ¹ | MA ² | Data ³ | QA ⁴ | QAO ⁵ |
|-----------------|--|--------------------|-----------------|-------------------|-----------------|------------------|
| QAPP | QAPP CAB | R | R | R | R | R |
| SOPs | Applicable CAB SOPs | R | R | R | R | R |
| SLD - Lab | Lab Safety Training Courses | R | R | R | R | R |
| BASC 102-SI | History of the Clean Air Act | S | S | S | | |
| BASC 103-SI | Types of Air Pollution | S | S | S | | |
| BASC 106-SI | Basic Concepts of Environmental Sciences | S | S | S | | |
| BASC 110-SI | Introduction to the National Ambient Air Quality Standards (NAAQS) | S | R | R | S | S |
| BASC 124-SI | Air Pollution Control Orientation Course | S | S | S | S | |
| BASC 197-CI | Principles and Practices of Air Pollution Control | | R | S | | |
| AMBM 103-SI | Introduction to Ambient Air Monitoring for Criteria Pollutants | R | R | R | R | R |
| AMBM 206-SI | Network Design and Site Selection for Monitoring PM _{2.5} and PM ₁₀ in Ambient Air | | R | S | S | S |
| AMBM 207-SI | Site Selection for Monitoring SO ₂ and PM ₁₀ in Ambient Air | | R | S | S | S |
| AMBM 208-SI | Quality Assurance for Air Pollution Measurement Systems | R | R | R | R | R |
| AMBM 102-CI | Principles of Ambient Air Monitoring | R | R | R | R | R |
| AMBM 301-CI | Analytical Methods for Air Quality Standards | R | R | R | R | R |
| AMBM 311-CI | Atmospheric Sampling | R | R | R | R | |
| MODL102-SI | Basic Air Pollution Meteorology | S | R | S | S | |
| EPA QSA-ppt | Assessing Quality Systems | | S | S | R | R |
| EPA QAPP-ppt | Introduction to Quality Assurance Project Plans | | S | | R | R |
| EPA lab-ppt | Detecting Improper Laboratory Practices | S | S | | | |
| EPA monitor-ppt | Interpreting Monitoring Data | | S | R | R | R |
| EPA multi-ppt | Interpreting Multivariate Analysis | | | S | S | S |
| EPA DQA-ppt | Introduction to Data Quality Assessment | | R | R | R | R |
| EPA DQI-ppt | Introduction to Data Quality Indicators | | R | R | R | R |
| EPA DQO-ppt | Introduction to Data Quality Objectives | | R | R | R | R |
| EPA | AMTIC website for regulatory requirements and guidance | S | S | S | S | S |
| EPA | Quality Assurance Handbooks Volume II and IV | R | R | R | R | R |
| EPA | QA Handbooks Appendix D Validation Templates, QA Guidance Documents and Technical Assistance Documents | R | R | R | R | R |
| EPA | AQS Training (various online: https://www.epa.gov/aqs/aqs-training) | | R | R | R | R |
| CAB | Envista ARM Training | R | R | R | R | R |
| CAB | Data Verification/Validation Training | R | R | R | R | R |
| CAB | Equipment Training (Various) | R | R | S | S | R |

¹ Field refers to the Air Quality Electronics Technicians (AQET) in the Monitoring & Analysis Section, Electronic Maintenance & Support Unit (EMSU) of the CAB (see Section A-4, Table A-1 of this QAPP).

² MA refers to the staff in the Monitoring & Analysis (MA) Section of the CAB.

³ Data refers to the staff in the MA Section of the CAB responsible for reviewing, validating, and auditing data.

⁴ QA (Quality Assurance) refers to staff in the CAB responsible for conducting technical and data assessments or audits.

⁵ QAO is the Quality Assurance Officer for the CAB.

All courses prefaced by EPA can be found on EPA's website at: <https://airknowledge.gov/SI/AMBM208-SI.html>

A.9 Documents and Records

Many of the documents and records produced by the air monitoring program consist of data and supporting information. Management of the vast amount of data collected and stored is covered in *Section B.10* of this QAPP.

The HDOH records management system addresses the following elements:

- A list of the files, records, and data considered to be official records and their media type (e.g. hardcopy paper or electronic).
- The type of files, records, and data received from external sources (e.g. contract laboratory cooperative agreements, and QAPPs).
- A schedule for retention and disposition of records.
- A storage and retrieval system for records.
- The person(s) responsible at each level of storage and retrieval.
- A procedure for appropriate levels of security.

A.9.1 Management and Organization

The CAB shall use the document standards described in the CABAMP QMP located on the EMD network server on the HAMP SharePoint site. The documents and records subject to management and distribution are listed in *Table A-19, in Section A.9.4 of this QAPP*. Some documents contain a list of specific individuals receiving the Hardcopy versions, these include:

- QAPPs (CABAMP QAPP, QAPPs of contractors)
- SOPs
- QMP
- TSA and Performance Audit Reports

Per CAB management, for those documents that have newer revisions and changes, instruction is provided at the appropriate disposition of any previous versions. Current document versions are posted on the *Hawaii Air Monitoring Program (HAMP)* SharePoint. Obsolete versions are identified as such and are archived by the QAO, in a separate file on HAMP, until such time that they are deemed unnecessary by the QAO and the MA Supervisor.

Document preparation, revision, and changes. Documents prepared by CAB follow the format described in EPA QA/R-5 for QAPP development and G-6 for SOP development. Revisions made by CAB are tracked as described in EPA QA/G-6 document control format i.e., page numbering will occur with the following information in the top right-hand corner of all QMP, QAPPs, and SOPs:

Short Title/ID # Rev. #

Date: Month dd, yyyy

Page 1 of ##

Most documents and records are electronically produced and maintained on the CAB Operations SharePoint site, unless specified otherwise. These documents consist of, but are not limited to: SOPs, equipment inventories, QC log sheets, Calibration Sheets, assorted logbooks, Data Validation Reports, and Audit Reports. Access to the CAB

Figure A-5: Example 1 of CAB Operations SharePoint site

SharePoint

Newsfeed OneDrive Sites

Wallace, Lisa M. M. +

SHARE FOLLOW

Search this site

Equipment

By Location By Description By Make ...

Status Make Model Serial Parameter Logbook Cal Log QC Log Maint Log Other Docs Manual 1 Manual 2 Spare Parts Criteria Table State ID

Location : STANDARDS (31)

Location : AL1 (155)

Location : AL2 (3)

Location : CAB Hilo (81)

Location : CAB Oahu (1)

Location : DH1 (16)

Location : HL11 (15)

Location : HN32 (2)

Location : KA5 (17)

Location : KH19 (8)

| | | | | | | | | | | | | |
|--------|-----------|----------|--------------|---------|---------|---------|--------|-------|--------|--------|----------|----------|
| In Use | Labcomp | ATX115 | 001 | Temp In | Logbook | Cal Log | QC Log | Other | Manual | | | |
| In Use | RM Young | 05103VP | 43338 | WD WS | Logbook | Cal Log | | Other | Manual | Parts | Criteria | |
| In Use | Advantech | 510 | ACI6004678 | Logger | Logbook | | | Other | Manual | | | H0107925 |
| In Use | APC | SMX750 | AS1009221272 | UPS | | | | Other | Manual | Parts | | |
| In Use | LG | LW1015ER | S03CSVUD3495 | Air Con | | | | Other | | | | H0117922 |
| Idle | Met One | 1020 | H5923 | PM2.5 | Logbook | Cal Log | QC Log | Maint | Other | Manual | Parts | Criteria |
| Idle | Met One | 1020 | P13454 | PM2.5 | Logbook | Cal Log | QC Log | Maint | Other | Manual | Parts | Criteria |
| Idle | Met One | 1022 | X22526 | PM2.5 | Logbook | Cal Log | QC Log | Maint | Other | Manual | Parts | Criteria |
| | | | | | | | | | | | | H0120763 |

Location : KK34 (2)

Figure A-6: Example 2 of CAB Operations SharePoint site

The screenshot displays a SharePoint page titled "Logbook-Thermo 43iQ 1182000001". The page layout includes a top navigation bar with "SharePoint", "Newsfeed", "OneDrive", and "Sites" tabs. Below this is a "BROWSE" section with two circular icons. The main content area is titled "EQUIPMENT LOGBOOKS SHOULD CONTAIN HISTORY OF:" and lists several bullet points regarding data collection and equipment maintenance. Below this is a "NEW ITEM" button and a table of logbook entries. The table has columns for "Date and Time", "Location", "Initials", and "Remarks". The entries are filtered by "PM Filter-Based Data" and show a list of tasks and equipment maintenance records.

| Date and Time | Location | Initials | Remarks |
|--------------------|----------|----------|---|
| 7/7/2022 12:25 PM | DH1 | JY | Replaced particulate filter |
| 5/26/2022 2:45 PM | DH1 | JY | Inspected particulate filter |
| 2/22/2022 8:00 AM | DH1 | MI | Remote in: Investigated why yesterday's so2 precision failed. logger took wrong value. Ran zps seq. again, passed ok. |
| 2/17/2022 12:00 PM | DH1 | DS | Replaced particulate filter |
| 1/8/2022 1:45 PM | DH1 | MI | Ran multipoint calibration |
| 12/2/2021 12:00 PM | DH1 | JC | Completed QC Checksheet, Replaced particulate filter |
| 11/18/2021 4:00 PM | DH1 | JC | Ran multipoint calibration, Cal ran okay |
| 11/3/2021 9:35 AM | DH1 | JTC | Ran Zero Prec Span sequence after hooking up new cal gas cylinder. |
| 10/5/2021 12:00 PM | DH1 | JC | Ran multipoint calibration |
| 5/21/2021 9:00 AM | DH1 | JC | Prez bioh. adjusted span lower to 1.00ph. Start 78%. |

Hardcopy records, such as Chain of Custody forms, are filled out in indelible ink. Corrections are made by striking out the incorrect entry with a single line, then initialing and dating it. The change is placed alongside the incorrect entry, if this can be accomplished legibly, or, if not possible, by providing the information on a new line. Hardcopy records are scanned and converted to PDF files that are archived onto the CAB Operations SharePoint site. All records on this site are backed up nightly.

A.9.2 Site Information

Site information is a vital component of the CABAMP and provides current and historical information that is used to determine and evaluate changes in measurement values as well as site characterization over time. Information contained in each individual site file is also used during the annual network review to determine if changes to the site or network are needed. All network (SLAMS and SPMS) modifications including the addition of new sites, discontinuance of existing sites or monitors, and changes in site locations or parameters are detailed in the Annual Network Plan. The Annual Network Plan is submitted to the EPA, Region 9, by July 1 and can be viewed by the public on the HDOH CAB website under *Reports* at:

<http://health.hawaii.gov/cab>

Site information files are kept at the CAB in hardcopy format. The locations of the current sites subject to this QAPP are depicted in *Section A.6.1, Figure A-4* with the parameters monitored at each site listed in *Section B.1.3, Table B-5* of this QAPP. Additionally, site details are provided in the Annual Network Plan, the most current network plan is available for viewing on the CAB website listed above.

The information in each site file includes:

1. The AQS site identification number.
2. Station type (SLAMS, SPMS, NCore).
3. Equipment, sampling, and analysis methods for each parameter (e.g., manufacturer model number, sampling method, AQS method and pollutant code).
4. The location, including street address or TMK (if there is no physical address) and geographical coordinates.
5. Monitoring objective and spatial scale of representativeness for each monitor (as defined in *40 CFR Part 58, Appendix D*).
6. Operating schedule for each monitor.
7. Census population and land use characterization maps.
8. Annual Site photos of a minimum of 8 cardinal directions (N, NE, E, SE, S, SW, W, NW), as viewed from the probe inlet.
9. Annual Site Survey that describes the surrounding area (topography, trees, buildings, roads). The surveyor shall verify that the location still meets siting requirements.
10. Traffic count data if available.
11. Data trend and completeness information (including discretionary meteorological data if available).
12. Any other pertinent site information.

A.9.3 Environmental Data Operations (EDO)

Data integrity is essential to the ambient air monitoring program and to the decisions made using the data. The data collected from the CABAMP can be used as evidence in court proceedings and as such must be shown to be representative of the conditions that existed at the time the data or sample was collected. Data sampler and logger time stamps should synchronize with the time on the NIST website:

<http://Time.gov>

The following elements are carefully monitored and documented to ensure data integrity and defensibility:

1. Data collection – measurement preparation and identification of the sample, sample location and sample time, conditions during the measurements (site logs, field data sheets, DAS logger, digital charts), and raw data.
2. Sample and/or measurement result handling – provides evidence that the sample and data were protected from contamination and tampering during transport, analysis, transmittal, and storage per the use of signed custody seals and chain of custody forms.
3. Analysis – evidence that the samples and data were properly stored prior to and after analysis, interpretation, and reporting.
4. Preparation and filing of measurement reports – evidentiary requirements and retention of records.

EDOs are all the operations required to successfully measure and report a value. In *Section A.6.6, Table A-3, Assessment Schedule and Critical Documents/Records* is a list of specific documents and records deemed important by HDOH. A properly functioning EDO requires:

- QMP – document is an organization or program specific plan that describes the general practices of an organization.
- QAPPs – document how the EDO is planned, implemented, and assessed during the life cycle of the project. One QAPP is associated with the CABAMP.
- QC – includes periodic maintenance, audits, acceptance testing, and other QC checks, such as biweekly flow checks, one-point QC, and zero/span checks (see *QA Handbook, Vol II, Appendix D, Validation Templates* for QC checks performed).
- SOPs – provides written detailed instructions on how tasks are performed, these include field, laboratory, quality assessment, and administrative tasks.
- Field and Laboratory Notebooks and Logs – provides additional documentation about the EDO and includes calibrations, strip charts, station or laboratory conditions, and maintenance records.
- Sample Handling and Custody Records – records tracking the sample and data handling from cradle to grave.

The records discussed below are maintained for a period of five years minimum. The retention schedule for these records is outlined in *Section A.9.4, Table A-19*, of this QAPP.

- Automated data collection. Continuous pollutant monitoring equipment provides an automated means of collecting data. *Section B.10* of this QAPP details how the information is collected and stored at the site and transmitted to the HDOH air monitoring database server in Pearl City. The CAB *Information Technology Specialist* (ITS) is responsible for maintaining the database, ensuring daily backup of the automated data on electronic tape, and data recovery when necessary. Primary and backup data are retained for a minimum of 5 years.
- Secondary data collection. Some of the continuous air monitors have the capability to store their own data. This is called secondary data since it is not the main database. This data is used as a backup source to replace missing data if site loggers fail to transmit data to the HDOH server. Secondary data is also useful for data validation, especially with the particulate monitors, due to the metadata stored that include instrument status codes. This metadata is stored on the CAB Operations SharePoint site under *Equipment* per sampler.
- Chart Recorders. Gaseous analyzers use paperless electronic strip chart recorders as a parallel logging system to the main data logger and serve as a backup when the main data logger fails to collect data. Site operators collect, review, and upload the data files to the CAB Operations Share Point site on a monthly basis. Chart records are retained for a minimum of 5 years.
- Manual Data Collection. PM_{2.5} filter-based instrument data is downloaded from the sampling instrument upon completion of sampling event, saved on a site data logger, and then uploaded to the CAB Operations SharePoint site. COC documents are completed by CAB staff, converted to PDF, and preserved electronically on the CAB Operations SharePoint site.

A.9.3.1 Quality Assurance and Quality Control

CAB MA staff assigned to QC and audits shall maintain these records. Quality assurance and control records include:

- flow rate and performance audits (internal and external).
- acceptance test procedures (see SOP, *Appendix I*)
- accuracy, bias, and precision checks.
- collocated instruments.
- control charts.
- NIST, manufacturers or the EPA certifications.

Note: Recertifications shall be performed with NIST traceable higher-level standards. Standards are used for audits and QC checks, for detailed reference Section B.5.4, Table B-19 of this QAPP. Also, see EPA 40 CFR Part, Appendix A, Sections 2.6.1 and 3.1.2.3 references.

Records are in the form of paper graphs, spreadsheets, and electronic data management systems. Paper and electronic documents are produced when implementing SOPs (*Appendix I*) and include routine QC and other checks, calibrations,

field audits, and data validations. The paper documents produced by CAB are kept as originals but are also saved as PDF files and are posted on the CAB Operations SharePoint site. This site is available for viewing by CAB quality assurance and air monitoring personnel. These documents are archived and retained as described in *Section A.9.4* and *Section B.10* of this QAPP.

The following QC information is retained in a manner that can be readily associated with the data it represents:

- Control charts – the management of control charts is detailed *Section B.5.6* of this QAPP.
- Data Quality Assessments – data assessments determine the validity and performance of the collection system and adequacy of the data set for its intended use and is detailed in *Section D* of this QAPP.
- QA reports – Quality Assurance reports are discussed in *Section A* and *Section C* of this QAPP.
- Evaluation/Audits – these are discussed in *Section C* of this QAPP.

A.9.3.2 Standard Operating Procedures (SOPs)

SOPs are written documents that thoroughly describe techniques and procedures in a clear, step-by-step, easy to understand manner for methods, analyses, or actions. This is to ensure consistent operation minimizing measurement uncertainties or significant variance and bias, and for improving data comparability, credibility, and defensibility. SOPs document routine or repetitive activities to ensure quality consistency within the organization and are used for personnel training. The format for SOPs should follow EPA QA/G-6 *Guidance for the Preparation of Standard Operating Procedures (SOPs) for Quality-Related Documents*.

As described in the EPA QA/G-6 SOP guidance document, a general format is followed for all SOPs written for the CABAMP which include:

1. Title page
2. Table of contents
3. Procedures
4. Quality control and assurance
5. References

SOPs for technical activities such as equipment use, maintenance, calibration, data collection, analysis and auditing include in the procedural section as applicable:

- a) Scope and Applicability
- b) Summary of Method
- c) Definitions
- d) Health and Safety Warnings
- e) Cautions
- f) Interferences
- g) Personnel Qualifications/Responsibilities
- h) Procedures
 - Calibration and standardization
 - Sample Collection
 - Sample Handling and Preservation

- Sample Preparation and Analysis
- Troubleshooting
- Data acquisition, calculations, and reduction
- Computer hardware and software
- Data and records management

SOPs for administrative activities such as reviews and assessments include in the procedural section:

- a) Purpose
- b) Applicability/Scope
- c) Summary of Procedure
- d) Definitions
- e) Personnel Qualifications/Responsibilities
- f) Procedure
- g) Criteria, Checklist, or Other Standards

The specifics of what is included in each element can be found in the *QA/G-6 Guidance* document. SOPs are written by the individuals responsible for the procedures being standardized. The personnel responsible for preparing SOPs must ensure that the contents and procedures conform to EPA and CABAMP requirements. CAB personnel responsible for writing QA SOPs are listed in *Section A.4, Table A-1*.

CAB SOPs are reviewed and approved by the CAB QAO (see *Table A-1*), CAB MA Supervisor, and AQET Supervisor annually or whenever revisions and/or additions are made. CAB will review all SOPs (*Appendix I*) for consistency with the MQOs specified in this QAPP. Approved and signed SOPs are archived on the *HAMP* and *CAB Operations* SharePoint sites. If an approved and signed version is not yet available an SOP labeled as *DRAFT* will be provided, if available and nearing finalization (within six months).

DRAFT SOPs are to be signed and dated by the author(s) with an expected completion date. The CAB MA Supervisor will also sign and date *DRAFT* SOPs to approve release for preliminary use amongst CAB Staff for process purposes (i.e., refining implementation steps or similar). Unapproved *DRAFT* SOPs shall not be used. *DRAFT* SOPs are tracked on the *SOP Log Sheet* found on the CAB Operations SharePoint site to ensure timely finalization by projected dates. A sample of the *SOP Log Sheet* can be found on in *Appendix I* of this QAPP.

SharePoint sites are accessible by all CABAMP personnel. As stated in *Section A.3* of this QAPP, everyone on the distribution list is notified by email when SOPs are created or revised. The CAB MA Supervisor and QAO shall maintain the *SOP Log Sheet* on the CAB Operations SharePoint site where SOPs are filed. The *SOP Log Sheet* lists all existing SOPs (Final & Draft versions) and SOPs that need to be written with target dates for completion and final approval. SOPs and the *SOP Log Sheet* can be found in the following location:

CABMAS HOME > DOCUMENTS > CABMAS Documents > CAB SOPs

A.9.3.3 CAB MA Documentation

The CAB MA personnel who perform tasks for the air monitoring program are responsible for maintaining all established site/equipment logbooks, maintenance records, calibration reports, QC logs, COC forms, and data sheets. These personnel shall ensure that the information recorded is accurate and legible.

CAB maintains electronic logbooks for all air stations. Logbooks are accessible on the CAB Operations SharePoint site and are password protected for each user. These entries cannot be modified once entered. Only authorized personnel have edit rights as SharePoint Administrators. If an entry requires changing, a new record is created that refers to the existing record, with a statement of the change and a reason for the change. The date, time, and personnel making the new entry are recorded by SharePoint. Time stamps should synchronize with the *time.gov* website. QC, calibration, and COC documents are stored in Excel and PDF formats and are accessible by authorized CAB personnel. SharePoint records the date, time, and personnel uploading documents. MS Excel sheets are converted into PDFs that serve as final versions. PDFs are stored on CAB Operations SharePoint. Changes to PDFs follow the same procedures as logbooks.

A.9.3.3.1 Standard Recertification and Acceptance Testing Records

CAB MA and HECO send audit and calibration standards for certification to instrument manufacturers or parties that are ISO/IEC 17025 accredited (not just conformance to ISO), with higher level standards than CAB MA's and traceability to NIST standards. Ozone calibration and audit standards are annually sent to the *California Air Resources Board* (CARB) and EPA Standards Laboratories with NIST traceable *Standard Reference Photometers* (SRP). Other calibration and audit standards are annually sent to vendors with accredited NIST-traceable calibration processes.

Acceptance testing is performed by CAB MA personnel on new or returning instruments, and gas standards for adequacy before use, see SOPs in *Appendix I* of this QAPP for these tasks. Records are stored on the CAB Operations SharePoint site to the electronic certification logbook.

Participation in the *EPA Ambient Air Protocol Gas Verification Program* is difficult for the HDOH due to its remote location. Therefore, the CABAMP must develop a procedure by July 2025 to verify the protocol gas cylinders received. Once an appropriated operating procedure for this task is complete it shall be implemented.

A.9.3.3.2 Field Operations Logbooks and Records

CAB staff shall maintain logbooks and records for the air monitoring sites on the CAB Operations SharePoint site in the following manner:

Site Logbooks

Each site operator is responsible for maintaining site logbooks. Site logbooks shall contain:

- date, time, and initials of the person(s) who have arrived and left the site.
- brief description of the weather (e.g., clear, breezy, sunny, raining).
- brief description of the exterior of the site. Any changes that might affect the data should be recorded – for instance, parking a truck or tractor near the site, this note may explain high NO_x values.

- any unusual noises, vibrations, or anything out of the ordinary.
- any station maintenance or routine operations performed.
- description of the work accomplished at the site (e.g., calibrated instruments, repaired).

Site Equipment Logbooks

Each site operator is responsible for maintaining equipment logbooks. Site equipment logbooks shall contain:

- date, time, location, and initials of the person(s) who have worked on the equipment.
- operation, maintenance, troubleshooting, repairs.
- adjustments, calibrations, audits, testing.
- problems, malfunctions, errors, power failures, noises, odors, vibrations, or anything out of the ordinary; corrective actions taken.
- modifications, firmware upgrades, factory service, power on/off, reboots.
- site relocation, transport, shipping, unusual handling.
- be detailed enough to determine easily and definitively which instrument was at which site(s) over any given time-period. Staff should be able to track problems to the date it initially surfaced and invalidate data even if the instrument was used at multiple sites.

Site Quality Control (QC) Documents and Records

Each site operator is responsible for maintaining QC documents and records.

Site QC documents and records include:

- calibrations
- zero/span/1-point QC logs for gases
- leak, temperature, pressure, and flow check QC logs for particulates
- maintenance logs
- control charts
- residence time calculation sheet
- sample handling and COC records
- acceptance testing
- NIST and instrument certifications.

Completion of these QC documents and records are required even when the field logbooks contain all appropriate and associated information required for the routine environmental data operation being performed.

A.9.3.3.3 Particulate Filter Handling Records

CAB staff shall maintain the filter handling documents and records for the particulate filters used in filter-based monitors. Operational documentation for these monitors is maintained in the *Field Operations* section of the CAB Operations SharePoint site by the CAB personnel at the *Filter Processing Area (FPA)* and air stations. These records are consistent with how the continuous air monitors are documented for maintenance, quality control, calibrations, repairs, and so on. CAB personnel coordinates with private contract laboratories to receive, record, deploy, process, and mail filters back to the respective labs. Detailed notes and records shall be maintained as it relates to particulate filter

handling, documentation is added onto the CAB Operations SharePoint site in the following manner:

Filter Tracking

In the CAB Operations SharePoint site, under the *FIELD OPERATIONS* section, there is a *PM_{2.5} FRM Filter Tracking* log. Filter information entries include:

- Filter ID number.
- Date shipped from contract lab and date received at CAB FPA.
- Received at FPA by initials.
- Was the filter inspected and was it okay?
- Filter expiration date.
- Was COC created?
- Assigned and actual sample run dates.
- Date filter was shipped back to the contract lab.
- Remarks may include observed filter condition, *Field Blanks*, and shipping information.

Documents

CAB personnel shall complete, file, and maintain documents and records for filters used in the PM_{2.5} filter-based monitors, which include:

- chain of custody forms.
- filter run data downloaded from monitors.
- field data sheets (if any).
- contract laboratory reports.

A.9.3.3.4 Quality Assurance Audit Records

Quality assurance audits help to identify problems and improve processes in the CABAMP's environmental data operation. CAB shall complete, file, and maintain quality assurance audit documents and records for continuous gas and PM monitors, and filter based particulate monitors, which include:

- EPA annual performance evaluations (NPAP and PEP)
- CAB annual gas quality assurance audits *
- CAB bi-annual PM quality assurance audits *
- EPA TSA reports *

* Copies of results are stored on the *CAB Operations* and *HAMP* SharePoint sites.

A.9.3.3.5 Data Validation Records

The continuous and filter-based air monitoring data collected must be validated. CAB *MA Data Validation Personnel* (DVP) are assigned to different air stations to validate. For each site, DVP follows the data validation SOPs (*Appendix 1*) to generate *Data Validation Reports* (DVRs). These reports are then saved onto the CAB Operations SharePoint site as PDF files. With these saved files, an Excel spreadsheet is used to log the completed DVRs.

A.9.3.3.6 Quarterly Data Submittal to EPA AQS Tracking and Records

After the quarterly data is approved, the CAB shall submit quarterly data to AQS as specified in *40 CFR 58*, no later than 90 days following the end of each calendar quarter. The quarterly data submittal shall contain the following:

- the AQS site ID, monitoring method code, and the POC.
- the results of all valid 1-Point *Quality Control* (QC), *Annual Performance Evaluation* (PE), Semi-Annual Flow Rate Audit, and Flow Rate Verification.

CAB MA shall maintain a log of all data submitted to AQS and a record of how the data was verified as correct after upload.

A.9.3.4 Sample Handling and Custody Records

Raw data includes all original information collected from a measurement activity and recorded in logbooks, computer (electronic) files, storage media, chart recorder or any other form that is necessary for the reconstruction and evaluation of a concentration, assessment, report, or decision.

Although most of the ambient air monitoring data is collected on continuous real-time instruments, co-located PM_{2.5} filters are prepared for shipping to a contract laboratory for analysis. Chain of custody procedures are critical to ensure filter integrity. QA procedures for both the handling of raw data and custody records are described in *Section A.9.3.3.3* and in SOPs (*Appendix I*) in this QAPP.

Exposed filters are archived by the contracted laboratory in cold storage ($\leq 4^{\circ}\text{C}$) for a minimum of one year. Per the contracted laboratory's QAPP, after one year the CAB must be notified and consulted regarding disposition of exposed filters for further archiving. Exposed filters are required to be stored a total of 5 years after post weighing.

A.9.4 Document Archiving and Retrieval

Documents and records are retained according to the policies and procedures established by CAB. These records are made available to all CABAMP staff. However, if any litigation, claim, negotiation, audit, or other action involving the records has been started before the expiration of any record retention period, the records are retained until completion of the action and resolution of all issues which arise from it. Documents and records are archived on the HAMP and CAB Operations SharePoint sites.

Table A-19: Air Monitoring Document and Record Retention

| Document or Record | Retention Period |
|---|---|
| Program policies, procedures, guidance (Management and Organization; Site Information; Environmental Data Operations) ¹ (QMP, QAPP, QAPPs for contractors PACE and HECO, historical information relevant for informing future activities) | Permanent ² |
| Sample collection and handling records (Raw Data; Data Reporting; Data Management) ¹ | Minimum of five years after date of collection ³ |
| Chain of Custody forms (Environmental Data Operations) ¹ | Minimum of five years after date of collection ³ |
| QC records (Quality Assurance) ¹ | Minimum of five years ³ |
| Reference materials (technical or administrative) | Minimum of five years ³ |

¹ See Table A-3 "Category" column.

² Updated as needed; archived versions maintained permanently.

³ Management discretion is used for maintaining specific records beyond five years.

B. MEASUREMENT/DATA ACQUISITION

B.1 Sampling Process Design

As described in *Section A.7*, air quality monitoring data is generally collected for one or more of the following objectives:

1. To determine compliance with the NAAQS and develop emissions control strategies.
2. To provide air pollution data to the general public in a timely manner.
3. To support air pollution research studies.

Other objectives include:

- determining pollutant trends.
- providing near real-time data to the public, for reporting the daily Air Quality Index, and for emergency episode monitoring.
- developing algorithms based on historical air quality and other conditions which will forecast air quality.
- verifying air quality modeling programs.
- correlating air quality to health effects.
- perform comparison studies between different sampling/monitoring methodologies.

Each site in the network is selected and designed by:

1. Determining and understanding the primary monitoring objective(s).
2. Identifying the appropriate spatial scale for the stated objective(s).
3. Identifying the general location where the site should be placed, in order to collect a representative pollutant measurement based on the objective and spatial scale.
4. Identifying the specific site location in the general area selected.

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

- *Appendix A: Quality Assurance Requirements for SLAMS, SPMS, and PSD Air Monitoring.*
- *Appendix D: Network Design Criteria for Ambient Air Quality Monitoring; and*
- *Appendix E: Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring.* All sites follow the criterion outlined in this appendix with some exceptions for temporary SPMS (i.e., PGV lowered the probe height for H₂S to breathing level which was approved by CAB).

B.1.1 Monitoring Objectives and Spatial Scales

The criteria pollutant ambient air quality monitoring network is designed to meet a minimum of six basic monitoring objectives. These basic objectives are to:

- determine the highest concentrations expected to occur in the area covered by the network.
- determine representative concentrations in areas of high population density.
- determine the impact of significant sources or source categories on ambient pollution levels.

- determine general background concentration levels.
- determine the extent of regional pollutant transport among populated areas and in support of secondary standards; and,
- determine the welfare-related impacts in rural and remote areas, such as visibility impairment and effects on vegetation.

The CAB NCore and Speciation site also shares these objectives, but the primary focus of NCore sites is to determine representative concentrations in areas of high population density and general background levels.

The ambient air monitoring networks for criteria pollutants and NCore use the network design criteria specified in *40 CFR Part 58, Appendix D*, to configure the appropriate network needed to meet monitoring objectives.

Once the objectives are determined, each monitor is assigned one of the following monitoring objective designations:

- *population exposure* – the monitor is located in an area associated with high population density.
- *background* – the monitor is located where anthropogenic pollution is minimal.
- *transport* – the monitor is located to measure pollutants transported from other areas.
- *maximum concentration* – the monitor is located where a high concentration of the pollutant is expected.
- *source impact* – the monitor is located to determine the impact of a source or source category.
- *welfare* – the monitor is located to determine pollution impacts on vegetation, crops, animals, or visibility.

Additionally, the NCore ambient air quality monitoring network may also include the objective of:

- *Trends* – track trends in air pollution
- *Modeling* – the monitor data will be used to evaluate air quality modeling.

Data collected within the network must be representative of the spatial area under study. The goal in siting a monitoring station is to match the spatial scale represented by the samples obtained with the spatial scale most appropriate for the monitoring objective of the station. Spatial scale of representativeness is described in terms of the physical dimension of the air parcel nearest to a monitoring site throughout which actual pollutant concentrations are reasonably similar. The spatial scales are:

| | |
|----------------------------|---|
| <u><i>Micro</i></u> | Concentrations associated with area dimensions from several meters up to 100 meters. |
| <u><i>Middle</i></u> | Concentrations representing areas from about 100 meters to 0.5 kilometers in size. |
| <u><i>Neighborhood</i></u> | 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. |

| | |
|------------------------|---|
| <u>Urban</u> | Citywide area of 4.0 to 50 kilometers. |
| <u>Regional</u> | Usually, a rural area of reasonably homogeneous geography that extends from tens to hundreds of kilometers. |
| <u>National/Global</u> | Concentrations characterizing the nation and the globe. |

Table B-1 lists the six (6) basic monitoring objectives and the spatial scales that are generally most appropriate for that objective. There are appropriate spatial scales for each criteria pollutant. The task of site selection involves reconciling the monitoring objective with the appropriate spatial scale as well as for the specified pollutant.

Table B-2 lists the appropriate scales for each criteria pollutant for SLAMS as specified in 40 CFR Part 58, Appendix D. Although SPM stations are not subject to pollutant specific spatial scales, it is generally used as a guide once the monitoring objective is established.

Table B-1 Monitoring Objectives and Appropriate Spatial Scales

| Monitoring Objective | Appropriate Spatial Scale |
|-----------------------|-----------------------------|
| Population | Neighborhood, Urban |
| Background | Urban, Regional |
| Transport | Urban, Regional |
| Highest concentration | Micro, Middle, Neighborhood |
| Source impact | Micro, Middle, Neighborhood |
| Welfare-related | Urban, Regional |

Table B-2 Pollutant Specific Spatial Scales

| Spatial Scales | Scales Applicable for SLAMS & SPMS | | | | | | | Scales Required for NCore | | | | | |
|----------------|------------------------------------|----|----------------|-----------------|-------------------|------------------|------------------|---------------------------|----|----------------|-----------------|-------------------|----------------------|
| | SO ₂ | CO | O ₃ | NO ₂ | PM _{2.5} | PM ₁₀ | H ₂ S | SO ₂ | CO | O ₃ | NO _y | PM _{2.5} | PM _{10-2.5} |
| Micro | x | x | | x | x | x | x | | | | | | |
| Middle | x | x | | x | x | x | x | | | | | | |
| Neighborhood | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Urban | x | | x | x | x | | | x | x | x | x | x | x |
| Regional | | | x | | x | | | x | x | x | x | x | x |

B.1.2 Site Selection

The CAB MA is responsible for selecting appropriate sites for the ambient air monitoring network. Selection of the number, locations, and types of sampling is a complex process involving consideration of many different criteria and variables. This includes knowledge of the location of area and point sources, geographic variability of ambient pollutant concentrations, meteorological conditions, and population density.

The site selection process also involves consideration of the following factors:

- **Economics** - The quantity of resources required to accomplish all data collection activities, including site preparation, instrumentation, installation, maintenance, data retrieval, data analysis, QA, and data interpretation.
- **Security** - Possible sites may have associated security risks such as theft, vandalism, etc. and these must be taken into consideration. Prior to final selection of a site, these problems must be addressed. If remedies cannot be established, then an attempt to locate the site to another location is made.
- **Logistics** - This process includes procurement, maintenance, and transportation of material and personnel for the monitoring operation. It requires full knowledge of all

aspects of the data collection operation including 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. The effects of buildings, terrain, and heat sources or sinks on air trajectories can produce localized anomalies of pollutant concentrations. Meteorology must be considered in determining the geographic location of a site as well as the height, direction, and extension of sampling probes. Evaluation of localized wind conditions (prevailing and non-prevailing) is essential to properly locate monitoring sites, for example, to locate or avoid emissions from specific sources if the objective is not source monitoring.
- **Topography** – Site selection also involves evaluation of the local topography based on land use maps, topographic maps, and other available resources. Minor and major topographical features that impact both the transport and diffusion of air pollutants are identified and evaluated. Minor features consist of trees and structures either upwind or downwind that may exert small influences on pollutant dispersion patterns. Major features include river canyons or deep valleys, mountain ranges, and large bodies of water. Major features significantly impact the prevailing wind patterns or create their own local meteorological patterns. *Table B-3* lists some relationships of topography to air flow that may affect site selections.
- **Pollutant Considerations** - The monitoring site location for a specific pollutant may or may not be appropriate for another pollutant. Evaluation of the changes that pollutants undergo temporally and spatially must be considered to determine the applicability of each specific site for a specific pollutant.

Table B-3 Topographical Influence on Air Flow in Site Selection¹

| Topographical Feature | Influence on Air Flow | Influence on Monitoring Site Selection |
|---------------------------------|---|---|
| Slope / Valley | Downward air currents at night and on cold days; up-slope winds on clear days when valley heating occurs. Slope winds and valley channeled winds; tendency toward down-slope and down-valley winds; tendency toward inversions. | Slopes and valleys as special sites for air monitors because pollutants generally are well dispersed; concentration levels not representative of other geographic areas; possible placement of monitor to determine concentration levels in a population or industrial center in valley. |
| Water | Sea or lake breezes inland or parallel to shoreline during the day or in cold weather; land breezes at night. | Monitors on shorelines generally for background readings or for obtaining pollution data on water traffic. |
| Hill | Sharp ridges causing turbulence; air flow around obstructions during stable conditions, but over obstructions during unstable conditions. | Depends on source orientation; upwind source emissions generally mixed down the slope, and siting at foot of hill not generally advantageous; downwind source emissions generally down washed near the source; monitoring close to a source generally desirable if population centers adjacent or if monitoring protects workers. |
| Natural or Man Made Obstruction | Eddy effects. | Placement near obstructions not generally representative in readings. |

¹ Source: EPA-454/R-98-004 *Quality Assurance Handbook for Air Pollution Measurement Systems*

The CAB conducts annual network reviews to address changes in monitoring objectives, site conditions, economics and other factors that would necessitate site or network

modifications. Also, as required in *40 CFR Part 58*, every five (5) years the CAB conducts an arduous, comprehensive assessment of the air quality surveillance system to determine, at a minimum, if the network meets the monitoring objectives defined in *Appendix D to Part 58*, whether new sites are needed, existing sites are no longer needed and can be terminated, new technologies can be incorporated into the network and whether the network supports characterization of air quality in areas of high populations of susceptible individuals.

B.1.3 Minimum Network Requirements

40 CFR Part 58, Appendix D and Appendix VIII, of this QAPP, identifies the minimum monitoring requirements for criteria and NCore parameters in the SLAMS network. The monitoring requirements are based on the latest census population in each *Metropolitan Statistical Area (MSA)*. MSAs are defined by the *Federal Office of Management and Budget (OMB)* and the U.S. Census Bureau.

According to the OMB, there are two MSAs in the state: Urban Honolulu with a 2010 census population of 953,207 and Kahului-Wailuku-Lahaina in Maui County with a 2010 census population of 144,444.

The CABAMP meets or exceeds the minimum monitoring requirements set forth in the *EPA 40 CFR Part 58, Appendix D (Table B-4)*. None of the sites operate on a seasonal basis as defined in the regulation; Hawaii operates all monitors 12 months in the year.

Table B-4 Current Monitors in the CABAMP SLAMS, SPMS¹, and NCore

| Parameter | Primary SLAMS Monitors | Primary NCore Monitors | Primary SPMS Monitors | Collocated | Total Primary Monitors in MSA ¹ | Total Primary Monitors in State | Total Required in MSA ¹ | Meets EPA Minimum for MSA ¹ |
|---|------------------------|------------------------|-----------------------|-----------------|--|---------------------------------|------------------------------------|--|
| CO | 2 | -- | -- | NA ² | 2 | 2 | NA | NA |
| CO (NCore, Trace) ³ | -- | 1 | -- | NA | 1 | 1 | 1 | Yes |
| NO/NO _y ³ | -- | 1 | -- | NA | 1 | 1 | NA | NA |
| NO ₂ | 1 | -- | 1 | NA | 1 | 2 | NA | NA |
| SO ₂ | 4 | -- | 7 | NA | 3 | 11 | 1 | Yes |
| SO ₂ (HECO, DRR) ⁴ | 1 | -- | -- | NA | 1 | 1 | NA | NA |
| SO ₂ (NCore, Trace) ³ | -- | 1 | -- | NA | 1 | 1 | 1 | Yes |
| O ₃ | 1 | 1 | -- | NA | 2 | 2 | 1 | Yes |
| H ₂ S | -- | -- | 1 | NA | -- | 1 | NA | NA |
| PM ₁₀ (Continuous) | 1 | 1 | -- | NA | 2 | 2 | 2 | Yes |
| PM _{2.5} (Continuous) | 4 | -- | 8 | 2 | 3 | 12 | 1 | Yes |
| PM _{10-2.5} (Continuous) | -- | 1 | -- | NA | 1 | 1 | 1 | Yes |
| PM _{2.5} (FRM) | -- | 1 | -- | NA | 1 | 1 | 1 | Yes |
| PM _{2.5} (NCore, Speciation) | -- | 2 | -- | NA | 2 | 2 | 2 | Yes |
| Wind Speed & Direction | 4 | 1 | 7 | NA | 1 | 12 | 1 | Yes |
| Ambient Temperature | -- | 1 | -- | NA | 1 | 5 | 1 | Yes |
| Relative Humidity | -- | 1 | -- | NA | 1 | 1 | 1 | Yes |

¹ Kahului MSA has no minimum monitoring requirements based on population and the absence of a design value per *40 CFR 58 Appendix D*. Minimum monitoring requirements only apply to the Urban Honolulu MSA.

² NA = Not applicable

³ NCore parameter that monitors at a lower range called Trace.

⁴ *Hawaii Electric Company (HECO)* Monitors that are a *Data Requirement Rule (DRR)*.

Visual aids that summarize the CABAMP are seen in *Section A.6.1, Figure A-4 and Table B-5*. Detailed site information as well as the results of network planning, design, and review can be found in the network plan which is updated annually. The most current network plan is available at:

<http://health.hawaii.gov/cab/>

(Look under “Reports”. The plan includes all sites listed in *Appendix VI*)

Table B-5 State of Hawaii SLAMS/SPMS/NCORE Monitoring Network

| Site ID | AQS Site Code | Location | Site Type ⁷ | Network | Pollutants Monitored | | | | | | | | | | | Met |
|-------------------|---------------|-------------------------------------|------------------------|------------------------|----------------------|--------------------|-----------------|----------------|-----------------|-------------------------|-----------------------|-------------------------|------------------------|----------------------------|------------------|-----|
| | | | | | CO | NO/NO _y | NO ₂ | O ₃ | SO ₂ | PM _{2.5} Cont. | PM _{2.5} FRM | PM _{2.5} Spec. | PM ₁₀ Cont. | PM _{10-2.5} Cont. | H ₂ S | |
| DH1 | 1001 | Honolulu, Oahu | Pop | SLAMS | • | | | | • | • ⁵ | | | • | | | |
| KA5 | 0010 | Kapolei, Oahu | Pop | SLAMS | • | | • | | • | • ⁵ | | | • | • | | |
| NC22 ¹ | 0010 | Kapolei, Oahu | Pop | SLAMS/NCORE | • | • | | • | • | | • | • | | | | • |
| SI2 | 1004 | Sand Island, Oahu | Trans | SLAMS | | | | • | | • | | | | | | |
| KE26 ² | 4001 | Kahe, Oahu | Srce | SPMS/DRR | | | | | • | | | | | | | |
| KL25 | 0025 | Kahului, Maui | Pop | SPMS | | | | | | • | | | | | | |
| KH19 ⁶ | 0006 | Kihei, Maui | Srce/Pop | SPMS | | | | | | | | | • | | | |
| NI18 | 0007 | Niimalu, Kauai | Srce | SPMS | | | | • ⁴ | • | • ⁴ | | | | | | |
| HL11 | 1006 | Hilo, Hawaii | Srce/Pop | SLAMS/SPM ³ | | | | | • | • | | | | | | |
| KN12 | 1012 | Kealahou, Hawaii (Konawaena School) | Srce/Pop | SLAMS/SPM ³ | | | | | • | • ⁵ | | | | | | |
| MV23 | 2023 | Mt. View, Hawaii | Srce/Pop | SPMS | | | | | • | • | | | | | | |
| OV20 | 2020 | Ocean View, Hawaii | Srce/Welf | SPMS | | | | | • | • | | | | | | |
| PA16 | 2016 | Pahala, Hawaii | Srce/Hi Conc | SPMS | | | | | • | • | | | | | | |
| KS27 | 3027 | Keaau, Hawaii (Kamehameha School) | Srce/Welf | SPMS | | | | | • | • | | | | | | |
| LE35 | 2035 | Pahoa, Hawaii (Leilani Estates) | Srce | SPMS | | | | | • | | | | | | • | |
| NA33 | 3033 | Naalehu, Hawaii (Naalehu School) | Srce/Pop | SPMS | | | | | • | • | | | | | | |
| KK34 | 3034 | Kailua-Kona, Hawaii | Srce/Pop | SPMS | | | | | | • | | | | | | |
| WL21 | 2021 | Waikoloa, Hawaii | Srce/Pop | SPMS | | | | | • | • | | | | | | |

¹ The only NCORE site in the CABAMP network is in Kapolei with the KA5 SLAMS site.

² This is the *Hawaii Electric Company* (HECO) site that is a *Data Requirement Rule* (DRR).

³ These sites are both SLAMS for SO₂ and SPMS for PM_{2.5}.

⁴ These parameters are temporarily offline due to resource challenges.

⁵ These parameters have co-located monitors operating alongside primary monitors.

⁶ This site was shut down then started up again for special purpose dust monitoring.

⁷ Site Types are: Pop (Population Oriented), Trans (Regional Transportation), Srec (Source Impact), Welf (Welfare Impact), and Hi Conc (Highest Concentration).

B.1.4 Operating Schedules and Completeness Requirements

All primary monitors in the CABAMP are continuous analyzers, except for the filter based PM_{2.5} analyzers. The continuous analyzer's data is collected onto site loggers then uploaded to the main database. Gas analyzers collect and store one minute, five minute, and hourly data averages, where resources permit (e.g., space allocation on Envista – which does not seem to limit the amount of data that can be preserved). Particulate analyzers only collect data as hourly averages.

Generally, at least 75 percent of the total possible observations in a sampling period must be valid before summary statistics can be calculated. The completeness goals are listed in *Table B-6*. While 75 percent is acceptable, the HDOH strives to attain 100 percent completeness as much as possible.

It is the responsibility of CAB MA data validation personnel to determine which data is valid and invalid. Null codes and qualifier codes are assigned per EPA guidelines and CAB SOPs (*Appendix I*). Once this is done, data completeness is determined. More information on data validation is covered in Section D of this QAPP.

The *QA Handbook Volume II, Appendix D, Measurement Quality Objective and Validation Templates*, provides the criteria for data completeness. Further information on completeness comparison to the NAAQS is in the *Federal Register 40 CFR, Subchapter C, Part 50*. Locate information, for each criteria pollutant, in *40 CFR, Part C, Section*:

- 50.9 and 50.10 for O₃
- 50.8 for CO
- 50.11 for NO₂, NO_x, NO
- 50.4 and 50.5 for SO₂
- 50.7 for PM_{2.5}
- 50.6 for PM₁₀

Table B-6 Completeness Goals for Ambient Air Monitoring Data

| Parameter | Minimum Number of Valid Data Points and Associated Standards (Highlighted Cells) | | | | | |
|------------------------------------|--|----------------------|----------------------|------------------------|-----------------------------|----------------------------------|
| | 1-hour | 3-hour | 8-hour | 24-hour | Quarterly | Annual |
| CO | 45 1-minute values in 60 minutes | | 6 of 8 hourly values | | | |
| O ₃ | 45 1-minute values in 60 minutes ¹ | | 6 of 8 hourly values | | | |
| SO ₂ | 45 1-minute values in 60 minutes | 3 of 3 hourly values | | 18 of 24-hourly values | | 75% of hourly values per quarter |
| NO ₂ | 45 1-minute values in 60 minutes | | | | | 75% of hourly values per quarter |
| PM _{2.5} Continuous | 1 value collected per hour | | | 18 of 24-hourly values | | 75% of hourly values per quarter |
| PM ₁₀ Continuous | 1 value collected per hour | | | 18 of 24-hourly values | | |
| PM _{2.5} Manual | | | | 23 of 24 hours | 75% of samples ² | |
| H ₂ S | 45 1-minute values in 60 minutes | 3 of 3 hourly values | | 18 of 24-hourly values | | 75% of hourly values per quarter |
| Meteorological NCore (WS,WD,AT,RH) | 45 1-minute values in 60 minutes | | | | 75% of samples ² | |

¹ Although there is no NAAQS for this pollutant, to achieve completeness goals, it is important that the hourly values meet the minimum completeness goal of 75%.

² The number of required samples per quarter each year can be found on the EPA website:
<https://www.epa.gov/amtic/sampling-schedule-calendar>

B.2 Sampling Methods Requirements

To establish data validity:

- the sampling method must comply with the appropriate monitoring regulations. Network Samplers must be EPA designated FRM or FEMs. Refer to *Section A.7.1.4, Table A-4*, of this QAPP, for HDOH CABAMP Network of analyzers used.
- the equipment must be properly sited.
- the air stations must follow proper equipment installation instructions and use EPA approved sample intake systems.
- the equipment must be accurately calibrated using correct and established calibration methods.
- there must be enough information from data quality indicators to assess data uncertainty.
- samples must be appropriately handled through proper chain of custody procedures.
- The staff responsible for implementing the data collection operation must be qualified and properly trained.

To accomplish these objectives:

- appropriate sampling method(s) are selected.
- procedures for collecting the required environmental samples are established.
- equipment used in the network, necessary support facilities, sample preservation requirements, implementation requirements, material requirements, and processes for preparing and decontaminating sampling equipment are described.
- corrective actions necessary to re-establish data integrity, responsible parties to implement corrective actions, and methods required to verify the effectiveness of corrective actions are identified.

B.2.1 Monitor Placement

The placement of each monitor is generally determined by the defined monitoring objective. Monitors and probes are usually placed according to potential exposure to pollution. Tradeoffs are often necessary to locate a site for the collection of optimally representative data. Final placement of a monitor and probe at the selected site is dependent on physical obstructions (e.g., trees, buildings, parapets) and activities in the immediate area. Monitors and probes must be placed away from obstructions to avoid airflow effects and interferences. To prevent sampling bias, airflow around a sampling probe must be representative of the general airflow in the area. Additionally, the availability of utilities such as electricity and telephone services are critical.

The placement of all monitors in the current network are described in the annual network plan which can be found on the CAB website at:

<http://health.hawaii.gov/cab/>

B.2.2 Monitoring Station Design

Once a site location has been selected, as described in *Section B.1* of this QAPP, the next priority is to ensure that the station is designed with careful thought to technician safety and access for optimal operation, maintenance, and repair. If the station is a stand-alone mobile shelter, it must be durable enough to withstand weather extremes. These shelters should follow the requirements outlined in the *QA Handbook, Volume II, Section 7.2.1*.

The stand-alone shelters used by CAB are either mobile offices or specially designed trailers for air monitoring.

The field technicians are required to access inlet probes and other equipment on the roof so shelters must have OSHA compliant access ladders, safety railings, and non-slip materials installed on any stand-alone monitoring trailer.

All sites not located in an existing building (e.g. a room in an office building) must be fenced or placed in secure areas with access only through locked gates or secure pathways and shelters must have a lockable door. To prevent temperature extremes within the shelter, it should be insulated (R-19) and must have a continuously operating air conditioner capable of sustaining a temperature range between 20 and 30 degrees Celsius throughout the interior space. All shelters must have enough electrical circuits (110/220 VAC voltage) for the current load of equipment, air conditioner, and for audit equipment.

All air quality instruments and support equipment, if not stand-alone, are mounted on racks with sliding rails or stationary carts with shelves. The racks or carts are placed away from walls to ensure access to the instruments without needing to be removed. Calibration gases must be secured upright either in cylinder racks or otherwise secured against a wall or instrument rack. Cylinders not in use must be capped with a threaded cylinder gas cap. Each station must have a fire extinguisher with a current certification. Important environmental parameters to be controlled to ensure proper functioning of samplers and their components and manufacturer and/or method specifications are outlined in *Table B-7*.

Table B-7 Environmental Control Parameters

| Parameter | Specification | Method of Control |
|------------------------|--|---|
| Instrument Environment | Manufacturer's specifications | Design of instrument housings, benches, etc., per manufacturer's specifications. Protect from excessive vibration, corrosives, intense heat, precipitation, dirt, and dust. |
| Light | Method description or manufacturer's specifications | Shield chemicals or instruments that can be affected by natural or artificial light |
| Electrical Voltage | 110/220 VAC voltage | Constant voltage transformers or regulators; separate power lines; isolated high current drain equipment such as HI-VOLs, heating baths, pumps from regulated circuits. Ensure electrical is properly grounded to protect instruments and site operators. |
| Temperature | Between 20° and 30° C or manufacturer's specifications | Regulated air conditioning system 24-hour temperature recorder, use electric heating and cooling only |
| Humidity | Method description or manufacturer's specifications | Regulated air conditioning system; 24-hour temperature recorder |

B.2.3 Sampling Probes and Manifolds

Probes and manifolds must be placed to avoid introducing sample bias. Considerations include probe height above ground, probe length (for control of residence time), and physical influences near the probe. *Table B-8* summarizes the appropriate spacing of probes from roadways and *Table B-9* summarizes the probe siting criteria. The CABAMP does not use open path analyzers.

Table B-8 Minimum Distance of Roadways from Probe Siting for NO₂, O₃, & CO

| Average Daily Traffic | NO ₂ , O ₃ Neighborhood & Urban Scales ¹ (meters) | CO Neighborhood Scale ¹ (meters) |
|-----------------------|--|---|
| ≤ 1,000 | 10 | |
| 10,000 | 10 | |
| ≤ 10,000 | | 10 |
| 15,000 | 20 | 25 |
| 20,000 | 30 | 45 |
| 30,000 | | 80 |
| 40,000 | 50 | 115 |
| 50,000 | | 135 |
| ≥ 60,000 | | 150 |
| 70,000 | 100 | |
| ≥ 110,000 | 250 | |

¹ Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count.

Table B-9 Summary of Probe Siting Criteria*

| Pollutant | Scale | Height from ground to probe or inlet (meters) | Horizontal and vertical distance from supporting structures ¹ to probe or inlet (meters) | Distance from trees to probe or inlet (meters) | Distance from roadways to probe or inlet (meters) |
|-------------------------|--|---|---|--|--|
| SO ₂ 2,3,4,5 | Middle, Neighborhood, Urban, Regional | 2-15 | >1 | >10 | Not Applicable |
| CO 3,4,6 | Micro Micro (near road) Middle and Neighborhood | 2.5-3.5 2-7 2-15 | >1 | >10 | 2-10 (micro) ≤50 (near-road) See Table B-8 |
| NO ₂ 2,3,4 | Micro (near road) Middle, Neighborhood, Urban, Regional | 2-7 2-15 (all other scales) | >1 | >10 | ≤50 (near-road) See Table B-8 for other scales |
| O ₃ 2,3,4 | Middle, Neighborhood, Urban and Regional | 2-15 (all scales) | >1 | >10 | See Table B-8 |
| PM 2,3,4,7 | Micro & near road Middle, Neighborhood, Urban, Regional | 2-7 2-7 2-15 (all other scales) | >2 (all scales, horizontal only) | >10 | 2-10 (micro) ≤50 (near-road) See Figure B-1 for all other scales |

¹ When a probe is on a rooftop, this separation distance references: walls, parapets, or penthouses located on the roof.

² Should be > 20 meters from the dripline of tree(s) and must be 10 meters from the dripline when the tree(s) act as an obstruction. For microscale sites, no trees or shrubs should be located between the probe or inlet and the source under investigation, such as a roadway or a stationary source.

³ Distance from probe or inlet to obstacle, such as a building, must be at least twice the height the obstacle protrudes above the probe or inlet. Sites not meeting this criterion may be classified as middle scale.

⁴ Must have unrestricted airflow 270° around the probe or inlet and 180° if the probe is on the side of a building.

⁵ The probe or inlet should be away from minor sources, such as furnace or incineration flues. The separation distance is dependent upon the height of the minor source's emission point, the type of fuel or waste burned, and the quality of the fuel (sulfur, ash, or lead content). This criterion is designed to avoid undue influences from minor sources.

⁶ For microscale CO monitoring sites, the probe must be > 10 meters from a street intersection and preferably at a midblock location.

⁷ Collocated monitors must be within 4 meters of each other and at least 2 meters apart for flow rates >200 liters/minute and at least 1 meter for flow rates < 200 liters/minute.

CAB will adhere to NCore requirements as specified in this section, as siting for NAAQS and NCore are the same according to Part 58, Appendix E: (1a) This appendix contains specific location criteria applicable to SLAMS and NCore ambient air quality monitoring probes, inlets, and optical paths after the general location has been selected based on the monitoring objectives and spatial scale of representation discussed in appendix D to this part. The Technical Assistance Document (TAD) for Precursor Gas Measurements in the NCore Multi-pollutant Monitoring Network, Revision 4, EPA-454/R-05-003, September 2005, which the NCore information may have been sourced is superseded by Part 58, Appendix E, last revised in 2013. General probe and monitoring path siting criteria required in *40 CFR Part 58, Appendix E* for CO, NO₂, NO_y, O₃, and SO₂ is discussed below:

- Carbon Monoxide (CO Criteria and NCore Analyzer)

Horizontal and Vertical Placement - For neighborhood scale CO sites, the probe is located between 2 and 15 meters above ground level (for NCore probe is 3 to 15 meters). For microscale monitors being used to measure roadway concentrations of CO, the probe is 3 ± 0.5 meters above ground level. Additionally, the probe is at least 1 meter vertically or horizontally away from any supporting structure, walls, parapets, and penthouses. If the probe is located near the side of a building, then it is located on the windward side of the building relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.

Spacing from Minor Sources - Unless monitoring of a minor source is the objective, plumes from local minor sources are not allowed to inappropriately impact the air quality data collected at the site.

Spacing from Obstructions - Buildings can act to restrict airflow. Therefore, the probe should be placed away from buildings to ensure an unrestricted airflow. The distance from the obstacle to the probe, inlet, or monitoring path is at least twice the height that the obstacle protrudes above the probe, inlet, or path. A probe, inlet or monitoring path has unrestricted airflow in an arc of at least 180 degrees and includes the predominant wind direction for the season of greatest pollutant concentration potential. For NCore, the probe arc should be 270 degrees.

Spacing from Trees - Trees can act as obstructions if they are located between the air pollution source and the monitoring site and where they are of a sufficient height and leaf canopy density to interfere with normal airflow around the probe. To reduce this possible interference, the probe, or at least 90 percent of the monitoring path is at least 10 meters or further from the drip line of trees. For NCore spacing should be 20 meters from dripline of trees and obstructions.

Spacing from Roadways - For microscale CO monitors, the probe inlet has a minimum distance of 2 meters and a maximum distance of 10 meters from the edge of the nearest traffic lane. Probes are located at least 10 meters from an intersection, preferably at a mid-block location. For neighborhood scale CO monitors, the minimum distance of a probe or 90 percent of a monitoring path shall follow the requirements of *40 CFR 58, Appendix E, Table E-2*. If the probes or monitoring paths are located closer than the criterion in *Table E-2*, then the site shall be classified as middle scale.

- Nitrogen Dioxide (NO₂) and Reactive Oxides of Nitrogen (NO_y)

The siting criteria for micro-scale near road NO₂ monitors is 2 to 7 meters. The siting criteria for other NO₂ analyzers is the same as for O₃ analyzers, except the inlet for the NO_y monitor must be 10 meters above grade.

Horizontal and Vertical Placement - The probe is located between 2 and 15 meters above ground level and at least 1 meter vertically or horizontally away from any supporting structure, walls, parapets, and penthouses. If the probe is located near the side of a building, then it shall be located on the windward side of the building relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.

Spacing from Minor Sources - Unless monitoring of a minor source is the objective, plumes from local minor sources are not allowed to inappropriately impact the air quality data collected at the site.

Spacing from Obstructions - The probe shall have unrestricted airflow and is located away from obstacles. The distance from the obstacle to the probe, inlet, or monitoring path shall be at least twice the height that the obstacle protrudes above the probe, inlet, or path. A probe, inlet, or monitoring path shall have unrestricted airflow in an arc of at least 180 degrees and includes the predominant wind direction for the season of greatest pollutant concentration potential. For NCore, the probe arc should be 270 degrees.

Spacing from Trees - The probe, inlet, or at least 90 percent of the monitoring path shall be at least 10 meters or further from the drip line of trees. For NCore spacing should be 20 meters from dripline of trees and obstructions.

Spacing from Roadways - In siting NO₂ analyzers for neighborhood and urban scale monitoring, it is important to minimize interferences from mobile sources. Spacing from roadways follow the requirements in *40 CFR 58 Appendix E, Table E-1*.

- Ozone (O₃) Criteria and NCore Analyzer

Horizontal and Vertical Placement - The probe shall be located between 2 and 15 meters above ground level and at least 1 meter vertically or horizontally away from any supporting structure, walls, parapets, and penthouses. If the probe is located near the side of a building, then it shall be located on the windward side of the building relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.

Spacing from Minor Sources - Local sources of nitric oxide (NO) and ozone-reactive hydrocarbons can have a scavenging effect causing unrepresentatively low concentrations of O₃, therefore probes are away from furnace or incineration flues or other minor sources of SO₂ or NO.

Spacing from Obstructions - The probe has unrestricted airflow and shall be located away from obstacles. The distance from the obstacle to the probe, inlet, or monitoring path is at least twice the height that the obstacle protrudes above the

probe, inlet, or path. A probe, inlet, or monitoring path has unrestricted airflow in an arc of at least 180 degrees and includes the predominant wind direction for the season of greatest pollutant concentration potential.

Spacing from Trees - The scavenging effect of trees is greater for O₃, necessitating that steps shall be taken to avoid siting O₃ monitors near trees. If unavoidable, then probes shall be at least 10 meters or more from the drip line of trees.

Spacing from Roadways - In siting an O₃ analyzer, it is important to minimize the scavenging effects of NO on ozone. Spacing from roadways follow the requirements in *40 CFR 58 Appendix E, Table E-1*.

- Sulfur Dioxide (SO₂ Criteria and NCore Analyzer)

Horizontal and Vertical Placement - The probe shall be located between 2 and 15 meters above ground level and at least 1 meter vertically or horizontally away from any supporting structure, walls, parapets, and penthouses (for NCore probe 3 to 5 meters above ground). If the probe is located near the side of a building, then it shall be located on the windward side of the building relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.

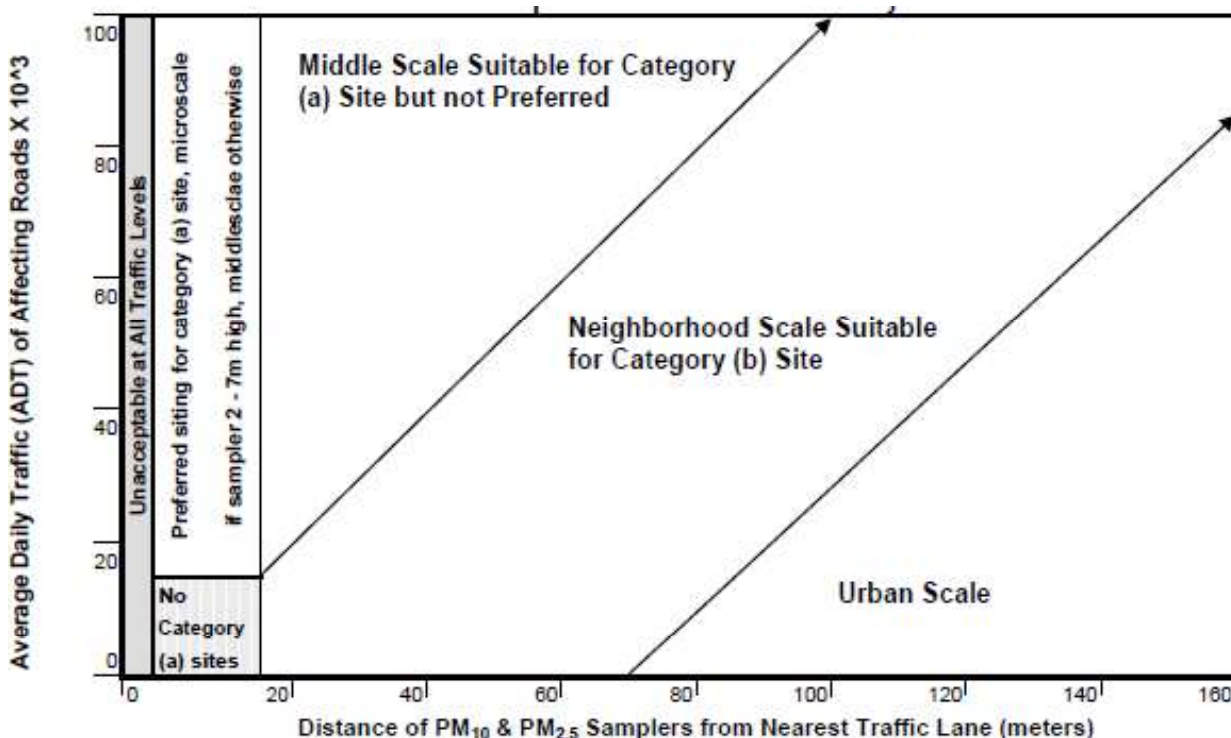
Spacing from Minor Sources - Unless monitoring of a minor source is the objective, plumes from local minor sources shall not be allowed to inappropriately impact the air quality data collected at the site.

Spacing from Obstructions - The probe shall have unrestricted airflow and is located away from obstacles. The distance from the obstacle to the probe, inlet, or monitoring path shall be at least twice the height that the obstacle protrudes above the probe, inlet, or path. A probe, inlet, or monitoring path has unrestricted airflow in an arc of at least 180 degrees and includes the predominant wind direction for the season of greatest pollutant concentration potential. For NCore, the probe arc should be 270 degrees.

Spacing from Trees - The probe, inlet or at least 90 percent of the monitoring path shall be at least 10 meters or further from the drip line of trees. The probe should be at least 20 meters from any trees or shrubs extending higher than the sampler intake. The distance shall be measured from the dripline or outside edge of the crown, not the trunk. The distance between the probe and any large obstruction (such as buildings) higher than the probe must be more than twice the height that the obstruction extends above the probe.

Figure B-1 depicts the acceptable distances from traffic lanes for PM₁₀ and PM_{2.5}. The placement and location of all probes in the current network are described in the annual network plan which can be found on the CAB website at:

<http://health.hawaii.gov/cab/>

Figure B-1 Distance of PM Samplers to Nearest Traffic Lane

General probe and monitoring path siting criteria for PM_{2.5} and PM₁₀, as required in EPA document *40 CFR Part 58, Appendix E*, is discussed below:

- Particulate Matter (General Considerations)

There are many factors to be considered in establishing a particulate matter sampling location. These include accessibility under all weather conditions, availability of adequate electricity, and the security of the monitoring personnel and equipment. The sampler must be situated where the operator can reach it safely despite adverse weather conditions. If the sampler is located on a rooftop, care is taken that the operator's personal safety is not jeopardized by a slippery roof surface. Ease of routine operational procedures such as calibration, maintenance, and access to the monitoring site and equipment need to be considered.

The lack of suitable power sources can often result in the loss of many samples because of power interruptions or fluctuations. To ensure that adequate power is available, the manufacturer's instruction manual for the sampler's minimum voltage and power requirements are followed.

The security of the sampler depends mostly on the location. In all cases, the security of the operating personnel as well as the sampler is considered.

- PM_{2.5}

When monitoring for PM_{2.5}, it is important to select a site or sites where the collected particulate mass is representative of the monitored area.

Horizontal and Vertical Placement - Optimum placement of the sampling inlet for PM_{2.5} is at breathing height level. However, practical factors such as prevention of

vandalism, security, and safety precautions require consideration. Thus, the sampler inlet for micro scale PM_{2.5} monitors shall be between 2 and 7 meters above the ground. For middle or larger spatial-scales the inlet shall be 2 to 15 meters above ground.

Spacing from Obstruction - If the sampler is located on a roof or other structure, there shall be 2 meters separation from walls, parapets, and penthouses. Collocated samplers shall be at least 2 meters, but not greater than 4 meters, away from each other. Samplers shall be located away from obstacles, such as buildings, so that the distance between any obstacle and the sampler is at least two times the height that the obstacle protrudes above the sampler. There shall be unrestricted airflow in an arc of at least 270° around the sampler. The predominant wind direction for the season with greatest pollutant concentration potential shall be included in the 270° unrestricted arc.

If the sampler is to measure concentrations from a road or point source, there shall be no obstructions between a road or point source, even when other spacing from obstruction criteria are met.

Spacing from Minor Sources – No furnace or incineration flues shall be near to any samplers.

Spacing from Trees - Samplers shall be located at least 20 meters from the drip line of the nearest trees but shall be 10 meters from the drip line when it acts as an obstruction.

- PM₁₀

When monitoring for PM₁₀, it is important to select a site or sites where the collected particulate mass is representative of the monitored area.

Horizontal and Vertical Placement - Optimum placement of the sampling inlet for PM₁₀ is at breathing height level. However, practical factors such as security and safety precautions are considered. Given these considerations, the sampler inlet for micro scale PM₁₀ monitors is between 2 and 7 meters above ground. For middle or larger spatial scales, the inlet shall be between 2 and 15 meters above ground.

Spacing from Obstruction - If the sampler is located on a roof or other structure, there shall be at least 2 meters of separation from walls, parapets, and penthouses. Collocated samplers shall be at least 2 meters, but not greater than 4 meters, away from each other.

Samplers shall be located away from obstacles such as buildings, such that the distance between any obstacle and the sampler is at least two times the height that the obstacle protrudes above the sampler. There shall be unrestricted airflow in an arc of at least 180° around the sampler. The predominant wind direction for the season with the greatest pollutant concentration potential shall be included in the 180° unrestricted arc.

If the sampler is to measure concentrations from a road or point source, there shall be no obstructions between the road or point source, even when other spacing from obstruction criteria are met.

Spacing from Minor Sources – No furnace or incineration flues shall be near to any samplers.

Spacing from Trees - Samplers shall be located at least 20 meters from the drip line of the nearest trees but shall be 10 meters from the drip line when the tree acts as an obstruction.

General monitoring siting criteria for meteorological measurements, as required for NCore per EPA document *QA Handbook for Air Pollution Systems, Volume IV: Meteorological Measurements Version 2.0 (Final)*.

- Towers

While performing meteorological measurements the type of tower used is determined by the type of support structure. CAB mounts towers to the air monitoring shelters at the sites. Meteorological towers should be able to reach 10 meters. A tower mounted on an existing structure must account for the height of the structure. CAB typically uses triangular adjustable (crank-up) towers.

Meteorological sensors should be sited at a distance beyond the influence of obstructions, such as buildings and trees; this distance depends on both the variable to be measured and the type of obstruction. Measurements should be representative of the meteorological conditions in the area of interest. Accessibility and security of the site must also be considered when selecting an area. Proper site selection is critical to obtaining representative meteorological data.

Towers should be in an open, level area that is representative of the area being monitored, see *Table B-10* for specific distances from obstructions, referenced from the EPA *QA Handbook, Volume IV, Section 1*. Towers should be securely mounted and located in areas that allow for easy maintenance.

Table B-10 Limits on Terrain and Obstacles near Towers

| Distance from Tower (m) | Slope, not Greater Than (%) | Maximum Obstruction or Vegetation Height (m) |
|----------------------------|--------------------------------|---|
| 0 – 15 | ± 2 | 0.3 |
| 15 - 30 | ± 3 | 0.5 – 1.0 (most vegetation < 0.3) |
| 30 - 100 | ± 7 | 3.0 |
| 100 - 300 | ± 11 | 10 x obstruction height (must be less than the distance to obstruction) |

- Wind Speed and Wind Direction

The most important meteorological parameters measured are *Wind Speed* (WS) and *Wind Direction* (WD). There are various types of monitors: cup anemometer with vane system, propeller anemometer with vane system, and sonic anemometers. CAB typically uses the propeller type WS/WD sensor that is mounted on a tower secured to the air monitoring shelter.

The standard exposure of wind instruments over level, open terrain is 10 meters above the ground. Open terrain is defined as an area where the horizontal distance between the instrument and any obstruction is at least 10 times the height of that obstruction. When wind instruments are mounted to towers attached to structures (monitoring shelters), the height of the structure must be accounted for.

Wind instruments should be mounted securely on a mast that will not twist, rotate, or sway. Sensor height and its height above obstructions, as well as the character of nearby obstructions, should be documented in site logbooks.

- Relative Humidity and Temperature

For the CAB NCore site the relative humidity and temperature measurements are performed by one device, a *Relative Humidity/Temperature Probe*. Relative humidity and ambient temperature sensors must be shielded from solar and terrestrial radiation, precipitation, and wind influences. Shields can be naturally ventilated, or motor aspirated. CAB typically uses the naturally ventilated shield.

The probe is installed in a location with good air circulation clear of large thermal masses such as buildings, pavement, solar panels, exhaust vents, electrical machinery, water fountains, and sprinklers.

Relative Humidity/Temperature Probes should be mounted over a plot of open ground at least 9 meters in diameter. The ground surface should be covered with non-irrigated or un-watered short grass or, in areas where grass does not grow, natural earth. Gravel surfaces are also acceptable. Concrete, asphalt, or oil-soaked surfaces are not acceptable.

The standard height for climatological purposes is 1.25 to 2 meters. Generally, the probe is mounted 2 meters above the ground level, with the inlet facing away, and no less than 1.5 times the tower diameter, from the tower. Probes should not be closer than four times the height of the nearest obstruction, such as trees or buildings. CAB typically mounts the Relative Humidity/Temperature Probe on the meteorological tower secured to the air monitoring shelter, more than the required two meters above the top of the roof.

B.2.3.1 Sample Residence Time

Sample residence time, defined as the amount of time that it takes for a sample of air to travel from the opening of the probe or cane to the inlet of the instrument, shall be less than 20 seconds for gas monitors. Residence time within the manifold and sample lines to the instrument shall be less than 10 seconds. A blower motor or other device, such as a vacuum pump, can be used to decrease the residence time so that it conforms to requirements.

The residence (**TR**) time for a manifold system shall be determined, as detailed in the EPA document: *Technical Note- Clarifications and Guidance on Residence Time Determination*, dated June 3, 2019. Residence time shall be calculated as follows:

1. Determine the total volume of the sampling system (cane, manifold, & sample lines):

$$\text{Total Volume} = \mathbf{Cv} + \mathbf{Mv} + \mathbf{Lv}$$

where: **Cv** = Volume of the sample cane and extensions
Mv = Volume of the sample manifold and trap
Lv = Volume of the instrument lines

2. Calculate the sum of the volumes of each sampling system component, determined using the following equation:

$$\mathbf{V} = \mathbf{L}\pi\mathbf{r}^2$$

where: **V** = volume of the component

$$\pi \approx 3.14159$$

L = length of the component

r = inside radius (1/2 inside diameter)

3. Residence time is determined by dividing the total sampling system volume by the sum of the flow rate of all the instruments sampling from the manifold, thus:

$$\mathbf{TR} = \text{System Volume} \div \text{Total Flow Rate}$$

The residence time of sampling systems shall be determined, as above, annually, or whenever system components change. CAB personnel shall document the calculations onto the station's *Residence Time Sheet* located on the CAB Operations SharePoint site.

B.2.3.2 Sample Manifold and Probe Design

The sampling system shall be used to collect outdoor air and deliver it to gas analyzers and shall be constructed of inert materials. A typical sample system, consisting of a borosilicate glass manifold with Teflon® fittings and inert tubing, is shown in *Figure B-2*. Alternate systems may also be used such as the *Sampling Lines as Inlet and Manifold* design or the *California Air Resources Board "Octopus" Style* design, which are both described in the *QA Handbook, Volume II, Appendix F*.

The manifold, intake vent, and interconnecting tubing design provide a minimum number of bends to avoid particles impacting onto surfaces. Impacted particles provide surfaces to which criteria pollutants may absorb, lowering the apparent analyte concentration. Such surfaces may also catalyze reactions which change analyte concentrations once the outside air enters the sampling system. The sampling system shall also be designed to prevent water from being retained in the system and from entering the analyzer. Any liquid entrained in the active sampling system will yield inaccurate environmental data. The airflow through the sampling system, as determined by the blower capacity, shall be sufficient to keep the residence time of gases in the sampling system less than 20 seconds. The airflow through the manifold shall not be so great as to cause the pressure inside the sampling system to be more than 1.8 mmHg below the ambient pressure outside the sampling system. These two constraints limit the allowable configuration for the sample probe and manifold.

The sampling system shall be inspected monthly and shall be cleaned at least once every six months, or more often, as required. Residue build-up on the inside of the manifold will absorb pollutants from the air stream during high concentration periods and release pollutants during low concentration periods, thus skewing the data collected. CAB MA personnel shall document manifold cleaning in the station's *Site Visit Logbook* located on the CAB Operations SharePoint site.

Figure B-2 Borosilicate Glass Manifold Configuration



B.2.4 Monitoring Methods and Technology

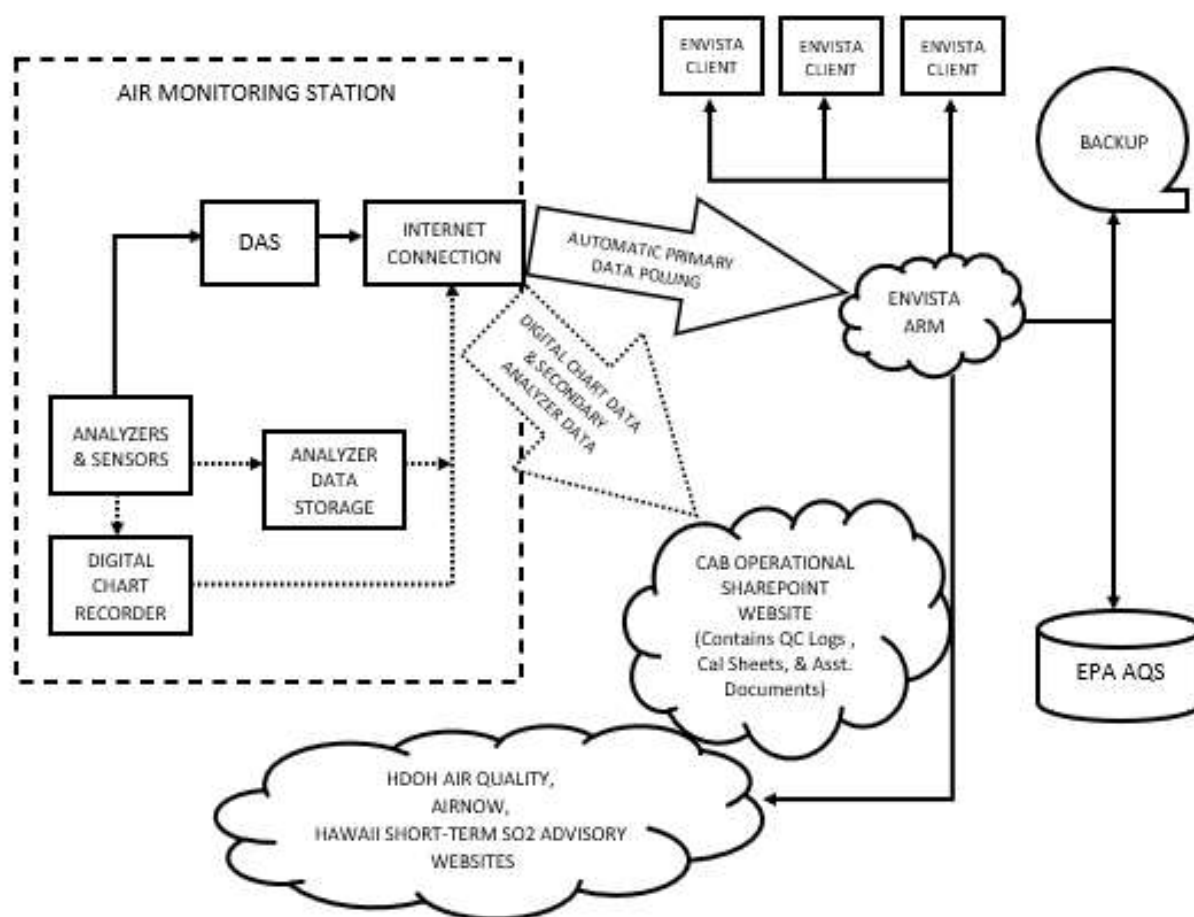
The HDOH uses only FRM or FEM monitors for both gases and PM as specified in *40 CFR Part 50*. The method and technology used for each criteria pollutant are detailed in this QAPP and SOPs (*Appendix I*).

B.2.4.1 Electronic Data Collection for Gas and PM Continuous Monitors

Criteria pollutant concentration data shall be collected electronically, at pre-determined intervals, from the scientific instruments located at each of the monitoring stations in the network. Monitoring instruments provide real-time analyte concentration data, at time intervals determined by instrument design and use. All instruments shall be used as detailed by the manufacturer, to ensure that all analyte concentration data meet all applicable EPA analysis requirements.

Electronic data generated by instruments and sensors is collected by a *Data Acquisition System* (DAS). The DAS also collects “metadata” from the monitors, this data is comprised of instrument operating temperatures, internal flow rates, lamp voltages, and so on. The DAS is a PC based data logger located in monitoring stations. The main air monitoring data system is comprised of a central database that uses *Envista Air Resources Manager* (Envista ARM) software and networked with Envista ARM client computers. The Envista ARM cloud server automatically polls the air monitoring stations DAS every three minutes via the internet, retrieving data from site data loggers. Some air sites do not have shelters, a site may consist of just a PM single monitor. For these stations, there are no on-site Envistas data loggers, data is transmitted directly from the instrument to the central database via modem. Refer to *Figure B-3* for the Electronic Data Flow Diagram.

Figure B-3 Electronic Data Flow Diagram



Site operators can log into an air station's data logger via *Microsoft Remote Desktop*. Stand-alone particulate monitors are accessed with manufacturers' software.

Once data is stored on the main database, the data can be accessed via Envista ARM client computers. Only CAB MA staff and the QAO have Envista ARM software and access rights to this data.

The air stations have various instruments and sensors connected to paperless chart recorders or data is directly uploaded into excel files; this secondary data is filed separately from the Envista ARM DAS. These files serve as a backup when the DAS fails to collect data. Site operators and IT Specialist routinely collect, review, and upload the chart recorder data and Met One BAM data files onto the CAB Operations SharePoint site. This SharePoint site is where the CABAMP stores its operational documents and records, such as site logbooks, data sheets, QC logs, maintenance logs, audit reports, inventory records, SOPs, network information, and instrument manuals.

Details of data collection, retrieval, and management are provided in *Section B.10*. Common corrective actions are provided in *Table B-11* Common Field Corrective Actions.

Table B-11 Common DAS Related Field Corrective Actions

| Item | Problem | Possible Actions | Notification |
|------------------------------|---|--|--|
| Hourly Data Inspection | Missing or non-representative for the site location | <ol style="list-style-type: none"> 1. Inspect data stream for clues as to what may have occurred, i.e. power failure, instrument failure. 2. Perform calibration. 3. If analyzer has failed, repair. | <ol style="list-style-type: none"> 1. Document in logbook and flag data. 2. Notify CAB MA technicians and Data Validation Personnel. |
| Analyzer Fault Lights Active | Analyzer component has exceeded a manufacturer's tolerance value. | <ol style="list-style-type: none"> 1. Inspect the analyzer immediately by scrolling through the analyzer operating parameters to determine component levels. Call the manufacturer if a solution cannot be found. 2. Repair the unit. 3. Perform calibration. | <ol style="list-style-type: none"> 1. Document in logbook and flag data. 2. Notify CAB MA technicians and Data Validation Personnel. |
| Analyzer Power | Power Interruptions | <ol style="list-style-type: none"> 1. Check line voltage. 2. Check circuit breaker. | <ol style="list-style-type: none"> 1. Document in logbook and flag data. 2. Notify CAB MA technicians and Data Validation Personnel. |
| DAS Power | LCD panel on, but sample not working. | <ol style="list-style-type: none"> 1. Check line voltage. 2. Check circuit breaker. | <ol style="list-style-type: none"> 1. Document in logbook and flag data. 2. Notify CAB MA technicians and Data Validation Personnel. |
| Data Downloading | Data will not transfer from DAS | <ol style="list-style-type: none"> 1. Check line voltage. 2. Check circuit breaker. 3. Check modem. 4. Check DAS. | <ol style="list-style-type: none"> 1. Document in logbook and flag data. 2. Notify CAB MA technicians and Data Validation Personnel. |

B.2.4.2 Sample Collection for Particulates using Manual Methods

B.2.4.2.1 PM_{2.5} Filter Sample Collection

When a physical sample of particulate matter is collected, a monitoring device passes ambient air through a filter. For PM_{2.5} the volume of air to be sampled and flow rate are specified in *40 CFR Part 50 Appendix L Section 3.3 & 7.4.3.1*, and CAB SOP (*Appendix I*). The total volume of air collected shall be 24 m³, based upon a 24-hour sample period (± 1) hour. If a sample period is less than 23 hours or more than 25 hours, the sample will be flagged. The sample flow rate of air is 16.67 L/min.

This methodology utilizes pre-weighed filters that are placed in a carefully controlled volumetric flow for a specified period of time such that a specified air volume (24 m³) passes through the pre-weighed filter. The mass added to the filter, divided by the volume of air passed through the filter, yields the average particulate concentration during the sampling period.

Trapped particulate matter is separated using an inertial separator on the inlet stream. These inertial separators selectively pass particulate matter classified as PM_{2.5}. The specific operations of the PM_{2.5} monitors shall be conducted according to the SOP in *Appendix I*.

Manual filter-based monitors require filters to be changed between each sampling period, sampling dates are determined by the US EPA. The filters are precisely weighed by a contract laboratory, shipped to the CAB MA building (under COC), and delivered to each sampling site for use (under COC). Once used, filters are returned to the CAB MA building (under COC) and shipped back to the contract laboratory (under COC). Filters are shipped within timelines specified in the CAB MA SOP (*Appendix I*) to ensure hold times for weighing can be met by the contract laboratory (see *Section D.1.4.2, Table D-5* for details). After reception, the contract laboratory conditions the filters, as per US EPA regulations, and reweighs the filters. The resulting difference in mass is the mass trapped during sampling.

The filter-based samples collected at the CAB Kapolei site serve dual purposes, i.e., NCore and criteria pollutant monitoring. For PM_{2.5}, the continuous sampler at this site is the FEM monitor (primary) and the filter-based sampler is the FRM collocated monitor. At this site, the FRM filters are installed and collected at a 1-in-3 day frequency. There could potentially be more FRM samplers installed at other sites with a 1-in-6 or 1-in-12 day frequency.

Exposed filters are sent back to the contract laboratory for post weigh processing. The contract laboratory sends the final filter processing reports to the CAB MA supervisor on a quarterly basis. These reports are reviewed, and the data results are entered onto the Envista database by CAB MA personnel, quarterly.

For continuous PM_{2.5} collocation, the primary and collocated samplers are located at the CAB Konawaena School site. Continuous PM₁₀ monitoring does not require collocation. Refer to *Table B-12* for Particulate Collection Frequency and Acceptance Criteria.

Table B-12 Particulate Collocation Frequency and Acceptance Criteria

| Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|---|---|--|--|
| PM _{2.5} Precision Collocated Samples | Minimum is 1 in 12 days (CAB conducts 1 in 3 days) | CV ≤10.1% of samples >3 µg/m ³ | 40 CFR Part 58, App A, Section 3.2.5 and CAB QAPP specific sampling frequency to meet NCORE and criteria pollutant requirements |

B.2.4.2.2 Particulate Collocated Samples

The filter-based samples are collected from the Kapolei site to serve a dual purpose, i.e., NCORE and criteria pollutant monitoring. For PM_{2.5}, the continuous instrument serves as the primary sampler and the filter-based sampler is designated as the collocated sampler. PM_{2.5} filter samples are currently collected by CAB at a 1-in-3 day frequency to meet NCORE requirements.

The 1-in-3 and 1-in-6 day sampling frequency for collocated samples are more stringent and exceeds the 1-in-12 day frequency required for collocated criteria pollutant monitoring.

B.3 Sample Handling and Custody Requirements

Maintaining sample integrity within the data collection phase involving physical samples (e.g. filters) is critical. This includes the handling of the media prior to sampling, during transport to the field, in the field at the time of collection, during transport from the field back to the laboratory, and in the analysis. Documentation of these processes ensures that proper handling has occurred at all phases and is part of the custody record.

In addition to collection of physical samples, hard copy field data (e.g. FRM sampler field data sheets and COCs) and electronic data (e.g. data and metadata downloaded from data loggers and directly from monitors, as listed in EPA document *40 CFR, part 50, Appendix L, Table L-1, in Column headed: End of period*). This data is integral to the data collection process, is irreplaceable, and represents the primary information upon which decisions are based. Chain of custody procedures apply to these types of data whenever they are transported and/or have a change of custody.

Handling and custody procedures are integral to sample preparation, identification and labeling, collection, transportation, analysis, storage and archiving, chain of custody, and inspection and acceptance are detailed in this QAPP and applicable SOPs (*Appendix I*).

The process of handling data records in the field from collection and transit through storage and analysis, is critical due to the potential use of the data for comparison to the NAAQS.

PM_{2.5} Filters

All filter-based operations shall follow the CAB Filter-Based PM_{2.5} Sampling SOP (see *Appendix I*). This SOP details all aspects of the transportation, collection, and validation of filter based PM_{2.5} samples and data. In general, CAB receives (biweekly) shipments of pre-weighed filters from the contract laboratory. Manual filter-based monitors require filters to be changed between each sampling period, sampling dates are determined by the US EPA. The filters are precisely weighed by a contract laboratory then shipped to the CAB Filter

Processing Area (FPA). When Filters are received at the FPA a CAB internal Chain of Custody form is created for each filter. Filters are logged and assigned sample dates from the EPA schedule. All filters are then delivered to the sampling sites under an internal CAB COC.

Some filters are designated as *field blanks* as outlined in *EPA-454/B-16-001, January 2016, QA Guidance Document 2.12*. Per guidance document, there is at least one field blank per weighing session. When at air site, field blanks are installed, then immediately removed from the sampler, and stored in a protective container inside the sampler during a sample run. Or preferably, installed in an idle single-filter sampler for 24 hours (prior to an actual sample run) then removed and processed. For sequential samplers, filters are installed in an unused holder.

All exposed filters are returned to the CAB FPA then mailed back to the contract laboratory under an external CAB COC, a Filter Relinquish & Receipt Form, which is signed and dated when sent out and upon receipt at PACE/IML. All filter movements are tracked using COC procedures and all packaging is secured with custody seals as detailed in the CAB Filter Handling SOP (*Appendix I*). Filters are shipped within timelines specified in the CAB SOP (*Appendix I*) to ensure hold times for weighing can be met by the contract laboratory. Upon receipt at the contract laboratory, filters are recorded into the PACE Data Management System, then conditioned and re-weighed per EPA regulations. The resulting difference in mass is the mass trapped during sampling.

Exposed filters are placed in an archiving container in cold storage ($\leq 4^{\circ}\text{C}$) at the contract laboratory facility for a minimum of one year. After one year the CAB is notified and consulted for disposition of exposed filters. Filters must be archived for a total of five years after post weighing.

Table B-13 Common Field Corrective Actions for PM_{2.5} Samples

| Activity | Problem | Possible Actions | Notification |
|-------------------|--------------------------------------|--|--|
| Filter Hold Times | >7 days 9 hours from sample end date | 1. Ensure personnel retrieves samples on time. | 1. Document in COC. 2. Document in station log and AQET II of any malfunctioning sampler. |
| Sampling Period | Not within 1380 to 1500 minutes | 1. Verify if sampler ran. 2. Verify sampler timer set correctly. 3. Verify sampler timer operating correctly. 4. Program sampler to run while operator is at site. | Document in COC and notify EMSU AQET II of any malfunctioning sampler. |
| Sample Flow Rate | Out of specifications | 1. Use a flow verification sample filter. 2. Verify sampler flow rate with appropriate flow rate device. 3. Determine cause of sampler flow rate malfunction and recalibrate sampler if necessary. | Document in COC and notify EMSU AQET II of any malfunctioning sampler. |

The filter-based sample collected at the CAB Kapolei site serves dual purposes, i.e., NCore and criteria pollutant monitoring. For PM_{2.5} the continuous sampler at this site is the FEM monitor (primary) and the filter-based sample is the FRM collocated monitor. At this site,

the FRM filters are installed and collected at a 1-in-3 day frequency. There could potentially be more FRM samplers installed at other sites with a 1-in-6 or 1-in-12 day frequency.

B.3.1 Data Labeling and Identification

Care shall be taken to properly mark all samples and monitoring device readings to ensure positive identification throughout the analysis procedures. All data are subject to legal proceedings; therefore, all transportation, handling, and sampling procedures shall follow the chain of custody procedures described in *Section A.9.3.3.3* of this QAPP, Particulate Filter Handling Records. All hardcopy data records shall be completed in indelible ink, scanned, and saved onto the CAB Operations SharePoint site.

B.3.1.1 PM_{2.5}

PM_{2.5} filters shall be stamped with unique ID numbers. These numbers shall be used for tracking the filters from receipt by the contracted weighing laboratory (sent directly to the laboratory from the EPA filter contractor) to final analysis. Filters shall be properly handled to ensure that there is no contamination and to ensure that the sample analyzed is the sample taken under the conditions reported. Filters shall not be used if they show any sign of damage. The Filter-based PM_{2.5} Sampling SOP (*Appendix I*) provides details.

B.3.1.2 Gaseous Pollutants and Continuous PM

See *Section B.2.4.1*, of this QAPP. Gaseous analyzers use paperless electronic chart recorders as a secondary logging system to the main data logger, which serves as a backup when the main data logger fails to collect data. The data files are compressed and are named with Site ID and date range (e.g. Monarch Data File DH1 2015-01-25 to 2015-02-03.zip). PM_{2.5} analyzers are equipped, by the manufacturer, with an internal data logger.

B.3.2 Transportation

The CAB MA personnel responsible for the transport of filters from the CAB building to the sites and back again shall be able to testify that no tampering occurred during sample transport and that the filters were always secured either with the person or in a locked vehicle. Filters shall not left be unattended unless in a locked vehicle and then for the minimal amount of time. Exposed filters shall be transported from the sampling site to the CAB building in a cooler containing ice packs and a min/max thermometer. After delivery to the laboratory, the PM_{2.5} filters are kept in a refrigerator. Access to the CAB building has restricted access.

B.3.3 Chain of Custody

Filter Based Monitors PM_{2.5}

All filter transportation and storage shall use COC procedures, as mentioned in *Section A.9.3.3.3* of this QAPP and the CAB Filter Handling SOP (*Appendix I*).

Filters are received from the contracted laboratory at the CAB *Filter Processing Area* (FPA). The FPA is a secured room currently located in the State Laboratories Division, access is limited to CAB personnel only. At the FPA individual filter numbers are entered onto the CAB Operations SharePoint site *Filter Tracking Log* by CAB technicians.

A CAB *Chain of Custody* (COC) form is created for each filter, it is essential to track filters with COC forms as they travel to air monitoring stations, back to the FPA, then return to the contracted laboratory for final analyses. COC forms demonstrate that the filters were always in possession of authorized CAB personnel and that the filter integrity was uncompromised (i.e., that the filter analyzed was the filter used to collect a specific sample). Filters shall be handled by the fewest number of authorized staff members as possible. Each person handling the filter samples must be able to document from whom the filter was received and to whom the filter was relinquished. *Figure B-4* of this QAPP is the COC form used by CAB to establish the chain of custody for PM_{2.5}. All parties who take possession of the filters shall initial the COC form. COCs shall be scanned into PDF files and archived onto the CAB Operations SharePoint site and the hardcopies filed at the CAB FPA by CAB technicians. Once the filters are mailed, the CAB COC form ends tracking. Upon receipt, each filter is assigned a sample run date, some filters are designated to be field blanks. All filters must be post weighed within 30 days of the pre-weigh date. Therefore, a sample run date is assigned to fall within two weeks of when a filter is received, thus giving enough time to mail the filter back to the contract laboratory for post weigh processing.

To send filters back to the contracted laboratories, filters shall be inserted into a custody (evidence) bag that is signed and dated by the FPA technician. The custody bag is then packed into an insulated container with ice packs and travel min/max thermometers per EPA guidance and CAB Filter Handling SOP (*Appendix I*). Since the CAB COC ends upon shipping, a *Filter Relinquish & Receipt Form* is sent with the filters to the contract laboratory. This form lists all filters included in shipment, their respective sample dates, filter barcode stickers, attached tab from custody bag, temperature at shipping, and the signature/date of when the technician in the FPA sealed the package. See a sample of a completed Filter Relinquish Form in *Figure B-5* of this QAPP. Packaged filters are shipped via Federal Express; the air shipment bill shall be retained as a record along with the COCs and *Filter Relinquish & Receipt Form* (if needed, the package is able to be tracked if lost in transit). The shipment shall be addressed to a staff member authorized to receive the package at the contract laboratory.

The Filter Relinquish & Receipt Form enclosed in the shipping package identifying the individual relinquished samples is signed and dated upon receipt at the contracted weighing laboratory. The party receiving the package at the contracted laboratory shall complete this form and retain it for their records.

All records for filter handling shall be kept by CAB. Hard copies will be at the CAB FPA and electronic copies on the CAB Operations SharePoint site. After a year has passed, the contract laboratory mails all the filters from the previous year back to CAB FPA, usually during the first few weeks of January. Filters are saved for a minimum of five years, the first year (12 months) is under chilled conditions per *40 CFR Part 58.16 (f)*.

Figure B-4 Chain of Custody Form for PM_{2.5}

| CAB PM _{2.5} CHAIN OF CUSTODY FORM (CAB, 10/26/2022, v.12) | | | | |
|--|------------------------|---------------------------------------|--|-----------------------|
| Site: _____ | | Instrument Type: _____ | | Instrument s/n: _____ |
| Filter ID Number: _____ | | | | |
| Scheduled Start Date: _____ | | Actual Start Date/Time: _____ / _____ | | |
| Scheduled End Date: _____ | | Actual Start Date/Time: _____ / _____ | | |
| Instrument Flags? yes <input type="checkbox"/> no <input type="checkbox"/> | | attach barcode sticker here | | |
| Run Data downloaded from sampler? yes <input type="checkbox"/> no <input type="checkbox"/> | | | | |
| FILTER CHAIN OF CUSTODY | | | | |
| | Date | (Time) | Initials | Print Name |
| Received from PACE/IML | () | () | | |
| Checked Filter Integrity? yes <input type="checkbox"/> no <input type="checkbox"/> | () | () | | |
| Relinquished By Filter Processing Area (FPA) | () | () | | |
| Received By Station Operator | () | () | | |
| Brought to Air Monitoring Site | () | () | | |
| Checked Filter Integrity? yes <input type="checkbox"/> no <input type="checkbox"/> | () | () | | |
| Installed in Sampler | () | () | | |
| Average Sampling Temperature _____ °C | () | () | | |
| Removed from Sampler | () | () | | |
| Chilled Post Sampling? yes <input type="checkbox"/> no <input type="checkbox"/> | () | () | | |
| Temperature Upon Receipt at FPA _____ °C | () | () | | |
| Relinquished By Station Operator | () | () | | |
| Received by FPA | () | () | | |
| Relinquished by FPA to Shipper | () | () | | |
| Sample Temperature at Shipping _____ °C | () | () | | |
| Shipping Vendor: _____ | | | Fill this portion out when shipping filter back to PACE/IML | |
| Shipping Tracking Number: _____ | | | | |
| Evidence Bag Number: _____ | | | | |
| Recording Thermometer Number: _____ | | | | |
| LOCAL CONDITIONS | | | | |
| (check all that apply) | During Installation | During Removal | | |
| Windy | | | | |
| Rain | | | | |
| Sunny | | | | |
| Hazy | | | | |
| Forest Fire | | | | |
| Grounds Maintenance | | | | |
| Construction/Demolition | | | | |
| Highway Construction | | | | |
| Prescribed Burning | | | | |
| Volcanic Activity | | | | |
| COMMENTS | | | | |
| | | | | |

**Figure B-5 Sample of filled in Filter Relinquish & Receipt Form
(older version)**

| -FILTER RELINQUISH & RECEIPT FORM - | | | | | | |
|---|---|---|-----------------|---|---------------------------------|------|
| Hawaii Department of Health, Clean Air Branch | | | | | | |
| FILTER SHIPMENTS TO PACE/IML Laboratories | | | | | | |
| ITEM | LAB ID (Lab Use Only) | SAMPLED DATE | TIME | FILTER BAR CODE | COMMENTS | |
| 1 | | 9/18/2022 ALT | '0000 | T0613061 | NC22-ESEQ ALTERNATE SAMPLING | |
| 2 | | 9/20/2022 | '0000 | T0613069 | NC22-ESEQ | |
| 3 | | 9/23/2022 | '0000 | T0613070 | NC22-ESEQ | |
| 4 | | 9/26/2022 VOID | '0000 | T0613071 | NC22-ESEQ -VOIDED RUN | |
| 5 | | 9/29/2022 | '0000 | T0613072 | NC22-ESEQ | |
| 6 | | 10/2/2022 | '0000 | T0613073 | NC22-ESEQ | |
| 7 | | 10/2/2022 FB | '0000 | T0613074 | NC22-ESEQ-FIELD BLANK | |
| | | DEPARTMENT NAME <u>HI DOH - CAB. AM</u> | | | | |
| | | RECEIPT NO. _____ | | DATE <u>11/8/2022</u> | | |
| | | RECEIVED BY <u>J.A. Licudine</u> (SIGNATURE) | | 00941082 | | |
| Lab Comments | Relinquished by (Signature / Printed Name) | Date | Time | Received by (Signature / Printed Name) | Date | Time |
| Shipping Temp = 3.5°C | <u>J.A. Licudine</u> | <u>11/8/2022</u> | <u>11:30 AM</u> | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| SHIPPING AGENCY : <u>Federal Express</u> TRACKING # : <u>7719 1550 2392</u> | | | | | | |
| RECORDING THERMOMETER ID # : <u>AIRLAB 20-01</u> EVIDENCE BAG # : <u>00941082</u> | | | | | | |

Continuous Monitor Electronic and Chart Data

COCs are not used when transmitting continuous monitor electronic data. Refer to *Figure B-3, Section B.2.4.1, Electronic Data Collection for Gas and PM Continuous Monitors and Section B.3.1.2, Gaseous Pollutants and Continuous PM*, of this QAPP. Data on Envista ARM and chart recorder data saved on the CAB Operations SharePoint site shall be kept for a minimum of 5 years, after this time data may be removed.

B.4 Analytical Methods Requirements

Most of the ambient air monitoring equipment is continuous instruments and does not involve laboratory analysis. The laboratory analyses performed in the CABAMP are for filter based PM_{2.5} methods and are conducted by contracted laboratories.

B.4.1 Purpose/Background

The individual monitoring instruments used for analysis of the continuous criteria and NCore pollutants are identified in *Table A-4*, of this QAPP. This table lists the equipment and analytical methods used to complete the analyses of the data collected throughout the CABAMP monitoring network. An EPA approved air monitor is basically classified as a *Federal Reference Method* (FRM) or a *Federal Equivalent Method* (FEM), as described 40 CFR Part 50 and 58.

Non-continuous instruments, such as filter based FRM PM_{2.5} analyzers, data collection require gravimetric and analytical methods, respectively. Samples are captured on a pre-weighed filter medium; the filter is then post weighed to determine pollutant concentrations. Sampling methods are discussed in this QAPP, *Section B.2.4, Monitoring Methods and Technology*. Continuous FEM analyzers are used to measure for; CO, NO_x, O₃, SO₂, PM₁₀, and PM_{2.5}. These analyzers are designed as completely contained monitoring units and do not require additional analytical methods to establish the pollutants' environmental concentrations.

The PM_{2.5} speciation samples for NCore are sent to the EPA contractor for analysis. The EPA contractor has an approved QAPP that is followed for the sample analysis. See Quality Assurance Guidance Document EPA-454/B-12-003, June 2012, and addendum dated 5/15/2014, for details on PM_{2.5} Chemical Speciation Sampling (*Appendix V*).

B.4.1.1 Carbon Monoxide: Continuous Gas Filter Correlation

Determination of CO and CO Trace-Level (for NCore) concentrations are based on a Beers-Lambert Law correlation between the absorbance of *Infrared* (IR) light (at a wavelength of 46 μ) and the concentration of CO in a gaseous sample. Broadband IR is generated and then modulated using *Gas Filter Correlation* (GFC) technology. GFC utilizes a rotating wheel containing two gas filled cells that selectively modulate the IR light. One cell contains nitrogen (the measurement cell), while the other contains CO (the reference cell). This configuration modulates the IR into reference and measure pulses.

During the reference pulse, the CO in the gas filter wheel absorbs all IR light at 4.6 mm, resulting in a reference reading.

During the measure pulse, the nitrogen in the filter wheel does not absorb any of the 4.6

mm light passing through. This unattenuated light passes into the sample cell, where any CO present absorbs light proportionately to the CO concentration. Sample sensitivity is increased (lowering detection limits) using standard multi-pass optical techniques.

Upon exiting the sample cell, the IR light passes through a band-pass filter and strikes a thermoelectrically cooled, solid-state photoconductor. This solid-state device, coupled with its support circuitry, amplifies the signal generated by the modulated IR beam and outputs a modulated voltage. This voltage is de-modulated, resulting in two voltage signals associated with the reference and measurement pulses. The ratio of the de-modulated voltage signals is indirectly proportional to the concentration of CO in the sample being evaluated. The specific operation of the carbon monoxide analyzer is conducted according to the SOP in *Appendix I*.

B.4.1.2 Nitrogen Dioxide and Oxides of Nitrogen: Continuous

B.4.1.2.1 CAPS Spectroscopy

Method for Criteria Pollutant. The operating principle for NO₂ analysis is Cavity-Attenuated Phase-Shift (CAPS) spectroscopy which renders true measurements. This monitoring method operates as an optical absorption spectrometer, wherein the absorbance (lost light) is directly proportional to the path-length and concentration of the absorbing gas (Bee-Lambert law), providing direct measurement of NO₂.

Measurement components consists of; an optical cell, a pair of highly reflective spherical mirrors centered at 450nm (strong NO₂ absorbance band), a *Light Emitting Diode* (LED), and a vacuum photodiode detector. The LED is located behind a mirror at one end of the cell, and the detector behind the other mirror at the opposite end of the cell. The LED emits *Ultraviolet Light* (UV) into the cell; the light reflects back and forth between the two mirrors, building intensity and running a very long path length. The long path length extends the “time” of “life” of the photon, thus providing ample time to measure absorbance when NO₂ is present. Using precisely timed data acquisition coupled with an algorithm the measured absorption is translated into a phase shift, from which the NO₂ concentration is calculated. The phase shift decreases as the NO₂ signal increases.

The CAPS method is faster than the traditional chemiluminescence method since the sample does not require cycling through a catalytic converter to calculate a difference measurement. This faster method also makes the measurement more precise due to the ability to capture samples closer to “real time.” The specific operation of the nitrogen dioxide analyzer is conducted according to the SOP (*Appendix I*).

B.4.1.2.2 Chemiluminescence

Method for NCore. *Nitrogen oxides* (NO_x) is the sum of *Nitric Oxide* (NO) and NO₂. *Reactive Oxides of Nitrogen* (NO_y) include all the nitrogen oxide compounds that are emitted to the atmosphere or that are formed in the lower atmosphere. The NO_y compounds include, NO, NO₂, and other organic and inorganic nitrogen containing species. Both NO_x and NO_y are measured using the same measurement principle.

The principle of measurement is based upon the reaction of a NO molecule with an internal source of O₃ in an evacuated reaction cell that results in the emission of light.

Single channel instruments divide the sample into two streams. The first stream passes the sample directly to the evacuated reaction cell. A reaction between the NO present in the sample and the analyzer supplied O₃ occurs. The resulting light emitted by the reaction is monitored and correlated to the concentration of NO in the sample.

The second stream of sample gas is passed through a converter. For NO_x, a photolytic converter is used to selectively reduce the NO₂ to NO. This second stream, now containing NO from both the reduction of NO₂ and the original NO, is cycled through the evacuated reaction cell where the new augmented concentration of NO is measured. The measurement of the untreated sample provides an NO concentration, while the measurement of the converted sample provides a measurement of the NO_x concentration. Subtracting the NO concentration from the NO_x concentration yields the NO₂ concentration. Periodically, a background measurement is taken to correct the zero offset of the instrument to maintain zero stability.

For NO_y, a catalytic converter is used to reduce the NO_y components to NO. The catalytic converter is positioned at the extreme sample inlet 10 meters above grade and has an enhanced sample flow rate of approximately 10 liters per minute to minimize any reactions in the sample line. This second stream, now containing NO from both the reduction of NO_y and the original NO, is cycled through the evacuated reaction cell where the new augmented concentration of NO is measured. The measurement of the untreated sample provides an NO concentration, while the measurement of the converted sample provides a measurement of the NO_y concentration. The specific operation of the Nitrogen Oxides analyzer is conducted according to the SOP in *Appendix I*.

B.4.1.3 Ozone: Continuous Ultraviolet Photometry

Method for Criteria Pollutant and NCore. The principle used to measure O₃ concentrations is based on a Beers-Lambert relationship between the absorption of UV radiation at 245 nm and the concentration of the ozone in the sample.

The UV photometer splits the sample into two streams. One stream is directed into a measurement cell and the second stream is passed through a catalytic converter to remove all traces of O₃. This measurement cell has a specified length, a UV source at one end, and a photometer at the other end. The analyzer allows a specified time to pass, determined by the cell volume and the sample flow rate, to ensure that a clean, uniform sample is present in the cell. A measurement is taken of this sample over the subsequent, equal time span. Next, the instrument cycles the catalyzed sample into the cell, utilizing the same time spans to ensure that a clean, O₃-free sample exists in the cell prior to measuring the O₃-free UV attenuation level. The cycle is then repeated with a new O₃ containing sample. Specific operation of the O₃ analyzer is conducted according to SOP (*Appendix I*).

B.4.1.4 Sulfur Dioxide: Continuous Pulsed Fluorescence

Measurement of SO₂ and SO₂ Trace-Level (for NCore) concentrations occur by exciting an electron using 214 nm UV radiation. Subsequent electron relaxation processes result in fluorescence from the excited SO₂ molecules. A photomultiplier tube measures the fluorescence emissions, which has an intensity proportional to the concentration of SO₂ present in the sample. A reference detector continuously monitors the intensity of the UV lamp, used to excite the molecule, 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 sample entering the measurement chamber. The specific operation of the sulfur dioxide analyzer is conducted according to the SOP (*Appendix I*).

B.4.1.5 Manual Particulate Sampling

FRM PM_{2.5} (filter-based) monitoring utilizes gravimetric analysis, to determine the pollutant concentrations present on the filter and, thus, the environment. PM_{2.5} mass determination is performed by the weighing laboratory. The net weight gain of a filter is exactly the captured particulate mass. This net weight gain is obtained by subtracting the initial filter weight from the final weight of the exposed filter. Once calculated, the net weight gain can be used with the total filter flow to calculate the concentration for comparison to the NAAQS.

Filters are received in cassettes per *Quality Assurance Guidance Document 2.12 Monitoring PM_{2.5} in Ambient Air Using Designated Reference or Glass I Equivalent Methods, EPA-454/B-16-001 January 2016*. Pre-weighed filters are logged, verified as meeting *40 CFR, Part 50, Appendix L, Section 6* requirements, and tracked through the CAB Filter Processing Area (FPA) (*Section A.9.3.3.3*). Exposed filters are mailed back to the weighing laboratory where they are post-weighed, and reports are generated. Reports are sent to CAB and archived. Actual filters are archived for five years. The first year is under chilled conditions per *40 CFR Part 58.16(f)*.

B.4.1.6 PM_{2.5}: Continuous Operation, Met One BAM 1022

The *Beta Attenuation Mass* (BAM) monitor consists of three components: the central unit, the sampling pump, and the sampling inlet hardware. The mass density is measured using beta attenuation. A 14C beta source (60 µCi) is coupled to a sensitive detector that counts the emitted beta particles. The instrument can calculate 1 hour to 24 hour averages and allows for long term unattended remote operation. Automatic zero and span calibrations are conducted each sampling cycle.

The sample inlet systems consist of a PM₁₀ head (BX-802) and a PM_{2.5} *Very Sharp Cut Cyclone* (BX-808). Ambient air is drawn through the inlet initially through the PM₁₀ “coarse” head, where sample particles are separated into the 10 microns and less. The pre-separated sample then enters the PM_{2.5} cyclone where particles are further separated into the 2.5 micron and less size. These smaller sized particles are deposited onto the glass fiber filter tape in the analyzer.

At the start of the sampling period beta ray transmission is measured across a clean section of glass fiber filter tape. This section of filter tape is then mechanically advanced to the sampling inlet. Particulate matter is drawn into the sample inlet and deposited onto the filter. At the end of the sampling period, the filter tape is returned to its original location between the beta source and the detector, and the beta ray transmission is re-measured. As the particulates deposited on the filter tape increase, the measured beta particle count is reduced according to a known equation. The difference between the two measurements is used to determine the particulate concentration, per BAM1022 SOP (*Appendix I*).

B.4.1.7 PM_{2.5}, PM₁₀, and PM_{10-2.5}: Continuous Operation, TAPI T640(X)

The *Teledyne Air Pollution Instruments* (TAPI) Model T640 measures 2.5 PM, and the 640X option measures 2.5, 10, and coarse PM. Data is collected in one-minute increments. This instrument is an optical spectrometer that converts optical measurements to mass measurements with sharp accuracy by determining sampling particle size via scattered light at the single particle level according to the Lorenz-Mie Theory. This theory presents a way to compute the optical properties of turbid materials such that their appearance can be predicted.

Ambient air is drawn into the sampling head with different sized particles. Particles are dried with the *Aerosol Sample Conditioner* (ASC) and moved into the optical particle sensor where scattered light intensity is measured to determine particle size diameter. Particles move separately in the T-aperture through an optically differentiated measurement volume that is homogeneously illuminated with polychromatic light. The polychromatic light source, an 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 and signal length are measured; the amplitude (height) 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.

B.5 Quality Control Requirements

Quality Control (QC) is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated objectives. QC of CAB activities are used to ensure that measured uncertainty is maintained within acceptance criteria for the attainment of the *Data Quality Objectives* (DQO).

MQOs identify the QC samples and acceptance criteria for those samples that allow the DQI of precision, bias, representativeness, sensitivity, completeness, and comparability to be quantified. The MQOs are designed to evaluate and control the various phases (sampling, preparation, analysis) of the measurement process to ensure that the total measurement uncertainty is within the range prescribed by the DQOs. The MQOs for the CABAMP are listed in *Appendix VIII* and describe the critical criteria that must be met, in order to validate and report reliable and defensible data.

Data Quality Assessments (DQAs) are the scientific and statistical evaluations of data to determine if they meet the project objectives and are the right type, quality, and quantity to support the intended use. CABMA personnel perform these assessments as seen in *Section C.1.8* of this QAPP.

To assure the quality of data from air monitoring measurements, two distinct and important

interrelated functions shall be performed. One function is the control of the measurement process through broad quality assurance activities, such as establishing policies and procedures, developing data quality objectives, assigning roles and responsibilities, conducting oversight and reviews, and implementing corrective actions. The other function is the control of the measurement process through the implementation of specific quality control procedures, such as audits, certifications, calibrations, checks, replicates, routine self-assessments, etc.

B.5.1 Quality Control Process

Upon initial receipt, movement, repair, and maintenance quality control is achieved through scheduled maintenance; calibrations, flow rate audits; acceptance testing; accuracy, bias, and precision checks; and control charts and other verification procedures. The goal of QC is to provide a reasonable level of checks to the various stages of the sample collection process to ensure that data quality is maintained throughout and that if data quality has been compromised, to discover and correct the source with a minimal loss of data (invalidation). The QC process is based on the requirements outlined in the criteria tables found in the *Quality Assurance Handbook, Volume II, Appendix D*. Specifically, quality control checks for gases should be performed a minimum of every 14 days and for particulates checks a minimum of every 30 days.

To minimize data invalidation, it is most beneficial to assess the data as soon as it is collected. This is where the data management system described in Section A.9 plays an important role by being able to flag or identify suspicious data for further review. This allows the technical staff to review the data as soon as possible, determine if it needs to be addressed and correct the problem expeditiously.

B.5.1.1 Data Collection

For the CABAMP, data collection is an ongoing process that involves the collection of a concentration or value from a variety of air monitors and meteorological sensors. Air sampling devices consist of both continuous and filter-based monitors. Generally, these sampling processes involve pre-sample preparation, field sampling, sample transport, field methods, and documentation. The MQOs for CAB are based on the *QA Handbook Volume II Appendix D*. These validation templates provide the minimum requirements for the frequency of QC checks, calibration, audits, and maintenance. CAB performs QC reviews of all contracted collections and analyses to ensure that they meet the requirements of the program and this QAPP. CAB also provides general oversight for HECO and PGV air monitoring sites by performing annual audits. CAB does not perform data validation for these outside agencies, they perform their own.

B.5.1.2 Data Management

There are several facets to data management which starts with ensuring that the data captured from an air monitoring site's DAS is accurately transformed, reduced, and transmitted to Envista ARM. Data reduction refers to verifying the accuracy of hourly and 24-hour averages on Envista ARM by comparing these values with manual calculations using minute, five minute, and hourly data. Data transmission checks are internal or external, internal checks are from DAS to Envista ARM, and external checks are between AQS and Envista ARM, both checks are to verify consistency. Data from these checks are required to be submitted to the AQS within the same time frame as routinely collected

ambient concentration data. The QC checks to be reported at the same time results are due are one-point QC for gases; and flow checks and collocated results for PM.

Data management QC activities are detailed in *Sections B.10* (Data Management) and *Section D* (Data Validation and Usability) of this QAPP. The automated QC checks programmed into the Envista ARM system are described. Backup of electronic data is implemented to minimize data loss. The protocol, including the schedule and method of backup are described in the ITS SOPs found in *Appendix II* of this QAPP.

B.5.1.3 Reference Materials

Reference materials are the standards by which many of the calibrations, QC checks, and audits are performed. These include gaseous standards (e.g., NIST-traceable gases) as well as devices such as flow rate, temperature, and pressure standards. Standards for calibrations/QC and audits are separate and distinct instruments. The CAB maintains all reference standards which include annual recertifications, such as Level II Ozone standard recertifications are performed by the EPA's Region 9 Laboratory or the California Air Resources Board Laboratory. CAB does not perform any level III recertifications for Ozone standards that would normally be on a six-month schedule. Standards are maintained separately by CABMA EHS IV auditors and the AQET II supervisor. Separate tracking logs for audit and operation standards are maintained on the CAB Operations SharePoint site. A list of these standards and devices is provided and discussed in *Section B.7* of this QAPP.

Other elements in this QAPP that describe related sampling and analytical QC requirements are detailed and include:

- *Sampling Method Requirements* (*Section B.2*) include how the QC requirements of the reference methods found in *40 CFR 50* are followed and how it is ensured that the sampling design accurately represents the representativeness of the sample.
- *Sample Handling and Custody Requirements* (*Section B.3*) discusses what QC procedures are in place to ensure the integrity of the sample.
- *Analytical Methods Requirements* (*Section B.4*) includes information on the preparation of QC samples such as blanks and replicates.
- *Equipment/Instrument Calibration and Frequency* (*Section B.7*) defines the criteria for triggering equipment recalibration as well as acceptance criteria for calibration standards and protocol gas standards.

B.5.2 CFR Related Quality Control Samples

40 CFR Part 58, Appendix A identifies the QC samples that must be implemented for the network of SLAMS and SPMS. *Table B-14* provides a summary of the QC checks for criteria pollutants and the CFR reference.

B.5.3 QC Procedures Implemented by CAB

Routine quality control shall be implemented by utilizing various check samples or instruments that are used for comparison to field-determined observables. *Tables A-5* through *A-15* identify the QC activities adhered to by CAB for monitoring criteria and NCore pollutants to produce data of known quality. Additional descriptions of these QC activities, evaluation criteria, and corrective actions taken when they do not meet acceptance criteria are discussed in *Section B.5.3.1* of this QAPP.

Table B-14 Monitoring Measurement Quality Requirements

| Method | 40 CFR | Coverage | Min. Frequency | MQOs ¹ |
|--|---|---|---|--|
| Automated Methods | | | | |
| 1-Point QC: O ₃ , CO, SO ₂ , NO ₂ /NO _y | Part 58 App A Sec 3.1.1 | each analyzer | Every 14 days | O ₃ : < ± 7.1% (percent diff) CO, SO ₂ : < ± 10% (percent diff) NO ₂ /NO _y : < ± 15% (percent diff) |
| Verification/ Calibration | O ₃ : Part 50, App D CO: Part 50, App C Sec 4 SO ₂ : Part 50, App A-1, Sec 4 NO ₂ /NO _y : Part 50, App F | each analyzer | Upon receipt/repair/moving/ adjustment/installation. Every 182 days. 2/calendar year if manual zero/span performed biweekly. Every 365 day and once/yr. if zero/span performed daily. | All points, < ± 2.1% or O ₃ , SO ₂ , NO ₂ /NO _y : ≤ ± 1.5 ppb* CO: ≤ ± 0.03 ppm* * Difference of best-fit straight line whichever is greater and Slope 1 ± .05 |
| Annual performance evaluation for gases | Part 58, App A Sec 3.1.2 | each analyzer | Every 365 days | Per Parameter, see Validation Templates in <i>Appendix VIII</i> |
| Flow rate verification PM_{2.5} | Part 58, App A Sec 3.2.3, 3.3.2 | each sampler | Every 30 days | < ± 4.1% of transfer std. < ± 5.1 % of design value |
| Flow rate verification PM₁₀ | Part 58, App A Sec 3.3 | each sampler | Every 30 days | < ± 7.1% of transfer std. |
| Semi-annual flow rate audit PM_{2.5} | Part 58, App A Sec 3.3.3 | each sampler | Twice a year, 5-7 months apart | < ± 4.1% of audit std. < ± 5.1 % of design value |
| Semi-annual flow rate audit PM₁₀ | Part 50, App A Sec 3.3.3 | each sampler | Twice a year, 5-7 months apart | < ± 10.1% of audit std. |
| Collocated sampling PM_{2.5} | Part 58, App A Sec 3.2.3 | 15% w/in PQAO | Every 12 days | CV < 10.1% of samples ≥ 3.0 µg/m ³ |
| PEP², PM_{2.5} | Part 58 App A Sec 3.2.7, 4.3.2, & 2.3.1.1 | 8 valid audits & all samplers in 6 years | over all 4 quarters | < ± 10.1% for values ≥ 3 µg/m ³ |
| Manual Methods | | | | |
| Collocated sampling, PM_{2.5} | Part 58 App A, Sec 3.2.3, 2.3.1.1 | 15% w/in PAQO | Every 12 days | CV < 10.1% of samples ≥ 3.0 µg/m ³ |
| Flow rate verification, PM_{2.5} | Part 58, App A Sec 3.3.1 | each sampler | Every 30 days | < ± 4.1% of transfer std. < ± 5.1 % of design value |
| Multi Flow Rate Verification/ Calibration | Part 50, App L Sec 9.3 | each sampler | Electromechanical maintenance or transport or every 365 days, once/yr. | < ± 2.1% of transfer std. |
| Semi-annual flow rate audit, PM_{2.5} | Part 58, App A Sec 3.2.2 | each sampler | Twice a year, 5-7 months apart | < ± 4.1% of audit std. < ± 5.1 % of design value |
| PEP², PM_{2.5} | Part 58, App A, Sec 3.2.4, 4.2.5, & 2.3.1.1 | 5 valid audits & all samplers in 6 years | Over all 4 quarters | < ± 10.1% for values ≥ 3 µg/m ³ |
| Meteorological Methods (NCore) | | | | |
| Verification/ Calibration AT, RH, WS, WD | Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) | each sensor | Upon receipt/adjustment/ repair/installation/moving 1/6 months or 1 audit and 1 calibration per year, six months apart. ³ | AT: ± 0.5 °C of standard RH: ± 7% RH of standard WS: ± 0.25 m/s ≤ 5 m/s, 5% > 2 m/s not to exceed 2.5 m/s. WD: ± 5 degrees, includes orientation error |
| Annual Accuracy/ Performance Evaluation AT, RH, WS, WD | | | Every site 1/year | |

¹ Some of the MQOs are found in the CFR and others in *Appendix VIII* of this QAPP.² HDOH operates >5 FEM PM_{2.5} samplers, therefore 8 audits are required for the automated method. Likewise, there are < 5 FRM PM_{2.5} samplers so 5 valid audits are required for manual methods.³ EPA has allowed for one audit and one calibration per year as long as they are six months apart.

B.5.3.1 Precision and Bias Checks for Gaseous and Collocated Particulate Data

Precision is the measure of mutual agreement among individual measurements of the same observable, usually under prescribed conditions. For gaseous Criteria and NCore monitors, QC tests must be performed at least once every two weeks and are used to calculate the 90% probability limits for the data following the criteria identified in *Table B-14* for one-point QC check acceptance criteria. Precision tests also check for bias, defined as the systematic or persistent distortion of a measurement process which causes error in one direction. Bias checks shall be used to calculate the 95% probability limits for the data, as per the criteria identified in *Table B-15*.

Table B-15 Gaseous One-Point QC Check Frequency and Criteria

| Analyte | Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|----------------------------------|------------------------------------|---------------|--|--|
| CO | One-point QC Check single analyzer | Every 14 days | $< \pm 10.1\%$ (percent difference) | 1 & 2) Part 58 App A Sec 3.1.1 3) Recommendation based on DQO Part 58 App A Sec 2.3.1 QC Check Conc range 0.5 – 5 ppm |
| | Zero/Span Check | Every 14 days | Zero drift $< \pm 0.41$ ppm (24 hr.) $< \pm 0.61$ ppm (> 24 hr. - 14 day) Span drift $< \pm 10.1\%$ | 1 & 2) QA Handbook Volume II Sec 12.3 3) Recommendation |
| NO ₂ /NO _y | One-point QC Check single analyzer | Every 14 days | $< \pm 15.1\%$ (percent difference) or $< \pm 1.5$ ppb difference whichever is greater | 1 & 2) Part 58 App A Sec 3.1.1 3) Recommendation based on DQO Part 58 App A Sec 2.3.1.5 QC Check Conc range 0.005 – 0.08 ppm and 05/05/2016 Technical Note on AMTIC |
| | Zero/Span Check | Every 14 days | Zero drift $< \pm 3.1$ ppb (24 hr.) $< \pm 5.1$ ppb (> 24 hr. - 14 day) Span drift $< \pm 10.1\%$ | 1 & 2) QA Handbook Volume II Sec 12.3 3) Recommendation and related to DQO |
| O ₃ | One-point QC Check single analyzer | Every 14 days | $< \pm 7.1\%$ (percent difference) or $< \pm 1.5$ ppb difference whichever is greater | 1 & 2) Part 58 App A Sec 3.1 3) Recommendation based on DQO Part 58 App A Sec 2.3.1.2 Check Conc range 0.005 – 0.08 ppm and 05/05/2016 Technical Note on AMTIC |
| | Zero/Span Check | Every 14 days | Zero drift $< \pm 3.1$ ppb (24 hr.) $< \pm 5.1$ ppb (> 24 hr. - 14 day) Span drift $< \pm 7.1\%$ | 1 & 2) QA Handbook Volume II Sec 12.3 3) Recommendation and related to DQO |
| SO ₂ | One-point QC Check single analyzer | Every 14 days | $< \pm 10.1\%$ (percent difference) or $< \pm 1.5$ ppb difference whichever is greater | 1 & 2) Part 58 App A Sec 3.1.1 3) Recommendation based on DQO Part 58 App A Sec 2.3.1.2 QC Check Conc range 0.005 – 0.08 ppm and 05/05/2016 Technical Note on AMTIC |
| | Zero/Span Check | Every 14 days | Zero drift $< \pm 3.1$ ppb (24 hr.) $< \pm 5.1$ ppb (> 24 hr. - 14 day) Span drift $< \pm 10.1\%$ | 1 & 2) QA Handbook Volume II Sec 12.3 3) Recommendation and related to DQO |

To meet the data quality objectives for precision and bias, CAB shall ensure that the entire measurement process is within statistical control by using the *Data Assessment Statistical Calculator* (DASC), *June 2013*. DASC is software developed by the Office of Air Quality Planning and Standards to assist in calculating precision, bias, and calibration for criteria pollutants, as data is collected. Equations in *40 CFR Part 58; Appendix A* are used in performing most of these calculations. For other calculations different guidance is required, such as:

- NCore NO_y converter efficiency, see *Quality Assurance Guidance Document 2.3, Reference Method for the Determination of Nitrogen Dioxide in the Atmosphere (Chemiluminescence)*, February 2002.

- PM difference from design, see *Section 14.2 of Quality Assurance Guidance, 2.12, Monitoring PM_{2.5} in Ambient Air Using Designated Reference or Class I Equivalent Methods, EPA-454/B-16-001, January 2016.*
- CAB SOPs (*Appendix I*) per parameter for specific calculations.

The quarterly precision 90% and bias 95% probability limits for the project are maintained within the one-point QC check criteria, listed in *Table B-15* of the known concentration for each criteria pollutant.

B.5.3.1.1 Precision Checks for Collocated Particulate Data

Precision checks are performed using collocated samples for PM_{2.5} concentrations. The DASC is used to calculate precision between the primary and collocated samplers for PM_{2.5}. See *Table B-15* for collocated sample precision criteria.

Table B-16 PM_{2.5} Collocation Frequency and Criteria

| Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|---|--|--|--|
| Precision Collocated Samples | Every 12 days for 15% of sites by method designation (For NCore/CAB performs 1 in 3 days) | CV < 10.1% of samples ≥ 3.0 µg/m ³ | 1 & 2) Part 58 App A Sec 3.2.3 and CAB QAPP specific sampling frequency to NCore and criteria pollutant requirements. 3) Recommendation based on DQO, Part 58 App A Sec 2.3.1.1 |
| Precision Single Analyzer Collocated Monitors | Quarterly | CV < 10.1% of samples ≥ 3.0 µg/m ³ | Recommendation in order to provide early (quarterly) evaluation of achievement of DQOs. |

B.5.3.2 Accuracy or Bias Check for Gaseous and Particulate Data

Accuracy is defined as the degree of agreement between an observed value and an accepted reference value and includes a combination of random error (precision) and systematic error (bias).

- Flow Rate Verification every 30 days (internal – particulates)
- One-point QC checks every 14 days (internal – gaseous)
- Performance audits (internal – gaseous and particulates)
- *National Performance Audit Program (NPAP)* (independent gaseous audit)
- *National Performance Evaluation Program (NPEP)* (independent particulate audit)

Tables B-14 through *B-15* identify the frequency and criteria for these checks.

B.5.3.3 Flow Rate Verification

Flow rate verifications shall be performed by CAB MA staff to verify a sampler's flow rate measurement system performs within the acceptance limit specified in *Table B-16* for particulate monitors.

Table B-17 Flow Rate Verification Frequency and Criteria

| Analyte | Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|---|----------------------------------|--|---|--|
| PM _{2.5} , PM _{10-2.5} | Average Flow Rate | Every 24 hours of operation; alternately, each hour can be checked | Average within 5% and 16.67 liters/min at local conditions | 1, 2, & 3) Part 50 App L Sec 7.4.3.1 |
| | Variability in Flow Rate | Every 24 hours of operation | CV ≤ 2% | 1,2, & 3) Part 50 App L Sec 7.4.3.2 |
| | One Point Flow Rate Verification | Every 30 days each separated by 14 days | < ≥ 4.1% of transfer standard < ± 5.1% of flow rate design value | 1, 2, & 3) Part 50 App L Sec 9.2.5 Part 58 App A Sec 3.2.3 & 3.3.2 |
| PM ₁₀ | One Point Flow Rate Verification | Every 30 days each separated by 14 days | < ± 7.1% of transfer standard | 1 & 2) Part 58 App A Sec 3.3 3) Method 2.10 Table 3-1 |
| | Average Flow Rate | Every 24 hours of operation | Average within < ± 5.1% of design | Recommendation |

B.5.3.4 Performance Audits

Performance audits shall be conducted by CAB for each gaseous analyzer, PM monitor, and meteorological sensor for all criteria and NCore monitoring sites annually or semiannually (PM requires semiannual audits). A transfer standard and the monitoring station's analyzer assay the same gaseous concentrations at the same time. The responses of the on-site analyzer are then compared against the output of the transfer standard and a linear regression is generated. The audit (actual) concentration and the concentration determined by the analyzer shall be reported for evaluation. *Table C-2* in this QAPP identifies the Frequency and Criteria for Performance Audits conducted by CAB.

B.5.3.5 National Performance Audit Program (Gases)

The NPAP's goal is to provide audit materials and devices that will enable EPA to assess the proficiency of agencies that are operating monitors in the SLAMS networks. To accomplish this, the NPAP has established acceptable limits or performance criteria, based on the data quality needs of the SLAMS requirements, for each of the audit materials and devices used in the NPAP. All audit devices and materials used in the NPAP are certified as to their true value, and that certification is traceable to a NIST standard material or device wherever possible. The audit materials used in the NPAP are as representative and comparable as possible to the calibration materials and actual air samples used and/or collected in the SLAMS networks. The audit material ranges used in the NPAP are specified in the Federal Register. In these blind audits, concentrations produced by the NPAP auditor's equipment are not known by auditees. For example, an ozone generator produces ozone concentrations to be measured by the station analyzer. Responses of the on-site analyzer are compared against those of the generator and a linear regression is calculated by the NPAP and results are sent to EPA. See *Table B-18* for NPAP Frequency and Criteria.

Table B-18 NPAP Frequency and Criteria

| Analyte | Frequency | Acceptance Criteria | 40 CFR Reference |
|-----------------|------------|---|-----------------------|
| CO | 1 per year | <ul style="list-style-type: none"> Audit levels 1 & 2 ± 0.03 ppm All other levels percent difference $\pm 15.1\%$ | Part 58 App A Sec 2.4 |
| NO ₂ | 1 per year | <ul style="list-style-type: none"> Audit levels 1 & 2 ± 1.5 ppb All other levels percent difference $\pm 15.1\%$ | Part 58 App A Sec 2.4 |
| O ₃ | 1 per year | <ul style="list-style-type: none"> Audit levels 1 & 2 ± 1.5 ppb All other levels percent difference $\pm 10.1\%$ | Part 58 App A Sec 2.4 |
| SO ₂ | 1 per year | <ul style="list-style-type: none"> Audit levels 1 & 2 ± 1.5 ppb All other levels percent difference $\pm 15.1\%$ | Part 58 App A Sec 2.4 |

B.5.3.6 Performance Evaluation Program Audit

A performance evaluation is defined as a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory. In the case of the PEP, the goal is to evaluate total measurement system bias, which includes measurement uncertainties from the field and the laboratory activities. The strategy is to collocate a portable FRM PM_{2.5} air sampling audit instrument with an established primary sampler at a routine air monitoring site, operate both samplers in the same manner, and then compare the results.

For PM_{2.5}, five PEP audits are required annually, for *Primary Quality Assurance Organizations* (PQAOs) with less than or equal to 5 monitoring sites or eight audits, annually for PQAOs with greater than five sites. *Table B-19* identifies the collocation frequency and acceptance criteria.

Table B-19 PEP Particulate Collocation Frequency and Acceptance Criteria

| Requirement | Frequency | Acceptance Criteria | 40 CFR Reference |
|--|---|---|-------------------------------|
| PM _{2.5} Precision (Collocated monitors) | <ol style="list-style-type: none"> 5 valid audits for primary QA orgs, with ≤ 5 sites 8 valid audits for primary QA orgs, with > 5 sites All samplers in 6 years | $\pm 10\%$ for values $> 3\mu\text{g}/\text{m}^3$ | Sec 3.2.7, 4.3.2, and 2.3.1.1 |

B.5.4 Standard Certification and Recertification

All audit devices and materials used in this project shall be certified as to their true value by parties meeting ISO 17025 and that certification shall be traceable to a *National Institute of Standards and Technology* (NIST) standard material or device. Scanned certificates shall be saved as PDF files on the CAB Operations SharePoint site.

Separate tracking spreadsheets for regular operations and audit reference standards shall be established on the CAB Operations SharePoint site. The purpose of these sheets is to keep track of certification and expiration dates for all gaseous and flow instrument reference standards used by CAB. This is to ensure that recertifications are performed before standards expire.

When multiple reference standards are identified on a certification, CAB shall require the certification office to identify the specific standard, and date of expiration the standard certification is traceable to.

B.5.4.1 Local Primary Standards

The CAB MA personnel shall be responsible for ensuring that all primary standards are recertified annually. See *Table B-19* for standard type, certification frequency, and acceptance criteria. Scanned calibration certificates shall be saved as PDF files on the CAB Operations SharePoint site by the CAB MA.

B.5.4.2 Transfer Standards

All transfer standards shall be recertified, annually, by a vendor that provides NIST traceable calibration services. Scanned certificates shall be saved as PDF files on the CAB Operations SharePoint site. CAB MA shall ensure that standards are recertified before expiration.

Table B-20 Local Primary & Transfer Standard Certification Frequency and Criteria

| Type | Make, Model | Certification Frequency | Acceptance Criteria | 40 CFR Reference |
|--|---|--|--|--|
| Primary Flow Standard | Mesa Labs ML-500 (Dry piston technology) ^C | Annually by Vendor | ± 2% of NIST Traceable Standard | Part 50 App L Sec 9.1 – 9.2 |
| | Sensidyne Gilibrator-2 ^A | | | |
| Primary Standard for Ozone L2 | Teledyne T753U ^A | Annually by CARB or EPA Standards Laboratory | <ul style="list-style-type: none"> • Certification/ recertification to Standard Reference Photometer (Level 1) • Single point difference ≤ ± 3% | Part 50 App D Sec 5.4 and Transfer Standard for the Calibration of Ambient Air Monitoring Analyzers for Ozone EPA-454/B-13-004 |
| | Teledyne T703 ^C | | | |
| | Teco 49iQPS ^C | | | |
| Primary Standard for Ozone L3 | Teledyne TAPI 750U ^A | Annually by Vendor | <ul style="list-style-type: none"> • Certification/ recertification to Standard Reference Photometer (Level 2) • Single point difference ≤ ± 3% • New slope = + 0.05 of previous and RSD of six slopes 3.7% Std. Dev. of 6 intercepts 1.5 | Part 50 App D Sec 5.4 and Transfer Standard for the Calibration of Ambient Air Monitoring Analyzers for Ozone EPA-454/B-13-004 |
| Transfer Standards (Flow, Temperature, Pressure) | Chinook Streamline Pro ^C | Annually by Vendor | <ul style="list-style-type: none"> • ± 2% of NIST Traceable Standard • ± 0.1 °C resolution • ± 0.5 °C accuracy of NIST Traceable Standard • ± 1 mmHg resolution • ± 5 mmHg accuracy of NIST Traceable Standard | Flow: Part 50 App L Sec 9.1 – 9.2 Temp/Press: EPA-454/B-16-001, January 2016 |
| | * Alicat Scientific FP-25 ^{A, C} | | | |
| | Mesa Labs/BGI deltaCal ^C | | | |
| Transfer Standard Pressure | Druck DPI 740 ^C | Annually by Vendor | <ul style="list-style-type: none"> • ± 1 mmHg resolution • ± 5 mmHg accuracy of NIST Traceable Standard | QA Handbook Method 2.12 Sec 4.2.2 |
| Gaseous Pollutant Standards | Certified Gas Cylinders ^{A, C} (manufacturer: Air Gas, Praxair, or Matheson) | Approximately 5 years Certification is dependent on type of gas & concentration | NIST Traceable Reference Material (VTRM) or certified Manufacturer's Internal Standard (GMIS) | CFR Part 58, Appendix A, Section 2.6 |

A = audit standard, and C = calibration standard.

Make and Models of equipment listed in table above are subject to change.

* There are multiples of this standard, some are used for audits, and some used for operations.

Flow Transfer Standards

Flow rate transfer standards used for flow rate calibrations shall have a certificate traceable to a NIST primary standard for volume or flow rate. CAB MA shall use continuous volumetric air flow calibrators and/or automatic dry piston flow meters for field flow rate calibrations and verification of network samplers. Designated standards, such as Chinook and Alicat flow standards, shall be separated and used for operations or audits only. A calibration relationship for the flow rate standard, such as an equation, curve, or family of curves, shall be established by the manufacturer (and verified if needed) as accurate to within 2% over the expected range of ambient temperatures and pressures at which the flow rate standard will be used. CAB flow transfer standards are identified in *Table B-19*.

Temperature and Atmospheric Pressure Transfer Standards

Temperature and pressure transfer standards shall be used for calibration of these sensors on PM₁₀, PM_{2.5} analyzers, and these standards shall be recertified annually. The recertification shall be overseen by the CAB MA personnel. Certificates shall be stored on the CAB Operations SharePoint site. *Table B-20* identifies the transfer standards used to perform semi-annual calibration of particulate samplers, certification frequency and acceptance criteria.

B.5.4.3 Compressed Gas Standards

EPA Protocol Gas Standards are purchased as certified cylinders with concentrations traceable to a NIST standard and are used only within the certified date range. The Vendors that supply gas standards must certify that they are providing CAB with "EPA Protocol Gas" and must be participants in the EPA *Ambient Air Protocol Gas Verification Program* per *40 CFR, Part 58, Appendix A, Section 2.6.1* guidelines. Certification documents shall be kept with each cylinder until the cylinder is taken out of service because it is empty or expired. A copy of the Certification documents for each cylinder shall be kept on the CAB Operations SharePoint site for at least five years after the cylinder is returned to the supplier.

The following information for all gas standards shall be tracked on the CAB Operations SharePoint site:

- Certificate of analysis
- Location
- Cylinder serial number
- Expiration date
- Components
- Date certified
- manufacturer

B.5.5 Calibration

Calibration is the comparison of a measurement standard or instrument with another standard or instrument to report, or eliminate by adjustment, any variation (deviation) in the accuracy of the item being compared. The purpose of calibration is to minimize bias. Calibration activities performed by CAB shall follow a three-step process:

- Certifying the calibration standard and/or transfer standard against an authoritative standard.

- Comparing the calibration standard and or transfer standard against the routine sampling/analytical instruments.
- Adjusting the sampling/analytical instruments to remove the bias.

Calibration requirements for the critical field equipment are found on Table B-21, in Section B.7.1.1, of this QAPP. Calibration methods are included in *Section B-7* and respective SOPs in *Appendix I* of this QAPP.

B.5.6 Control Charts

CAB shall use control charts to track QC results. Control charts provide a graphical means of determining whether various phases of the measurement process are in statistical control. The control charts shall be utilized as an “early warning system” with tighter limits than EPA criteria to evaluate trends in precision and bias.

B.5.7 Corrective Action

If any of the checks discussed in *Section B.5* violate the acceptance criteria, corrective action shall occur and then a multi-point calibration shall be performed. Routine data back to an acceptable calibration shall be identified, flagged, and reviewed to determine validity. If a review of the previous and corrective calibration verification check data does not show a problem, there is a potential that the transfer standard needs to be re-certified.

B.6 Equipment Testing, Inspection, & Maintenance Requirements

All instruments, equipment, and gas standards procured for the data collection activities in the CABAMP are inspected and undergo acceptance testing. Acceptance testing is performed upon initial acceptance of instrument or gas standard from the manufacturer, upon return from certification, upon repair or maintenance, or movement of the instrument. Acceptance testing is performed by CAB MA personnel. Any discrepancies related to instrument/equipment quality or performance are resolved with the manufacturer prior to acceptance and deployment. Instrument or standard inspection and acceptance testing is documented and filed as described in *Section A.9*, of this QAPP.

Elements included in testing, inspection, and maintenance documents include:

- total equipment inventory.
- equipment list by station.
- spare equipment/parts lists - by equipment, including suppliers.
- inspection/maintenance frequency - by equipment.
- testing frequency and source of the test concentrations or equipment.
- equipment replacement schedules.
- instrument repair history - by equipment.
- service agreements.
- monthly check sheets and forms documenting testing, inspection, and maintenance performed.

The manufacturer’s instructions are followed concerning:

- unpacking and verifying that all component parts were delivered.
- checking for damage during shipping.

- checking for loose fittings and electrical connections.
- assembling the analyzer.
- installing the analyzer.
- calibrating the analyzer.
- operating the analyzer.
- electrical diagrams.
- preventive maintenance schedule and procedures.
- trouble shooting.

B.6.1 Testing and Inspection

B.6.1.1 Samplers and Analyzers

All gaseous and particulate matter analyzers used by the HDOH CABAMP criteria pollutant, and NCore ambient air monitoring network shall be certified to adhere to EPA *Equivalent* or *Reference* methods to ensure that they meet EPA requirements, which can be found at:

<https://www.epa.gov/criteria-air-pollutants>

The *Equivalent* or *Reference* designations for all of the analyzers and monitors used by CAB are identified in *Section A.7.1.4, Table A-4*, of this QAPP.

New or repaired instruments, and gas standards undergo acceptance testing and documentation prior to deployment to ensure proper function. CAB MA personnel assemble and initially operate samplers and analyzers at the technician lab. Instruments are performance tested by ensuring that the diagnostics are functioning appropriately per manufacturer manuals. Multipoint checks are then performed as outlined in the respective instrument SOPs (*Appendix I*). If any of the tests or calibrations are out of specification, corrective action shall be taken and documented in the individual equipment logbooks located on the CAB Operations SharePoint site. Once a new monitor is installed at a site, CAB personnel shall again perform and document tests. If the sampler meets the acceptance criteria outlined in *Tables B-15 and B-16* of this QAPP, it shall be assumed to be operational. All results, including acceptance test results and/or corrective actions shall be documented and stored on the CAB Operations SharePoint site. Details on acceptance testing and inspection of samplers and analyzers are included in this QAPP.

B.6.1.2 Support Systems

Specifications for support instruments and systems shall be determined by CAB personnel prior to procurement. Upon receipt, new or repaired instruments and systems shall be inspected for completeness, tested for quality, and the results documented. Selection of support instruments and systems shall be based on a variety of criteria including, but not limited to staff experience, ease of maintenance, reliability, technical design and performance, price, and customer service. All certifications and calibration documents shall be reviewed by CAB personnel to ensure that monitoring requirements are met. Documents shall be stored on the CAB Operations SharePoint site.

Support systems include:

- station shelters.
- calibration standards.
 - *mass flow controllers (MFC)*.

- standards that meet the *EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards* (EPA -600/R- 23/531).
- photometers.
- flow measurement devices.
- barometric pressure measurement devices.
- temperature measurement devices
- *data acquisition systems* (DAS).
- analog chart recorders.
- instrument racks or carts.
- zero air systems.
- gas regulators.
- signal and power systems.

B.6.1.3 Data Acquisition and Management Systems

The on-site DAS consists of a computer loaded with the *Envitech Envidas Ultimate* software and a signal interface unit. The DAS is purchased, tested, maintained, and kept uniform across the network to maintain operating efficiency. The accuracy of the system's transformation, reduction, and transmission of data shall be confirmed as described in *Section B.10* of this QAPP. Upon deployment, the DAS shall be configured and fully tested at the station by CAB technical staff per SOP (*Appendix I*).

The CAB IT person is to be responsible for the Envista ARM central data management system, operating in Dr. DAS's (DAS vendor) cloud servers. The system includes computers, printers, servers, *Universal Power Supply* (UPS), peripherals, and software. The CAB ITS shall ensure that the software is kept current, with updates and patches applied, as necessary. See SOP in *Appendix II*.

B.6.2 Preventive Maintenance

A preventive maintenance program is integral to the ambient air monitoring network. The preventive maintenance activities and schedules for the CABAMP are detailed in this QAPP.

CAB personnel shall perform regularly scheduled maintenance of the analyzers and support systems. For example, O₃ scrubbers shall be replaced at least annually, and more frequently, as needed; nozzle, vane, capstan shaft and pinch roller cleaning (BAM) shall occur every 30 days. All activities shall be documented in equipment logbooks on the CAB Operations SharePoint site (see *Section A.9* of this QAPP). Maintenance schedules and procedures shall be documented in the SOPs in *Appendix I*.

B.6.3 Station Maintenance

CAB MA personnel shall perform routine maintenance at each station and shall include (but not limited to) the following tasks:

- floor and general station cleaning.
- exterior shelter inspection for corrosion, wear, leaks, and weathering.
- air conditioner filter cleaning and replacement.
- weed abatement.
- general grounds maintenance and cleaning.
- inspection of electrical and communication cables.

B.6.4 Routine Operations

Routine operations are checks that occur at specified intervals during monitoring station visits. See *Figure B-6* to view the Site Visit Checklist posted at each air monitoring station. This list describes routine checks conducted during each monitoring station visit.

CAB MA personnel routine station operations include:

- review of data.
- review QC checks and perform, as necessary.
- review equipment performance.
- install and collect sample filters.
- complete site visit checklist (*Figure B-6*).
- perform equipment preventive maintenance tasks and repairs, as necessary.
- perform station maintenance tasks listed in *Section B.6.3*.
- perform equipment inventory.
- complete QC forms and logbooks.

B.6.5 Replacement Parts Inventory

An inventory of replacement parts is maintained at the CAB by MA staff to ensure timely response to field maintenance and repair. An up-to-date and complete inventory shall be maintained to reduce downtime and data loss due to equipment malfunctions. If equipment or instruments can be repaired in the field, the CAB MA technicians shall acquire the necessary parts from inventory. At air sites, technicians' complete repairs and verify instrument operation per applicable SOPs. If equipment or instruments are unable to be repaired in the field, they are brought into the CAB technician lab for diagnostics and repair, if possible. When available, spare instruments shall be deployed to replace malfunctioning equipment temporarily or permanently. Spare analyzers will also be deployed due to emergency response e.g., volcanic activity on Hawaii Island, annual hurricane season. Spare analyzers shall routinely be tested to ensure availability when needed. Equipment or instruments that cannot be repaired by CAB technicians are sent back to the manufacturer for repair. All efforts shall be made to ensure that instrument downtime is minimized.

Figure B-6 Site Visit Checklist Posted at Air Stations**SITE VISIT CHECKLIST**

(April 1, 2023, version 1)

Record YES observations in site logbook. Specify Who, What, Where, When, How, and Why problem was addressed:

SITE & SHELTER EXTERIOR

1. Any vandalism?
2. Site unsecured upon arrival?
3. Shelter damaged, unstable, or unsafe?
4. Nearby activities or sources affecting data?
5. Met tower unstable or unsafe?
6. Met tower not fully extended?
7. Wind sensors damaged or malfunctioning?

SHELTER INTERIOR

8. Any unusual noises or odors?
9. Air conditioner malfunctioning?
10. Any water leaks?
11. UPS beeping or malfunctioning?
12. Power outage occurred?

MANIFOLD SYSTEM

Glass components, tubing, fittings, filters, rotameter, booster pump.

13. Any components damaged, obstructed or unattached?
14. Any signs of grime or moisture buildup?
15. Any kinked tubing or loose fittings?
16. Booster pump malfunctioning?
17. Booster pump flow incorrect?
18. Heater malfunctioning? (if installed)

DATA LOGGER

19. Logger malfunctioning?
20. Date and time incorrect?
21. Any parameters not correlating to instruments?
22. Any parameters not collecting data?
23. Any unusual or erratic readings?
24. Any channel flags incorrect?
25. Modem offline or malfunctioning?

CHART RECORDER

26. Recorder malfunctioning?
27. Date and time incorrect? (Set to data logger's time)
28. Any parameters not correlating to instruments?
29. Any parameters not collecting data?
30. Any unusual or erratic readings?

GAS ANALYZER(S)

31. Analyzer malfunctioning?
32. Any unusual or erratic readings?
33. Any alarms?
34. Sample flow incorrect or erratic?
35. Date and time incorrect? (Set to data logger's time)
36. Range, sample mode, and time response settings incorrect?

GAS CALIBRATION SYSTEM

37. Calibrator malfunctioning?
38. Calibrator not communicating with logger?
39. Calibrator certification expired?
40. Cylinder certification(s) expired?
41. Cylinder valve or regulator shut off?
42. Cylinder pressure below 500 psi?
43. Zero air generator power switch off?

PARTICULATE MONITOR(S)

44. Monitor malfunctioning?
45. Date and time incorrect?
46. Any alarms?
47. Any unusual or erratic readings?

BAM type monitors:

48. Filter tape installed incorrectly?
49. Insufficient filter tape?
50. Monitor not in "sample mode"?
51. Time not set 1 minute ahead of logger?

RECORD KEEPING**Ensure that:**

52. All activities are recorded in site and equipment logbooks.
53. QC, calibration, and maintenance logs are up to date.
54. Equipment serial numbers are correct on SharePoint site equipment list.
55. Tasks are updated.
56. Cylinder pressure(s) are recorded on log sheet.
57. PQ200 sample run reports are up to date & filed (if used).
58. PM filter COC documents are up to date & filed (if used).

B.7 Equipment Calibration/Certification and Frequency

B.7.1 Monitoring and Audit Instrument Certification

All CABAMP, HECO, and PGV equipment shall be calibrated/certified as described in each of the agencies respective QAPPs. The difference between calibration and certification can be described as:

- Calibration: is to verify and correct accuracy from a known standard.
- Certification: is the verification of accuracy from a known standard.

B.7.1.1 Analyzers

Analyzer calibration is a function of air monitoring which establishes a relationship between actual pollutant concentration and the instrument's response. This relationship converts response values into pollutant concentrations. As analyzers tend to change over time (drift), calibrations and analyzer response adjustments are made periodically to ensure the highest degree of accuracy. The analyzer calibration methods, frequency and criteria are described in this QAPP. See Table B-21, calibration frequency and criteria per pollutant for Criteria and NCore monitoring sites. Specific calibration procedures for the field analyzers and equipment can be found in the applicable SOPs (*Appendix I*). Calibration acceptance criteria are detailed in the Validation Templates in *Appendix VIII*.

All analyzers shall be calibrated and documented per appropriate SOPs by EHS and AQET personnel in the CAB MA section, calibrations are required as follows:

- When an analyzer's physical relocation is changed.
- After the analyzer is adjusted, repaired, or serviced.
- Following an interruption in analyzer operation of more than a few days.
- Upon any indication of malfunction or significant inaccuracy.
- At a minimum of every six months for gaseous analyzers.
- At a minimum of once per year for particulate monitors.

Refer to *Section 10.4 of the QA Handbook, Volume II, 2017* to see how our operating ranges and calibration scales are determined. CAB has the flexibility to customize monitoring ranges and scales per concentration levels normally measured at sites. Also, refer to *Section B.5.3.1, Tables B-15, and B-16* for details on analyzer calibration requirements, frequency, and criteria. Specific calibration and documentation procedures for instruments and equipment can be found in the applicable SOPs (*Appendix I*).

The stability of analyzers are tested during routine QC checks or annual performance audits where attention is paid to the analyzer and gas delivery system, per EPA QA Handbook Volume II, Section 10.4. The EPA suggests the collection of 5 data points, at a minimum, is needed to produce a chart that will show "walkable stair steps" pattern. This is the method CAB uses to test the stability of gas analyzers per CAB SOPs (*Appendix I*). Another way to test stability is through the use of Quality Control Charts as mentioned in *Section B.5.6* of this QAPP.

**Table B-21 Pollutant Instrument Calibration Frequency and Criteria
for Criteria and NCore Monitoring Sites**

| Analyte | Requirements | Frequency | Acceptance Criteria | 40 CFR Reference |
|---|---|--|--|--|
| CO | Multipoint Calibration (at least 5 points) | Every 182 days and 2 per calendar year if zero/span is performed biweekly ¹ | All points $< \pm 2.1\%$ or $< \pm 0.03$ ppm difference of best fit straight line whichever is greater and Slope 1.0 ± 0.05 | 1) Part 50 App C Sec 4 2 & 3) Recommendation See details about CO ₂ sensitive instruments Multipoint calibration (0 and 4 upscale points) Slope criteria is a recommendation |
| | Verification/Calibration | Every 365 days and 1 per calendar year if zero/span is performed daily ¹ | | |
| NO ₂ , NO _y | Multipoint Calibration (at least 5 points) | Every 182 days and 2 per calendar year if zero/span is performed biweekly ¹ | Instrument residence time < 2 min Dynamic parameter > 2.75 ppm-min All points $< \pm 2.1\%$ or $< \pm 1.5$ ppb Difference of best fit straight line whichever is greater and Slope 1.0 ± 0.05 | 1) Part 50 App F 2 & 3) Recommendation Multipoint calibration (0 and 4 upscale points) Slope criteria is a recommendation |
| | Verification/Calibration | Every 365 days and 1 per calendar year if zero/span is performed daily ¹ | | |
| O ₃ | Multipoint Calibration (at least 5 points) | Every 182 days and 2 per calendar year if zero/span is performed biweekly ¹ | All points $< \pm 2.1\%$ or $< \pm 1.5$ ppb Difference of best fit straight line whichever is greater and Slope 1.0 ± 0.05 | 1) Part 50 App D 2) Recommendation 3) Part 50 App D Sec 4.5.5.6 Multipoint calibration (0 and 4 upscale) Slope criteria is a recommendation |
| | Verification/Calibration | Every 365 days and 1 per calendar year if zero/span is performed daily ¹ | | |
| SO ₂ | Multipoint Calibration (at least 5 points) | Every 182 days and 2 per calendar year if zero/span is performed biweekly ¹ | All points $< \pm 2.1\%$ or $< \pm 1.5$ ppb Difference of best fit straight line whichever is greater and Slope 1.0 ± 0.05 | 1) Part 50 App A-1 Sec 4 2 & 3) Recommendation Multipoint calibration (0 and 4 upscale) Slope criteria is a recommendation |
| | Verification/Calibration | Every 365 days and 1 per calendar year if zero/span is performed daily ¹ | | |
| PM _{2.5} & PM _{10-2.5} (Continuous and filter based) | Flow Rate Multipoint Verification/Calibration | Electromechanical maintenance or transport or every 365 days and 1/calendar year. ¹ | Flow $< \pm 2.1\%$ of transfer standard | 1) Part 50 App L Sec 9.2 2) Part 50 App L Sec 9.1.3 Method 2.12 Sec 6.3 & Table 6-1 3) Recommendation |
| | | | Temperature $< \pm 2.1$ °C | 1) Part 50 App L Sec 9.3 2) Method 2.12 Sec 6.4.4 Table 6-1 |
| | | | Pressure $< \pm 10.1$ mmHg | 1) Part 50 App L Sec 9.3 2) Method 2.12 Sec 6.5 Sampler BP verified against independent standard verified against a lab primary standard that is certified as NIST traceable 1/yr. |
| PM ₁₀ (continuous) | Flow Rate Multipoint Verification/Calibration | Every 365 days and 1 per calendar year ¹ | Flow 3 of 4 Cal points Within $< \pm 10.1\%$ of design | 1) Part 50 App J Sec 8.0 2 & 3) Method 2.10 Sec 2.2.4 |
| | | | Temperature $< \pm 2.1$ °C | Part 50 App L Sec 9.3 |
| | | | Pressure $< \pm 10.1$ mmHg | Part 50 App L Sec 9.3 |
| PM _{2.5} Speciation | Flow Rate Multipoint Verification/Calibration | Every 365 days and 1 per calendar year ¹ | Flow $< \pm 2\%$ of transfer standard | 1, 2, and 3) Quality Assurance Guidance Document EPA-454/B-12-003, Table 16-1 |
| | | | Temperature $< \pm 2.1$ °C | |
| | | | Pressure $< \pm 10.1$ mmHg | |

¹Also upon receipt, adjustment, repair, installation, and moving.

B.7.1.2 Local Primary Standards

Local primary standards (*Section B.5.4.1*) shall be calibrated and/or certified. Acceptance testing shall be performed and documented upon return to CAB; if acceptance tests fail standards are sent back to the vendor. CAB does not calibrate local primary standards.

B.7.1.3 Field Transfer Standards

Transfer standards (*Section B.5.4.2*) shall be calibrated and/or certified/recertified. Acceptance testing shall be performed and documented upon return to CAB by EHS and AQET personnel in the MA Section; standards are sent back to the vendor if acceptance tests fail. CAB does not calibrate transfer standards.

B.7.1.4 Data Acquisition System

To calibrate the DAS, known voltages are supplied to each of the input channels and the corresponding measured response of the DAS is recorded. Specific calibration procedures in the DAS owner's manual should be followed when performing DAS calibrations. Data acquisition systems that receive digital data from instruments should have full-scale checks performed to see if the data received digitally is the same as the data displayed on the instrument. Full scale is when an instrument is set to a mode where the output is at full scale. The DAS should be calibrated at least once per year. Also see the *QA Handbook, Volume II, Section 14.1.3*, and *Appendix G*.

Data trail audit should be performed by CABMA and/or IT personnel who are not involved with the data collection process. This audit tests for accuracy and consists of following a value or values from the monitoring instrument to the DAS, and then from the DAS to the Envista ARM database. Per instrument SOPs, a procedure similar to the following should be conducted:

- A data value(s) should be collected from the instrument (usually an hourly value or another aggregated value reported to AQS) and be compared to the data stored in the DAS for the same time period. Also, for secondary data collected by analyzers and chart recorders, a random number of hourly values should be compared to the data collected by the DAS. This audit should be completed on a regularly defined frequency and for every pollutant reported, per instrument SOPs (*Appendix I*).
- Personnel performing audits should compare the instrument values to the values stored on station loggers and the main database.

The above actions shall be completed well in advance of data submittal to AQS. If the data has been submitted to AQS, then the AQS database shall be checked and modified as necessary per the appropriate AQS procedures. Whether a monitoring organization is transferring the data from an instrument via an on-site DAS or transferring the data digitally, the data trail audit shall be performed on a routine basis.

B.7.2 Calibration Frequency Documentation

All calibration documentation shall be stored on the CAB Operations SharePoint site. CAB MA personnel have password protected entry to the CAB Operations SharePoint site which can be accessed from the field or individual office computers. This documentation is used for reviews and data validation.

All calibration documents shall be recorded at the time of completion, at minimum, with;

date/time/initials of person performing calibration, results, and any corrective actions.

B.8 Inspection/Acceptance for Supplies and Consumables

All supplies and consumables including gaseous analyzer supplies and particulate sampling filters are procured, inspected, and maintained by the CAB personnel.

Tracking and quality verification of supplies and consumables has two main purposes. The first is the need of the end user of the supply or consumable to have an item of the required quality when needed. The second is the purchasing department to accurately track goods received so the payment or credit invoices can be approved. To address these two issues, the following procedures outline the proper tracking and documentation procedures to follow:

- CAB personnel receiving the shipment perform a brief inspection of each package as they are received from the courier or shipping company. The shipper shall be notified if there are any obvious problems such as a crushed box or wet cardboard.
- Each package shall be opened, inspected, and the contents compared against the packing slip.
- Each supply/consumable shall be inspected. Each piece of equipment is inspected and tested prior to deployment to ensure that it meets all performance specifications (*Section B.6*). If there is a problem with the equipment or supply, the problem should be noted on the packing slip, the CAB MA Supervisor is notified of the issue, and the vendor is contacted as soon as practicable.
- If the equipment/supplies appear to be complete and in good condition, sign, and date the packing slip and submit it to CAB MA or the Air Quality Electronic Technician Supervisor.
- The exterior of the package that contains a shipment is labeled with the date received, and any applicable expiration dates.
- Received equipment and supplies are inventoried and stored primarily at the AQET lab then distributed to air stations as needed. The AQET II supervisor tracks and ensures supplies are always available and rotated to use oldest items first. The manner of inventory record keeping depends on the type of equipment received. Air monitoring equipment is inventoried on the CAB Operations SharePoint site when received, physical locations are updated as devices are moved around.
- Equipment used in this project shall have its location and status (in use/idle) tracked on the CAB Operations SharePoint site. Most devices have digital logbooks also on CAB Operations SharePoint site, idle devices shall have log entries that include the following:
 - Date out of use,
 - Working condition (working or not working),
 - Initials of personnel that made entries in logbook.

B.8.1 Gaseous Analyzer Supplies

Gas analyzers use inlet filters, charcoal canisters, desiccants, mass flow controllers, and calibration gas cylinders which are replaced by CAB station operators and shall be documented in equipment logbooks stored on the CAB Operations SharePoint site. Calibration gas cylinders are also tracked on the CAB Operations SharePoint site and shall be replaced prior to expiration dates.

B.8.2 Particulate Analyzer Supplies

Continuous monitors use glass fiber filter tape (BAM 1022) and filter-based monitors use individual Teflon filters. All particulate filters shall pass inspection and acceptance testing before deployment and usage as specified in the Filter Handling SOP (*Appendix I*). Acceptance tests are documented per SOP. Inspection and acceptance of glass fiber and Teflon filters are completed by CAB personnel and the contracted laboratory. Documentation of acceptance testing results shall be filed on the CAB Operations SharePoint site *Filter Tracking Log*.

B.9 Data Acquisition Requirements for Non-Direct Measurements

Non-direct measurements include data from outside sources and historical monitoring data. Outside data used include:

- chemical and physical properties data.
- sampler manufacturers' operational literature.
- *geographic information systems* (GIS) data.
- external air monitoring databases (EPA AQS, IMPROVE, etc.).
- National Weather Service data.
- HVO national park data (included in *Hawaii Short Term SO₂ Advisory* website).
- PGV data (collected per permit requirement)

Use of outside data will be quality controlled to the extent possible following the QA procedures outlined in this document and in applicable EPA guidance documents. Listed data is not reviewed or reported by CAB.

B.10 Data Management

The data collected in the CABAMP must be reliable, of known quality, easily accessible to a variety of users, and aggregated in a manner consistent with its prime use.

The CAB is responsible for performing all air monitoring related activities and routine QA/QC activities as specified in this QAPP, which includes:

- Verifying data prior to submitting to AQS.
- Maintaining the integrity and validity of data that is transmitted, recorded, and transformed as briefly described in *Section B.5.1.2*.
- Managing the storage and retrieval of data.

Raw and final data for the CABAMP are stored and managed on computers and software systems maintained by the CAB ITS. Raw data is an original unedited set of data. Final data is data that has been reviewed, verified, and validated, with edits performed directly on Envista. Edits may consist of adding or replacing null codes, adding qualifier codes, and replacing missing data with secondary data. A record of all edits is tracked on Envista ARM. See *Section A.4*, *Table A-1*, and *Figure A-3* of this QAPP for the specific roles and responsibilities of the CAB personnel that assess, validate, and approve data prior to uploading to AQS. CAB submits annual data certifications as required in EPA regulations *40 CFR Part 58.15*. The processes and procedures used by CAB personnel in reviewing and assessing data are provided in the SOPs for Data Review and Data Assessment (*Appendix I*).

B.10.1 Data Acquisition

Much of the data collected in the HDOH network is initially recorded by data loggers located in the air monitoring shelters that are equipped with gaseous and particulate analyzers. Site loggers are polled every two minutes from the main data logger. Most of the continuous monitor data are collected in one-minute averages except for the PM_{2.5} monitor (BAM 1022) that collects only one reading per hour. Data recording requirements of parameters, for units and decimal places, are followed per Table 14.1 of the QA Handbook, Volume II.

Some air monitoring sites in the network have no shelter, these sites consist of stand-alone particulate monitors with no onsite data logger, for these sites data is transmitted by modem to the main database. In addition to onsite data loggers, most sites have chart recorders that collect data, and some analyzers can store their own data. Chart and secondary analyzer data storage is used as a backup when logger data is lost or not properly collected.

Documentation that requires manual entry, such as COC forms used for filter-based samplers, are filled out by station operators on hardcopy forms. These forms are brought back to the CAB MA *Filter Processing Area* (FPA) along with the sample filters collected. Designated personnel at the FPA process the filters and scan COC forms on to the CAB Operations SharePoint site from a computer assigned to the FPA. COC hardcopies are stored and filed at the FPA.

B.10.2 Data Transmittal

A dedicated server automatically polls the individual station loggers to collect stored data, this is accomplished by using Envista ARM software. All station data loggers are connected to the internet which allows them to be polled. See *Figure B-3* in *Section B.2.4.1* to view flow diagram showing how data is transmitted from the air monitoring sites to the main database. Uploading data does not remove the data from the station's data loggers. The data logger maintains its own database and has the capacity to hold several years' worth of data. If there are communication problems, the data is retrieved either by directly accessing the data logger or retrieving the data remotely using the Envista ARM client computers once the communication problem is resolved. If a site experiences communication issues which are anticipated to be long-term, frequent site visits will be scheduled to ensure data is transferred by storage device between that site and the server.

Chart recorders simultaneously record the analog output of each analyzer. Site operators are responsible for manually downloading chart data to site loggers into files that are then uploaded onto the CAB Operations SharePoint site. This task is performed weekly to monthly.

For filter based particulate samplers, such as FRM PM_{2.5} and Speciation, collected filters and field documents are delivered by station operators to designated CAB MA personnel at the FPA. The exposed FRM PM_{2.5} and Speciation filters with appropriate documents are sent to contracted and EPA laboratories for post weigh processing and analysis. Contract laboratories are notified of flaws during sampling by documenting incidences on COCs sent back with filters. Filter documents are scanned and saved on to the CAB Operations SharePoint site and at the FPA. Upon receipt, *Filter Reports* from contracted laboratories

are uploaded and saved onto the CAB Operations SharePoint site.

B.10.3 Data Transformation

The inherent accuracy of an instrument is incorporated into the system accuracy when the instrument is calibrated. Multipoint verifications should be performed before and after calibrations to establish as-found and as-left statuses. Each criteria pollutant analyzer shall be adjusted by site operators to accurately reflect the concentration at which the instrument is tested during calibrations. Analyzers should be linear within the range of 10% to 90% of full scale. If background analyte concentrations do not violate this range, the accuracy of the instrument is not questioned.

CO, NO_x, O₃, SO₂, and H₂S analyzers are adjusted during the calibration operation to correlate the output to match the actual gas concentrations present in the analysis cell. PM₁₀ and PM_{2.5} analyzers are adjusted during the calibration operation to correlate the output flow rates with the expected flow rates. Detailed information and procedures for all analyzers are in *Section B.5.5* of this QAPP, appropriate SOPs in *Appendix I*, and individual analyzer operations manuals located in the CAB Operations SharePoint site.

Gas analyzer calibrations rely on readings taken from the site DAS loggers. DAS loggers should have regular voltage checks, voltage calibrations should be performed annually or as needed per *QA Handbook, Volume II, Appendix G*.

B.10.4 Data Reduction

Data reduction involves aggregating the data into averages that are compared to the NAAQS criteria pollutant limits (see *Tables A-5 to A-15* in this QAPP for DQIs and MQOs per parameter). There is a loss of detail in the data and may involve averaging across time (i.e., 1 minute, 5 minutes, hourly, or daily averages). This summarizing process produces a few values to represent a group of many data points. Data averages should be verified as described in *Section B.5.1.2* of this QAPP.

CAB personnel should routinely verify data reduction processes by comparing the raw data from the analyzer to data stored on station data loggers, and verify data stored on the station data loggers to data stored in the main database. Checks on zero/span/precision points and calibrations shall also be performed at least annually by station operators to compare data on the station data logger to data reported into the Envista database (e.g., check 60-minute average equivalent to the hourly average).

The DAS is set up to automatically flag analyzer data whenever the following occurs:

- Zero check
- Span check
- One-point QC check (gas and particulates)
- Multipoint calibration
- Maintenance procedures

The Envista ARM software is set up to automatically flag data when it falls below the absolute minimum acceptable sample values per EPA AQS protocols (*Table B-22*).

Based on these data reduction tests, ambient monitoring results can be compared to NAAQS criteria pollutant limits per *QA Handbook Volume II Appendix D*. NAAQS generally exceeds specified MDL for the instrument. While still good laboratory practice, unless “required” by the regulatory authority, there is generally no need to test for MDL for the criteria pollutant continuous instruments, as the instrument has an established MDL and should capture concentrations below and above NAAQS. For NCore trace monitoring, MDL determination is recommended, dependent on NCore DQOs and concentration detected. Quantitation begins at two to three times the MDL. Despite, at trace levels (parts per trillion) closer to the MDL (2-3x), results are prone to more error (precision and accuracy) being introduced. If occurring, discuss use of wider acceptance window for lower detections with QAO. See *40 CFR Part 136, Appendix B* for determining detections limits.

Once data has been flagged as void or questionable, Data Validation Personnel (DVP) shall identify underlying causes and decisions are made regarding data validity, as described in the Data Validation SOP in *Appendix I*. If data are invalid, they are not used in calculations and AQS null codes are submitted in their place. If the data are valid, but flagged due to extenuating circumstances, the data will still be used in calculations with an appropriate EPA AQS data qualifier code reported. If the data is correlated to an exceptional event, the event shall be documented for EPA concurrence.

B.10.5 Data Storage and Recovery

Data aggregated from air monitoring stations are stored on the Envista ARM. Envista ARM is a Microsoft SQL based system. It maintains two versions of the data in its database, Raw and Edited. The Raw version of the data shall not be altered or used.

All data reduction, viewing, and reporting shall use the Edited version of the data. Data reduction operations shall be performed on the Edited version of the data as often as needed, ensuring that the integrity of the Raw data is not violated. Envista ARM's audit trail software feature automatically tracks changes made to the data with time/date and authorized personnel stamps.

Backup of raw and edited data on the cloud server shall be performed by Dr. DAS (DAS vendor) automatically, every night. The CAB IT shall ensure that the scheduled backups are completed successfully. Should the cloud server go down, Dr. DAS will start a backup server to replace the primary server.

Any data lost from the cloud server shall be retrieved from the individual station data loggers. The SOP documenting data storage, recovery, and back up shall be written and updated by Dr. DAS with review and approval provided by CAB MA. This document shall be located on the CAB Operations SharePoint site and in *Appendix II* of this QAPP.

The contract laboratory archives exposed filters in cold storage ($\leq 4^{\circ}\text{C}$) for a minimum of one year. After one-year CAB is consulted for disposition of exposed filters. CAB personnel at the *Filter Processing Area* (FPA) receive the exposed filters and store them, un-chilled, for an additional 4 years in accordance with *40 CFR 58.16*. PM_{2.5} results and supporting documents shall be stored at the FPA and on the CAB Operations SharePoint site. SharePoint server is automatically backed up nightly.

Table B-22 EPA AQS Protocols for CABAMP Network Parameters

| Criteria Parameter | Parameter Code | Method Code | Recording Mode | Analysis | Method Type | Federal MDL ¹ | Min. Value | Max. Value | Units | Decimal Places ² |
|------------------------------------|------------------------|-------------|----------------|---|-------------|--------------------------|------------|------------|--------------------|-----------------------------|
| CO | 42101 | 093 | Continuous | Gas Filter Correlation | FRM | 0.5 | -0.4 | 50 | ppm | 1 |
| NO ₂ | 42602 | 212 | Continuous | Cavity Attenuation Phase Shift Spectroscopy | FEM | 0.04 | -5 | 1000 | ppb | 1 |
| O ₃ | 44201 | 047 | Continuous | Ultraviolet Photometry | FEM | 0.005 | -0.004 | 0.5 | ppm | 3 |
| SO ₂ | 42401 | 060 | Continuous | Pulsed Fluorescence | FEM | 2 | -4 | 10000 | ppb | 1 |
| PM _{2.5} | 88101 | 209 | Continuous | Beta Attenuation | FEM | 5 | -10 | 975 | µg/m ³ | 1 |
| PM _{2.5} | 88101 | 116 | Intermittent | Gravimetric | FRM | 2 | 0 | 5000 | µg/m ³ | 1 |
| Non-Criteria Parameter | Parameter Code | Method Code | Recording Mode | Analysis | Method Type | Federal MDL ¹ | Min. Value | Max. Value | Units | Decimal Places ² |
| H ₂ S | 42402 | 20 | Continuous | Pulsed Fluorescence | n/a | 0.002 | -0.002 | n/a | ppm | 3 |
| NCore Parameter | Parameter Code | Method Code | Recording Mode | Analysis | Method Type | Federal MDL ¹ | Min. Value | Max. Value | Units | Decimal Places ² |
| CO | 42101 | 593 | Continuous | Gas Filter Correlation Trace | FRM | 0.02 | -0.4 | 50 | ppm | 3 |
| | | 554 | | | | 0.04 | -0.4 | 50 | ppm | 3 |
| NO _y | 42602 | 574 | Continuous | Chemiluminescence | FRM | 0.05 | -5 | 1000 | ppb | 1 |
| O ₃ | 44201 | 047 | Continuous | Ultraviolet Photometry | FEM | 0.005 | -0.004 | 0.5 | ppm | 3 |
| SO ₂ | 42402 | 560 | Continuous | Pulsed Fluorescence Trace | FEM | 0.2 | -4 | 1500 | ppb | 1 |
| PM _{2.5} | 42101 | 554 | Continuous | Gas Filter Correlation Trace | FRM | 0.04 | -0.4 | 50 | ppm | 3 |
| | 88101 | 238 | Continuous | Broadband Spectroscopy | FEM | 0.1 | 0 | 10000 | µg/m ³ | 1 |
| PM _{2.5} | 88101 | 545 | Intermittent | Gravimetric | FRM | 2 | 0 | 5000 | µg/m ³ | 1 |
| PM ₁₀ | 81102 | 239 | Continuous | Broadband Spectroscopy | FEM | 0.1 | 0 | 10000 | µg/m ³ | 1 |
| PM _{10-2.5} | 86101 | 240 | Continuous | Broadband Spectroscopy | FEM | 0.1 | 0 | 10000 | µg/m ³ | 1 |
| RH | 62201 | 014 | Continuous | Hygrometer | n/a | 1 | 0 | 100 | % RH | 0 |
| AT | 62101 | 020 | Continuous | Thermistor | n/a | -60 | -60 | 150 | °F ³ | 0 |
| WD | 61104 | 020 | Continuous | Vector Summation | n/a | 0.1 | 0 | 360 | °Comp. | 0 |
| WS | 61103 | 020 | Continuous | Vector Summation | n/a | 0.1 | 0 | --- | Knots ³ | 1 |
| Speciation Parameter | Parameter Code | Method Code | Recording Mode | Collection | Method Type | Federal MDL ¹ | Min. Value | Max. Value | Units | Decimal Places ² |
| PM _{2.5} Local Conditions | Assorted analyte codes | 811 | Intermittent | SASS Teflon filter | n/a | Varied | n/a | n/a | µg/m ³ | 3 |
| | | 812 | | SASS Nylon filter | | Varied | | | | 2 |
| | | 838 | | URG Quartz filter | | 0.002 | | | | 3 |
| | | 88348 | | SASS Teflon filter | | 0.002 | | | | 3 |
| | | 818 | | SASS Teflon/Nylon & URG Quartz filters | | 0.002 | | | | 3 |
| | 88401 | 819 | | | | 0.002 | | | | 3 |

¹ MDL testing is generally not required for NAAQS concentrations; however, it is generally good practice to determine the MDL. Two to three times the MDL begins quantitation (i.e., where one can credibly state that one can quantify detections).

² In EPA's TSAs, comments are now added regarding the need to report three significant figures for gases (better resolution). This is in addition to *Table 14.4 Data Reporting Requirements, QA Handbook, Volume II*.

³ These units are what is listed on the *AQS Code List for Met only*, found on the AMTIC website. CAB records ambient temperature in °C (degrees Celsius) and wind speed in mph (miles per hour).

C. ASSESSMENT AND OVERSIGHT

C.1 Assessments and Response Actions

An assessment is the process used to measure the performance or effectiveness of the quality system, the criteria pollutant and NCore network of sites, and various measurement phases of the data operation. Assessment schedules are included in *Table A-3, Section A.6.6* of this QAPP. The following is a list of quality assurance assessments that are performed by CAB:

- Network Reviews
- Performance Audits
- Technical Systems Audits
- Site Surveillance
- Data Quality Assessments
- Corrective Actions

C.1.1 Network Reviews and Assessments

Conformance with the criteria and NCore ambient air quality monitoring network requirements as set forth in *40 CFR 58, Appendices D and E*, are determined through an annual network review as required by *40 CFR 58.10*. The network review conducted by the MA section of CAB is used to determine if the air monitoring network is collecting adequate, representative, and useful data in accordance with network objectives. Additionally, the review can identify possible network modifications to reduce or enhance the system, to correct deficiencies in attaining network objectives, or to address specific air quality concerns.

The information used in the review includes:

- station files, including current site information and photographs.
- the most current performance audit reports to assess potential site problems.
- *Geographical Information System* (GIS) maps showing population densities and land use.
- five-year air quality data summaries and trend charts to determine if a site is producing appropriate data for its objectives.
- most recent emissions inventory and information such as maps of site emission density delineating an area's major emissions sources.
- National Weather Service summaries for the monitoring network area.

In addition to the annual network review, the state is required to perform and submit to EPA Region 9 an assessment of the air quality surveillance system every five years.

The first assessment was due and submitted to EPA Region 9 in 2010, with subsequent assessments submitted in 2015 and 2020. The assessment determines if the network meets the monitoring objectives defined in *40 CFR Part 58, Appendix D*, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the network. The assessment also determines whether the existing and proposed sites support air quality characterization for areas with relatively high populations of susceptible individuals (e.g.,

children with asthma and the elderly), and for sites proposed for discontinuance, what effects that may have on data users or health effects studies. The CAB may adjust the network based on these assessments, and adjustments are dependent upon adequate funds and staff. Any network additions or modifications will be detailed in the annual network plan and submitted to the EPA for approval.

C.1.2 Number and Location of Monitors

One main purpose of the network review is to determine whether it meets the minimum number of monitors specified in *40 CFR Part 58, Appendix D*. As the NAAQS are revised, the number of required monitors may also change and some of the tools that may be used to determine network adequacy are:

- historical monitoring data.
- maps of emissions densities.
- dispersion modeling.
- special studies.
- best professional judgment.
- State Implementation Plan requirements.
- monitoring strategies (e.g., air toxics).
- population density changes.
- traffic counts.

The actual geographical location of monitors in the SLAMS and SPMS network is reviewed by the use of maps, photographs, and GIS information. Plots of source emissions, historical monitoring data, population density and other special study findings may also be used to evaluate the monitor locations.

NCore stations are generally located in an urban or neighborhood scale to provide representative concentrations of exposure expected throughout the metropolitan area. The CAB NCore site is in the Kapolei Business Park in the city of Kapolei, on the island of Oahu. This area is a mix of business, commercial, and government activities surrounded by an expanding residential community.

The stated objective for each monitoring site is reconfirmed and the location's spatial scale is verified. If the site location does not support the stated objectives or the designated spatial scale, changes will be proposed to the EPA per monthly call, since census population for Oahu is greater than one million. When a new monitoring location is selected and planned for ambient monitoring inclusion, an addendum shall be added to the QAPP and updated in the annual network plan.

An integral part of the network review is an in-depth determination of whether it meets the needs of specific state objectives as well as budgetary and staff limitations. This includes reviewing for:

- the need for new monitors or monitoring sites.
- the need to relocate existing monitors.
- siting problems and solutions.
- data submittal and completeness problems.
- station maintenance issues.
- quality assurance problems.

- the need for air quality studies and special monitoring programs.
- other issues such as proposed regulations and funding.

In addition to the list above, see following *Section C.1.3* for list of documentation that is maintained for each station. This information shall be evaluated during the annual network plan review.

The network review is documented in the annual network plan and is made available for public inspection at least thirty (30) days prior to submittal to EPA Region 9 on or before July 1 of each year. The most current network plan is posted on the public CAB website (under Reports) at:

<http://health.hawaii.gov/cab>

C.1.3 Probe Siting Requirements

Monitor probe siting criteria for SLAMS and NCore are specified in *40 CFR 58, Appendix E*. At a minimum, during the site surveillances, physical measurements and observations are performed to determine compliance with the *40 CFR 58, Appendix E* requirements such as height above ground level, distance from trees, appropriate ground cover, etc.

CAB conducts site surveillances such that each station is evaluated at a minimum once every year (see *Section C.1.7* of this QAPP).

Photographs and the most recent hard copy site descriptions maintained at the CAB office are updated when there are any changes or as needed.

The following information is documented in each station file maintained at the CAB:

- photographs of the station in the eight cardinal directions.
- distance and direction of any obstructions.
- unrestricted airflow.
- distance from roadway.
- condition of manifold and inlet probes.
- general condition of the station and site (leaks, safety, and security).

If any discrepancies or deficiencies are identified, a CAN is generated following the protocol in *Section C.1.9* of the QAPP.

C.1.4 Performance Evaluations

A performance evaluation (PE) is a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with the routinely obtained data. PEs evaluate instrument performance, provide a level of confidence that the instruments are operating within an acceptable degree of data quality, help verify the precision and bias estimates, and identify where modifications or improvements are needed. *Table C-1* provides detailed information on the types of internal and external PEs performed on the CABAMP.

Table C-1 Performance Evaluation Activities

| Lead Agency | Description |
|----------------------------------|--|
| EPA (Independent assessment) | National Performance Audit Program (NPAP) provides audit standards for the gaseous pollutants either as devices that the site operator connects to the back of the instrument or through the probe in which case the audits are conducted by presenting audit gases through the probe inlet of ambient air monitoring stations. Flow audit devices are also provided through the NPAP. NPAP audits are required at 20% of the PQA sites annually so that all sites are audited in 5-7 years. |
| EPA (Independent assessment) | PM _{2.5} Performance Evaluation Program: (PEP) collocates a portable FRM PM _{2.5} audit instrument with an established primary sampler at a routine air monitoring site, operates both samplers in the same manner, then compares the results. For Hawaii, with a total of 12 SLAMS and SPMS PM _{2.5} , EPA is required to conduct eight audits annually. |
| CAB (Semi-Annual & Annual PE) | Per 40 CFR 58, Appendix A, each site in the network is audited by CAB personnel not involved with site operation. Both gaseous and particulate audits are conducted. Audit details are provided in this QAPP and SOPs in <i>Appendix I</i> . |

Independent assessments are performed by individuals or groups that are not part of the operations directly performing and accountable for the work being assessed. These independent assessments can be conducted by EPA or a contractor. The annual performance evaluations as required in 40 CFR 58, Appendix A are conducted by personnel not involved with the generation of routine monitoring, calibration, or analysis of the data. Personnel assigned to conduct the annual PEs are detailed in this QAPP.

An audit finding report is generated if any discrepancies or deficiencies requiring corrective actions are discovered during a PE. Protocols for issuing CANs are detailed in Section C.1.9 of this QAPP. CANs are initiated and submitted through the point of contact as detailed in Section C.1.9 up to thirty (30) days upon receipt of the audit finding.

C.1.5 Performance Audits

Performance audits are conducted by CAB MA personnel not involved with station operations. Audits are conducted on criteria and NCore monitoring systems for gaseous pollutants, particulate matter, and meteorology annually or semi-annually (PM requires audits every 180 days and twice a calendar year). A transfer standard and the monitoring station's analyzer assay the same gaseous concentrations at the same time. The responses of the on-site analyzer are then compared against the output of the transfer standard and a linear regression is generated. The audit (actual) concentration and the corresponding indicated concentration by the analyzer are reported for evaluation. Table C-2 identifies the frequency and criteria for performance audits of criteria and NCore pollutants conducted by CAB MA staff.

Each parameter and monitoring range have selected audits levels. The CAB MA section's EHS IV auditor creates a sheet that summarizes the ranges, spans, precisions, audit levels, detection limits, method codes, analyzer models, etc., per parameter and site. This sheet is updated annually and posted on CAB Operations SharePoint site. The rationale for the audit levels is based on EPA *Technical Note – Guidance on Identifying Annual PE Audit Levels Using Method Detection Limits and the 99th Percentile*, 05/03/2016. This guidance document is added as an Appendix to the CAB Audit SOPs (*Appendix I*).

Table C-2 Performance Evaluation/Audit Acceptance Criteria and Frequency for Criteria and NCore Parameters

| Requirement | Frequency | Acceptance Criteria | Detection Limits ¹ | 40 CFR Reference |
|---|---|--|--|---|
| CO, CO _{Trace} Annual Performance Evaluation Single analyzer | Every site 365 days and 1/calendar year within period of monitor operation. | Percent difference of audit levels 3-10 < ± 15.1%. Audit levels 1 & 2 ± 0.031 ppm difference or ± 15.1%. | Lower limit for: • CO = 0.5 ppm (0-50 ppm range) • CO _{Trace} = 0.02 ppm (0-5 ppm range) | 1 & 2) 40 CFR Part 58 App A Sec. 3.1.2. 3) Recommendation- 3-audit concentrations not including zero. AMTIC guidance 2/17/2011. AMTIC Technical Memo ² |
| NO ₂ , NO _y O ₃ SO ₂ , SO _{2 Trace} Annual Performance Evaluation Single analyzer | Every site 365 days and 1/calendar year within period of monitor operation. | Percent difference of audit levels 3-10 < ± 15.1%. Audit levels 1 & 2 < ± 1.5 ppb difference or < ± 15.1% | Lower limits for: • NO ₂ = 0.04 ppb (0-200 ppb range) • NO _y = 0.05 ppb (0-200 ppb range) ³ • O ₃ = 5.0 ppb (0-200, ppb range) ³ • SO ₂ = 2 ppb (0-200, 0-500, or 0-1000 ppb ranges) • SO _{2 Trace} = 0.2 ppb (0-100 ppb range) ³ | 1 & 2) 40 CFR Part 58 App A Sec. 3.1.2. 3) Recommendation- 3-audit concentrations not including zero. AMTIC guidance 2/17/2011. AMTIC Technical Memo ² |
| PM _{2.5} , PM _{10-2.5} Semi-Annual Flow Rate Audit | Twice a calendar year and between 5-7 months apart. | < ± 4.1% of audit std. < ± 5.1% of design flow rate. | Federal MDL ⁴ per method in (µg/m ³): • TAPI T640X = 0.1 • BGI PQ200 = 2.0 • BAM 1022 = 5.0 | 1 & 2) 40 CFR Part 58 App A Sec 3.2.2. 3) Method 2.12 Sec 11.2.1. AMTIC methods list for all. |
| PM ₁₀ Semi-Annual Flow Rate Audit | Every 180 days and twice a calendar year. | < ± 10.1% of audit std. Results in standard temperature and pressure. | Federal MDL ⁴ per method in µg/m ³ : • TAPI T640X = 0.1 | 1 & 2) 40 CFR Part 58 App A Sec 3.3.3 3) Method 2.10 Sec 7.1.5. |
| PM _{2.5} Speciation Semi-Annual Flow Rate Audit | 1/6 months, if failed, 1/quarter until passes twice | ± 5 % of audit std. ± 5 % of design flow rate | Federal MDL ⁴ per method in µg/m ³ : • S/SASS = Varied • URG3000N = 0.002 | 1, 2, and 3) EPA Quality Assurance Guidance Document, EPA-454/B-12-003, June 2012, Table 16-1 |
| NCore Meteorological AT, RH, WS, WD Annual Accuracy Evaluation | Every site 1/year | AT = 3 pt. Water Bath. All pts. within ± 0.5 °C of std. RH = NIST traceable Psychrometer or standards solution. ± 7% RH WS = 4 to 5 points between 0.5 and 50 m/s. ±0.25 m/s ≤ 5m/s. 5 % > 2m/s not to exceed 2.5 m/s. WD = 4 to 5 compass pts. between 0 and 360 degrees. ±5 degrees; includes orientation error. | Federal MDL ⁴ per method: • AT = -60 °F (CAB monitors in °C) • RH = 1% RH • WS = 0.1 Knots (CAB monitors in mph) • WD = 0.1 °compass | 1, 2 and 3) Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements, Version 2.0 (Final) Table 0-4 NCore Calibration and Accuracy Criteria |

¹ This is a Method Detection Limit (MDL) defined as the minimum measured concentration of a substance that can be reported with 99% confidence that the measured concentration is distinguishable from the method blank results.

² Use of Expanded Audit Levels for Annual Performance Evaluation for CO, NO₂, O₃, and SO₂ as described in 40 CFR Part 58. Appendix A, Section 3.3.2, November 2010, and Technical Note- Guidance on Identifying Annual PE Audit Levels Using Method Detection Limits and the 99th Percentile, 05/03/2016.

³ Ranges are from the document *CAB Selected Audit Levels Per Parameter and Monitor Range*. This document is updated annually and is posted on the CAB Operations SharePoint site.

⁴ From AMTIC website, Methods lists for All Parameters, PM_{2.5} Speciation Only, and MET Only.

Gas analyzer audits within the PQAQ must have one point within two to three times the method detection limit. The second point is less than or equal to the 99th percentile of the data at the site or network of sites or the next highest audit concentration level. The third point can be around the primary NAAQS or the highest 3-year concentration at the site or the network of sites.

C.1.6 Technical and Independent System Audits

A *Technical Systems Audit* (TSA) is a thorough and systematic on-site review and inspection of the ambient air monitoring program to assess compliance with regulations for the collection, analysis, validation, and reporting of ambient air quality data as well as conformance with the QAPP.

A TSA is conducted by the EPA Region 9 Air Quality Analysis Office once every three years. The following activities are audited during an EPA TSA:

- network management.
- field operations.
- laboratory operations (if any).
- data management.
- quality assurance and quality control activities.
- documentation and data processing.
- corrective action procedures.

Key personnel interviewed during a TSA are individuals responsible for; planning, field operations, technical assistance, quality control/assurance, data validation, data management, and reporting. At the discretion of CAB, a TSA may be conducted more frequently by an independent audit organization.

The QAO shall conduct a minimum of one *Independent Systems Audit* (ISA) approximately every eighteen months between EPA TSAs. ISA can be performed all together or in parts. This ISA is similar to an EPA TSA and is specific to CAB activities. The following is audited during a QAO ISA:

- network management.
- field operations.
- data management.
- quality assurance and quality control activities.

The QAO ISA procedures are based on *Appendix H* of the *QA Handbook*. The checklist used for a QAO ISA is provided in *Appendix IX* of this QAPP. Details of EPA TSAs are also found in *Appendix H* of the *QA Handbook, Volume II (EPA- 454/B-13-00, May 2013)*.

Post TSA and ISA Audit Activities

Upon completion of an EPA TSA or CAB ISA, the EPA/QAO auditor(s) shall deliver a TSA/ISA report detailing the audit activities, conclusions, and recommended corrective actions. Audit reports shall include:

- An audit title, identification number, date of report, and any other identifying information.
- A list of audit team leaders, audit team participants, and audited participants.

- Background information about the project, purpose of audit, dates of audit, particular measurement phase or parameters audited, and a brief description of the audit process.
- Summaries and conclusions of the audit and corrective action required.
- Attachments or appendices that include all audit evaluations and audit finding forms.

To prepare TSA/ISA reports, the EPA/QAO auditor(s) compare observations with collected documents and the results of interviews with key personnel. QAPP implementation is compared with observed implementation. A TSA/ISA report detailing compliance with the QAPP shall then be written and distributed to the HDOH senior staff who approved this QAPP.

HDOH senior staff responds to findings upon receipt of preliminary TSA/ISA reports. The auditor(s) review received comments and incorporates them into the final TSA/ISA report. The final TSA/ISA report shall include a schedule for corrective action implementation, as agreed upon by CAB senior staff and the auditor(s). The corrective action plan is submitted as specified in *Section C.1.9* of this QAPP.

Follow-up and Corrective Action Requirements

As part of corrective action and follow-up, an Audit Finding Response Form shall be generated by the audited organization for each finding in the TSA/ISA report and signed by CAB management. The audit finding response form shall be signed by the regional air quality managers and sent to the TSA/ISA team, which shall review and either accept or reject the corrective action plan. The Audit Response Form shall be completed upon acceptance of the audit report.

C.1.6.1 Assessment Personnel

The following personnel shall be responsible for conducting audits, assessing findings, developing plans, initiating corrective actions, preparing QA reports, evaluating impacts, and implementing follow-up actions.

EPA Region 9, Air Division, Air Quality Analysis Office

Staff shall conduct a TSA, performance audit, and data quality audit at least once every three years. Regional air quality managers are responsible for assessing audit findings, issuing appropriate response/corrective actions, assigning response/corrective actions to specific personnel, and assuring the completeness and efficacy of the work.

Managers are also responsible for ensuring that information and applicable reports are disseminated to the appropriate agencies.

HDOH CAB

The QAO officer conducts ISAs on all SLAMS and SPMS stations at least once every two years, between EPA TSAs, and shall participate in the audits conducted by EPA. CAB personnel shall be responsible for conducting the Annual Network Review, 5-year Network Assessment, and Annual Data Assessments.

CAB air monitoring personnel are responsible for implementing the day-to-day QC/QA activities specified in this QAPP, including generating control charts, conducting data

quality assessments, and conducting data audits. Staff shall implement and document corrective actions performed in response to Corrective Action Notices generated by CAB staff.

The CAB MA Supervisor, with input from the Air Quality Electronic Technician Supervisor shall be responsible for identifying problems, overseeing the timely implementation of corrective actions, and assuring that appropriate documentation is generated, distributed, and filed. The CAB MA section is responsible for following all SOPs, keeping up with preventative maintenance, performing repairs, and ensures that all certifications are up to date for an assortment of standards and equipment.

C.1.6.2 Audit of Data Quality

Audits of Data Quality (ADQ) reveal how data are handled, what judgements were made regarding data acquisition and validation, and the effectiveness of QC/QA procedures on data quality. ADQs are helpful in identifying systematic data reduction and validation errors.

EPA Region 9 shall conduct an ADQ once every three years, according to written procedure. The audit shall serve as an effective framework for organizing the copious quantities of information gathered during by the CABAMP. The ADQ shall have the same reporting and corrective action requirements as a TSA.

C.1.7 Site Surveillance

The CAB conducts unannounced site visits such that each station is evaluated at a minimum, once per year. The purpose of these visits is to observe the general condition of the grounds, shelter (if present), equipment, and surrounding environment. Reports should highlight whether new or upgraded equipment is needed. During these inspections, site photos are updated and included with the report that is generated. This allows the CAB to effectively evaluate station maintenance as well as safety and siting issues.

The number and location of sites visited each year are dependent upon budget and staff availability, but it is the goal of the CAB to visit each site at least once every two years. If problems are found at any station, the CAB conducts follow-up site visits until all concerns and issues are satisfactorily addressed. For each site surveillance visit, a report is generated (*Appendix X*) along with any *Corrective Action Notification* (CAN) if needed and these are posted on the HAMP SharePoint site.

C.1.8 Data Quality Assessments (DQA) and Audits

A DQA is the statistical analysis of ambient air quality data to determine whether the data meet the assumptions that the DQOs and the data collection design were developed under and if the level of uncertainty in a decision based on the data is acceptable. Calculations for DQA activities shall follow the requirements and equations identified in *40 CFR 58, Appendix A, Section 4*. The DQA process is detailed in *Section 18* of the EPA guidance document *Data Quality Assessment: A Reviewers Guide* (EPA QA/G-9R). This document as well as *EPA QA/G-9S* providing appropriate statistical tests can be found at:

<https://www.epa.gov/sites/default/files/2015-08/documents/g9s-final.pdf>

Additionally, the EPA has a *Data Assessment Statistical Calculator* (DASC) that the CAB uses in calculating the precision, bias, and statistics to compare against the validation template criteria in *Appendix VIII*. The DASC file is downloaded from:

https://www.epa.gov/sites/default/files/2020-10/dasc_11_3_17.xls

CAB performs a DQA annually on the previous year's data to ensure that the data meets all QA/QC expectations and is of the quality and quantity needed to be used in decision-making processes. The DQA is found in the Data Assessment Procedure SOP in *Appendix I* of this QAPP.

DQA reports for gaseous pollutants are compiled annually by the EPA's *Office of Air Quality Planning and Standards* (OAQPS) and the box and whisker plots are found on the AMTIC site at:

www.epa.gov/ttn/amtic/qareport.html

PM_{2.5} data assessment reports are compiled by OAQPS every 3-years and are found at:

www.epa.gov/ttn/amtic/anlqa.html

Estimates of data quality are calculated on the basis of single monitors and aggregated to all monitors. The individual results of these tests for each method or analyzer are reported to the EPA and are included in the annual data certification.

Data quality audits reveal how the data are handled, what judgments are made, whether mistakes are corrected, and can identify the means to correct systematic data reduction errors. EPA Region 9 conducts a data quality audit once every three years, usually during the TSA. The data quality audits have the same reporting and corrective action requirements as the TSA in *Section C.1.5* of this QAPP.

CAB performs *Data Quality Assessments* for individual monitors and for all monitors, aggregated, in the ambient air monitoring network. These assessments shall be performed by CAB personnel utilizing the *AQS AMP 256* and *AMP 600* reports and shall be performed annually. These reports shall be uploaded to the CAB Operations SharePoint site, by CAB MA section staff.

C.1.9 Response and Corrective Actions

For assessments, audits, and reviews to be effective, the findings and corrective actions are systematically categorized for the responsible party to address.

A *Corrective Action Notification* (CAN) documents issues that meet the criteria of potentially impacting data quality, completeness, storage and/or reporting. Anyone in the CABAMP who identifies a need for corrective action may submit a CAN form. A blank CAN form is shown in *Figure C-1* of this QAPP. CANs may be initiated during performance audits or QAO ISAs (see *Sections C.1.5* and *C.1.6* of this QAPP), when necessary. A blank PDF version of the CAN form is found in the CAB HAMP SharePoint site. This site shall be made available to all in the air monitoring program.

A CAN may be submitted by an *Initiating Person* (IP) through their immediate supervisor or directly from a supervisor. The *Initiating Supervisor* (IS) determines if a CAN meets the

necessary criteria of impacting data as described in the CAN SOP (*Appendix I*). The **IS** completes *Section I* of the CAN form and identifies the responsible agency/section that can resolve the problem. The **IS** emails the initiated CAN form to the *Point of Contact*, which is the CAB QAO.

The QAO processes the CAN form by first assigning an *Identification Number* (ID), and secondly by logging the CAN onto to a *Corrective Action Notice Log* spreadsheet, located in the CAB HAMP SharePoint site. As the point of contact, the QAO is responsible for forwarding the CAN to the supervisor of the responsible agency/section identified by the **IS**. The QAO names the in-progress CAN file with the CAN ID number and date the document was signed by the **IS**, as follows:

CAN_ID Number_In-Progress_yyyy-mm-dd
(Example: CAN_22-001_In-Progress_2022-01-31)

CAN is received by the *Responsible Supervisor* (**RS**) of the agency/section that can resolve the identified problem. Depending on the level of importance, the **RS** generally must respond within a week to thirty (30) days. The **RS** coordinates with staff to resolve the issue and ensures that steps are taken to prevent its recurrence. The **RS** completes *Section II* of the CAN and forwards the form back to the QAO. **RS** renames the in-progress CAN file with the date *Section II* was signed off on, as follows:

CAN_ID Number_In-Progress_yyyy-mm-dd
(Example: CAN_22-001_In-Progress_2022-02-28)

The QAO circulates the CAN back to the **IS** for review. It is the **IS**'s responsibility to accept or reject the corrective action, in writing, as an entry in *Section III* of the CAN. QAO may be consulted at this time for acceptance recommendations. Accepted CANs are simply marked "yes" and signed by the **IS**. The **IS** renames the finalized CAN file with the date the finalized document was signed in *Section III*, as follows:

CAN_ID Number_FINAL_yyyy-mm-dd
(Example: CAN_22-001_FINAL-2022-03-05)

If a CAN response is rejected, the **IS** adds comments to *Section III* and forwards document back to the QAO, CAN is then recirculated back to the **RS**. The cycle of circulating the CAN is repeated as displayed in *Figure C-1* of this QAPP. The file name of the in-progress CAN changes by updating the date at each step in the cycle.

All CANs are archived on the HAMP SharePoint by the QAO. The QAO verifies that quality system corrective actions are implemented and ensure they are tracked to satisfactory completion. QAO works with staff to resolve all EPA issued TSA findings under internal corrective actions. The *Corrective Action Notice Log* is updated as CANs are cycled through the process. As the point of contact, the QAO is responsible for keeping track of circulating CANs to ensure they are not overlooked or ignored. The different CAN phases/versions are saved into one folder which is labeled as follows:

CAN_ID Number
(Example: CAN_22-001)

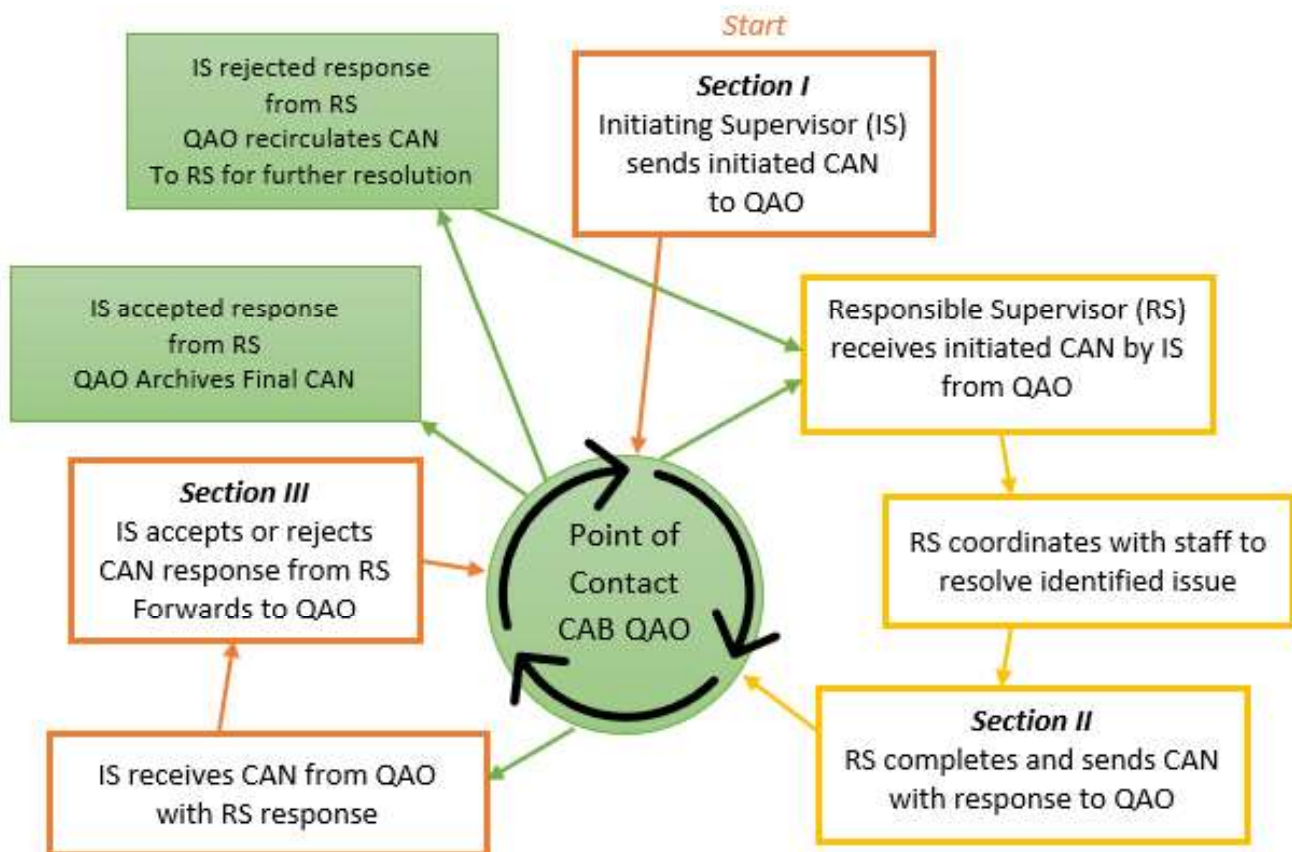
It is the responsibility of all CABAMP section supervisors and QAO to ensure that appropriate CANs are implemented in response to TSAs or DQAs, depending on the area or operation requiring corrective actions. Extenuating circumstances notwithstanding (e.g.

budget, purchasing or staff constraints), corrective actions shall be implemented within the specified time period stated on the CAN. See the CAN SOP for further details describing this process. All CAN documents archived on the HAMP website are available for viewing by the CAB, ITS and EPA via secured access.

The CAB conducts performance audits for gaseous and particulate monitors as detailed in *Section C.1.5* of this QAPP. Initiation of a CAN for an audit is evaluated when a response is received. The CAB may conduct a follow-up audit to verify the efficacy of the corrective action and submit another audit report documenting that the problem or deficiency has been corrected. If a corrective action requires an update or change to a SOP, the CAB and QAO will verify that the changes were adequately completed.

For gaseous pollutant performance audits conducted by the EPA and/or their contractor, a preliminary audit report will be provided the day of the audit. For the PM_{2.5} PEP audit EPA has not been providing a formal report, however, the data from these audits are available in AQS thirty (30) to ninety (90) days after the corresponding HDOH data for that audit day has been uploaded to AQS. Preliminary PM_{2.5} PEP audit results are usually available within thirty (30) days upon request.


Figure C-1 Corrective Action Notification Process



The CAB also conducts a daily review of real-time data to ensure that stations and monitors are operating and collecting data as expected, to verify and document any NAAQS exceedance(s) for immediate public notification, and to ensure that any public concerns can be addressed in a timely manner. See *Section D.1.1* for details on the daily CAB data review process.

Communication within CAB is ongoing, supervisors regularly meet with staff where EPA updates are presented, recurrent corrective actions are discussed, and the QAO gives status updates on quality assurance issues. Further, the CAB Program Manager regularly meets with supervisors and the QAO. These meetings allow everyone within the program to hear and learn at the same time thus giving better understanding for the resolution of problems, workloads, and other concerns. Dispute resolution, if necessary, is performed as described in *Section A.4* of this QAPP.

Figure C-2 Ambient Air Monitoring Corrective Action Notice

| | | | |
|--|-------------------|---|----------------------|
|  | | STATE OF HAWAII Ambient Air Quality Monitoring Program Corrective Action Notification (CAN) | |
| This form is used to document issues that may impact or potentially impact data quality, completeness, storage, or reporting. | | | |
| Section I (to be completed by the <i>Initiating Person "IP"</i> and <i>Initiating Supervisor "IS"</i>) | | | |
| IP: | | Date: | |
| Job Title: | | Initiating Agency: | |
| Subject: | | | |
| Reason for CAN (add attachments if needed): | | | |
| Responsible agency/section to resolve issue(s), as identified by IS: | | | |
| IS (name and title): | | | |
| Signature: | | Date: | |
| URGENT: | IMMEDIATE: | ROUTINE: | DUE DATE: |
| Section II (to be completed by the <i>Responsible Supervisor "RS"</i> and staff of responsible section/agency) | | | |
| Corrective Action Taken (add attachments if needed): | | | |
| Action Taken by (name and title): | | Date: | |
| Resolution (what was done to prevent problem from reoccurring): | | | |
| RS (name and title): | | | |
| Signature: | | Date: | |
| * "RS" makes additions or changes to Section II if CAN is sent back for further resolution, updates signature and date. | | | |
| Section III (to be completed by the "IS" upon receipt, after "RS" response) | | | |
| Is action/response by RS acceptable? | | YES | NO |
| | | | Date: |
| If no, why? (recirculate back to RS through QAO) | | | |
| IS (name and title): | | | |
| Signature: | | Date: | |
| URGENT: | IMMEDIATE: | ROUTINE: | NEW DUE DATE: |
| * "IS" makes additions or changes to Section III after receiving CAN after further resolution, updates signature and date. | | | |
| Point of Contact: Current CAB Quality Assurance Officer (QAO) | | | |
| QAO Verifies that quality system corrective actions are implemented and ensures they are tracking to satisfactory completion. Works with staff to resolve all EPA issued TSA findings under internal corrective actions. | | | |
| Assigned CAN Identification Number: _____ | | | |
| For questions regarding the CAN process, see CAN SOP in current HAAMP QAPP or contact current CAB QAO. | | | |

C.2 Reports to Management

This section describes the quality-related reports and communication to management necessary to support criteria pollutant and NCore SLAMS/SPMS network operations and associated data acquisition, validation, assessment, and reporting. *Table C-3* describes the type, responsible agency, frequency, and conveyance method of quality related reports for the CABAMP.

C.2.1 Frequency, Content, and Distribution of Reports

Reports required for the SLAMS, NCore, and SPMS programs in general are discussed in various sections of *40 CFR 50, 53, and 58*. Guidance for report format and content is provided by EPA's Quality Assurance Division and Office of Air Quality Planning and Standards. See *Appendix I* of the *QA Handbook, Volume II, 2017* and/or refer to *Table C-3* in this QAPP for the reports to be produced.

Table C-3 Types of QA Reports to Management

| Type of Report | Responsible Agency | Frequency | Conveyance Method | Recipient |
|--|--------------------|--|---|---------------------------|
| Annual Data Certification (according to <i>40 CFR 8.15</i>) | CAB MA section | Annually by May 1 | Written Electronic ¹ | EPA Region 9 ² |
| Annual Network Plan (according to <i>40 CFR 58.10</i>) | CAB | Annually by July 1 | Written Electronic ¹ | EPA Region 9 ² |
| Network Assessment (according to <i>40 CFR 8.10</i>) | CAB | Every 5 years by July 1 Beginning 2010 | Written Electronic ¹ | EPA Region 9 ² |
| Quarterly ambient air and QA data (according to <i>40 CFR 8.16</i>) | CAB/ITS | Within 90 days after the end of the quarterly reporting period | Electronic upload | EPA AQS ² |
| Hawaii Air Quality Data Book (according to 105 Grant) | CAB | Annually by December 1 | Electronic ¹ (CAB website) | EPA Region 9 ² |
| National Performance Audit Program (NPAP) | EPA | Annually | Electronic | CAB MA |
| PM _{2.5} Performance Evaluation Program (NPEP) | EPA | Annually | Electronic | CAB MA |
| CAB Internal Systems Audits | CAB | Annually between EPA audits | Written | CAB MA |
| Performance Audits | CAB | Semi-Annually and Annually | Electronic ¹ - HAMP SharePoint | CAB MA |
| Technical Systems Audits | EPA | Every 3 years | Written | CAB MA |
| Site Surveillance | CAB | Each site once per year | Written | CAB MA |
| Response/Corrective Action | EPA CAB ITS | Reports are available to always view on the HAMP SharePoint | Written Electronic ¹ | CAB ITS |

¹ Reports may be sent via email if requested, additionally, the Annual Network Plan is placed on the CAB web page.

² All reports that go to the EPA are reviewed and signed by the CAB Program Manager.

C.2.1.1 Annual Data Certification Report

This report is prepared and submitted to the EPA by May 1 each year by the CAB as described *Section D.2.3* of this QAPP. The purpose of this report is to certify that all air quality data collected in the previous year has been verified and that all CAB quality control data has been entered into the ENVIDAS and AQS databases. The following AQS generated reports shall also be included:

- AMP600 – Certification Evaluation and Concurrence Report
- AMP450NC – Quick Look Summary Report
- AMP430 – Data Completeness Report

Data shall be complete and in accordance with *40 CFR 58.15*. CAB submits a data summary and letter to the EPA certifying that the data collected from January 1 through December 31 of the previous year at all SLAMS and SPMS stations meet the criteria in *40 CFR 58 Appendix A*.

C.2.1.2 Annual Network Plan

As required in *40 CFR 58.10*, the plan includes a statement of purposes for each monitor in the network (SLAMS, NCore, and SPMS) and evidence that siting and operation of each monitor meets the requirements of *40 CFR 58, Appendices A, C, D, and E*. The plan is prepared by the CAB and made available for public inspection for thirty (30) days prior to submission to EPA. The final plan submitted by July 1 each year includes any public comments and CAB's responses.

C.2.1.3 Network Assessment

As required in *40 CFR 58.10*, an in-depth assessment of the air quality surveillance system is conducted by the CAB once every five (5) years beginning July 1, 2010. At a minimum, the network is reviewed to determine if it meets the monitoring objectives defined in *40 CFR 58, Appendix D*, whether new sites are needed, or existing sites can be terminated and whether new technologies can be incorporated. The assessment must consider whether new or existing sites support air quality characterization for areas with relatively high populations of susceptible individuals and, for sites proposed for termination, what effects it may have on the data users. The CAB utilizes various sources of information to conduct the assessment including other government agencies, health and population reports and studies, GIS, emissions inventory, and business and economic development plans. The network assessment report is submitted to the EPA.

C.2.1.4 Quarterly Ambient Air and QA Data

The quarterly ambient air and associated QA data is prepared by the CAB MA section personnel. The data is then reviewed and approved by the CAB MA Supervisor and QAO. The CAB IT specialist uploads the approved data to AQS following the schedule in *Tables D-2 and D-3* of this QAPP. CAB shall supervise the upload, to AQS, of all concentration and associated quality data collected at SLAMS, NCore, and SPMS stations including FRM, FEM, and ARM monitors, as required in *40 CFR 58.16 (b)*. Air quality data submitted for each reporting period shall be edited, validated, and entered into AQS using the procedures described in the *AQS User Guide*.

C.2.1.5 Hawaii Air Quality Data Book

This report summarizes the air pollution data collected at the monitoring stations during a calendar year. Tabular and graphic summaries are provided which compare the measured concentrations with State and Federal ambient air quality standards. In addition, air pollution concentration trend summaries are depicted in graphic form. Various other data may be summarized as the need arises. These reports are due annually by December 1.

C.2.1.6 National Performance Audit Program and PM_{2.5} Performance Evaluation Program

Gaseous NPAP audits performed by an EPA contractor will have a preliminary audit report that can be provided the day of the audit. For PEP audits, a formal report is not provided, however the data from the audits are available in AQS thirty (30) to ninety (90) days after the corresponding HDOH data for the audit day has been uploaded to AQS. Preliminary PM_{2.5} PEP audit results are available by request usually thirty (30) days after audit completion.

C.2.1.7 Technical System Audit Reports

EPA Technical System Audits Reports: As required in 40 CFR 58 Appendix A, Section 2.5, EPA Region 9 shall perform TSAs of the monitoring network every three years. The EPA audit team shall prepare an audit report and submit the same to HDOH within 30 days of completion of the audit.

QAO Internal Systems Audit Reports: The CABAMP QAO conducts an ISA on selected sites approximately every 18 months between EPA TSAs. The audit report is submitted to CAB within thirty (30) days of audit completion. If a response or CAN is generated as a result of a QAO audit, CAB MA or CAB IT will submit the report within thirty (30) days after receipt of the audit report detailing how the deficiency or problem will be corrected and the approximate implementation date. The response/corrective action report will be updated as needed to reflect when the problem or deficiency has been corrected. The audit, response, and CAN are posted on the HAMP SharePoint site for secure access by all CAB staff.

C.2.1.8 CAB Performance Audit Data

The CAB MA section conducts performance audits on each of the criteria and NCore air monitoring sites in the CABAMP. The audits are conducted by CAB MA personnel not involved with data collection and site operation. The frequency of these audits is annual for gaseous pollutant monitoring, NCore meteorological monitoring, and bi-annually for particulate monitoring. Audit data is generated by CAB within thirty (30) days of the audit. If needed, a CAN is created for any deficiencies detected during the audit. All audit data and findings shall be posted on the CAB Operations and HAMP SharePoint sites within 30 days of audit. CANs initiated due to findings discovered during a Performance Audit shall follow the CAN SOP in *Appendix I*.

C.2.1.9 CAB Site Surveillance

The CAB conducts annual site surveillance for each station. Upon completion a Site Surveillance report (*Appendix X*) is generated, and if needed, a CAN is completed and submitted to section supervisors. These are also posted on the HAMP SharePoint site. The CAN process is detailed in *Section C.1.9* of this QAPP.

C.2.1.10 Response/Corrective Action Reports

If a response or CAN is generated resulting from an EPA audit (NPAP, PEP, TSA), CAB audit, or any other CAB issue, the responsible section/agency shall submit a response/corrective report within thirty (30) days after receipt of the audit report detailing how the deficiency or problem will be corrected and the approximate implementation date. The response/corrective action report will be updated as needed to reflect when the problem or deficiency has been corrected. The CAN process is discussed in *Section C.1.9* of this QAPP.

D. DATA VALIDATION AND USABILITY

D.1 Review Verification and Validation Methods

All data collected by CAB shall be demonstrated to be scientifically valid and legally defensible, according to US EPA requirements. This is accomplished through a documented system of data review, verification, and validation as described below and in the appropriate SOPs. Every deviation from the procedures outlined in this QAPP shall be investigated and its effect on data quality and data usability determined. Deviations in the data, quality control/assurance checks, calibrations, and so on, are factors in how hourly data is flagged and invalidated.

The following shall be considered when performing review, verification, and validation:

Sampling Design

Sampling network design and monitoring site selection shall comply with:

- *40 CFR 58 Appendix A* - Quality Assurance Requirements for SLAMS, SPMS, and PSD Air Monitoring.
- *40 CFR 58 Appendix D* - Network Design Criteria for Ambient Air Quality Monitoring.
- *40 CFR 58 Appendix E* - Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring.

Refer to *Sections B.1.1 Monitoring Objectives and Spatial Scale*, *B.1.2 Site Selection*, and *B.2.1 Monitor Placement*, in this QAPP.

Additional guidance is provided in “*Guidance for Choosing a Sampling Design for Environmental Data Collection (EPA QA/G-5S)*.”

Sample Collection Procedures

Sample collection procedures are outlined in *Section B* of this QAPP and detailed in the SOPs for each instrument (*Appendix I*). Many instrumental states and malfunctions can be identified by the ENVIDAS software, which can then flag the data as per a set of rules programmed into the DAS, e.g., performance of a calibration sequence, QC checks, power outages, etc. These flags are routinely checked by CAB personnel to ensure their accuracy. A sample compilation of the allowable AQS null codes is presented in *Table D-1* and is available on the CAB Operations SharePoint site. The latest complete list of AQS qualifier and null codes is found on the AQS website at:

<https://aqs.epa.gov/aqsweb/documents/codetables/qualifiers.html>

Continuous Analyzers

Hourly data collected from continuous monitors should be reviewed by the site operators daily or as soon as practical. Consistent, timely data reviews make it easier to identify and invalidate suspect data and often allow staff to anticipate instrumental problems before they lead to greater data loss. Details of the data verification and validation processes are described in *Sections D.1.4.1*, as well as in the Data Validation SOP (*Appendix I*).

Table D-1 AQS Null Code Description and Type

| Qualifier Code | Null Code Description | Qualifier Code | Null Code Description |
|----------------|---------------------------------------|----------------|--|
| AA | Sample Pressure out of Limits. | BC | Multi-point Calibration. |
| AB | Technician Unavailable. | BD | Auto Calibration. |
| AC | Construction/Repairs in Area. | BE | Building/Site Repair. |
| AD | Shelter Storm Damage. | BF | Precision/Zero/Span. |
| AE | Shelter Temperature Outside Limits. | BG | Missing ozone data not likely to exceed level of standard. |
| AF | Scheduled but not Collected. | BH | Interference/co-elution/misidentification. |
| AG | Sample Time out of Limits. | BI | Lost or damaged in transit. |
| AH | Sample Flow Rate or CV out of Limits. | BJ | Operator Error. |
| AI | Insufficient Data (cannot calculate). | BK | Site computer/data logger down. |
| AJ | Filter Damage. | BL | QA Audit. |
| AK | Filter Leak. | BM | Accuracy check. |
| AL | Voided by Operator. | BN | Sample Value Exceeds Media Limit. |
| AM | Miscellaneous Void. | BR | Sample Value Below Acceptable Range. |
| AN | Machine Malfunction. | CS | Laboratory Calibration Standard. |
| AO | Bad Weather. | DA | Aberrant Data (Corrupt Files, Spikes, Shifts). |
| AP | Vandalism. | DL | Detection Limit Analyses. |
| AQ | Collection Error. | EC | Exceeds Critical Criteria. |
| AR | Lab Error. | FI | Filter Inspection Flag. |
| AS | Poor Quality Assurance Results. | MB | Method Blank (Analytical). |
| AT | Calibration. | MC | Module End Cap Missing. |
| AU | Monitoring Waived. | QV | Quality Control Multi-point Verification. |
| AV | Power Failure. | SA | Storm Approaching. |
| AW | Wildlife Damage. | SC | Sampler Contamination. |
| AX | Precision Check. | ST | Calibration Verification Standard. |
| AY | Q C Control Points (zero/span). | SV | Sample Volume out of limits. |
| AZ | Q C Audit. | TC | Component Check & Retention Time Standard. |
| BA | Maintenance/Routine Repairs. | TS | Holding Time Or Transport Temperature Is Out Of Specs. |
| BB | Unable to Reach Site. | XX | Experimental Data. |

Above table only lists the Null Data Qualifiers

PM_{2.5} Filter-based Samples

For filter-based PM_{2.5} monitoring, samples are collected following the EPA's 1 in 3 sample schedule. Sample operating schedules are discussed in *40 CFR Part 58.12* and can be found at:

<https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-58/subpart-B/section-58.12>

CAB site operation personnel shall document any deviation from the established sample collection SOP in the appropriate logbooks, located on the CAB Operations SharePoint site. Accurate and complete documentation of all sample collection deviations are vital to data evaluation and validation, investigations, and instrument troubleshooting. Details of this process shall be described in the appropriate SOPs.

CAB site operators shall record all deviations from established sample, for each filter sample. These deviations (e.g. missed sample date, damaged filter, unusual deposits on filter) shall be recorded on the COC form assigned to each filter and noted in the logbook stored on the CAB Operations SharePoint site. CAB site operators shall flag each sample with the appropriate AQS code(s). Operators should also record any unusual activities

that may affect the collected sample (e.g. nearby brush fires, lawn mowing, bad weather) in the instrument logbook stored on the CAB Operations SharePoint site.

Analytical Procedures

The continuous and non-continuous data obtained from the electronic evaluation of gaseous criteria pollutant concentrations are verified by CAB personnel as described in *Sections D.2.1 – D.2.5* of this QAPP and detailed in relevant SOPs (*Appendix I*). Specific criteria shall be employed that identify the range of acceptable data, the minimum and maximum acceptable values, the rate of change of specific values, and other criteria that are indicative of valid data (*EPA QA Handbook, Volume II, Appendix D, Validation Template Criteria*). Suspect data shall be flagged as per EPA requirements. CAB personnel shall perform the different levels of data verification and validation. These levels are explained in *Section D.1.4* of this QAPP.

Quality Control

Section B.5, of this QAPP, specifies the QC checks that are to be performed during sample collection, handling, and analysis. For each specified QC check, the procedure, acceptance criteria, and corrective action are specified. Data validation includes documenting the corrective actions that were taken, which samples were affected, and the potential effect of the actions on the validity of the data. The discovery of systematic data errors via the data validation process shall trigger a CAN and appropriate corrective action, as per *Section C.1.9*, of this QAPP.

Calibration

Section B.7, of this QAPP, addresses the calibration of instruments and equipment. To produce data of sufficient quality for use by CAB and the EPA, all calibration procedures shall be performed as per the appropriate SOP (*Appendix I*). When calibration problems are identified, the data produced between the suspect calibration event and any subsequent re-calibration shall be flagged appropriately.

The site operators shall review calibration problems and determine whether those calibrations meet the criteria established in this QAPP. Failed calibrations and corrective actions taken shall be documented (as per specific SOPs) on the appropriate equipment logs on the CAB Operations SharePoint site and shall be available for CAB staff to review.

Data Reduction and Processing

Refer to *Section B.10.4*.

Measurement Quality Objectives and Validation Templates

For data verification and validation, CAB personnel shall use the most recent US EPA *Validation Templates* (Criteria Tables) found in *Appendix D, Measurement Quality Objectives and Validation Templates*, in the *QA Handbook, Volume II*, dated 03/17.

The EPA created *Validation Templates* for each criteria pollutant to assist air monitoring organizations produce quality data. Additional validation templates (criteria tables) were created by CAB for Speciation and NCore parameters by referencing other documents, such as the *EPA-454/B-12-003, June 2012* document for speciation, the *EPA QA Handbook for Air Pollution Measurement Systems, Volume IV* for meteorological measurements, and approved QAPPs from other States. All of the original and newly created criteria tables are found on the CAB Operations SharePoint site and in *Appendix VIII* of this QAPP. These criteria tables consist of three categories.

- Critical Criteria
- Operational Criteria
- Systematic Criteria

Each category lists the appropriate regulatory and data validation responses for the *Requirement, Frequency, Acceptance Criteria, and Information/Action* for each criteria pollutant.

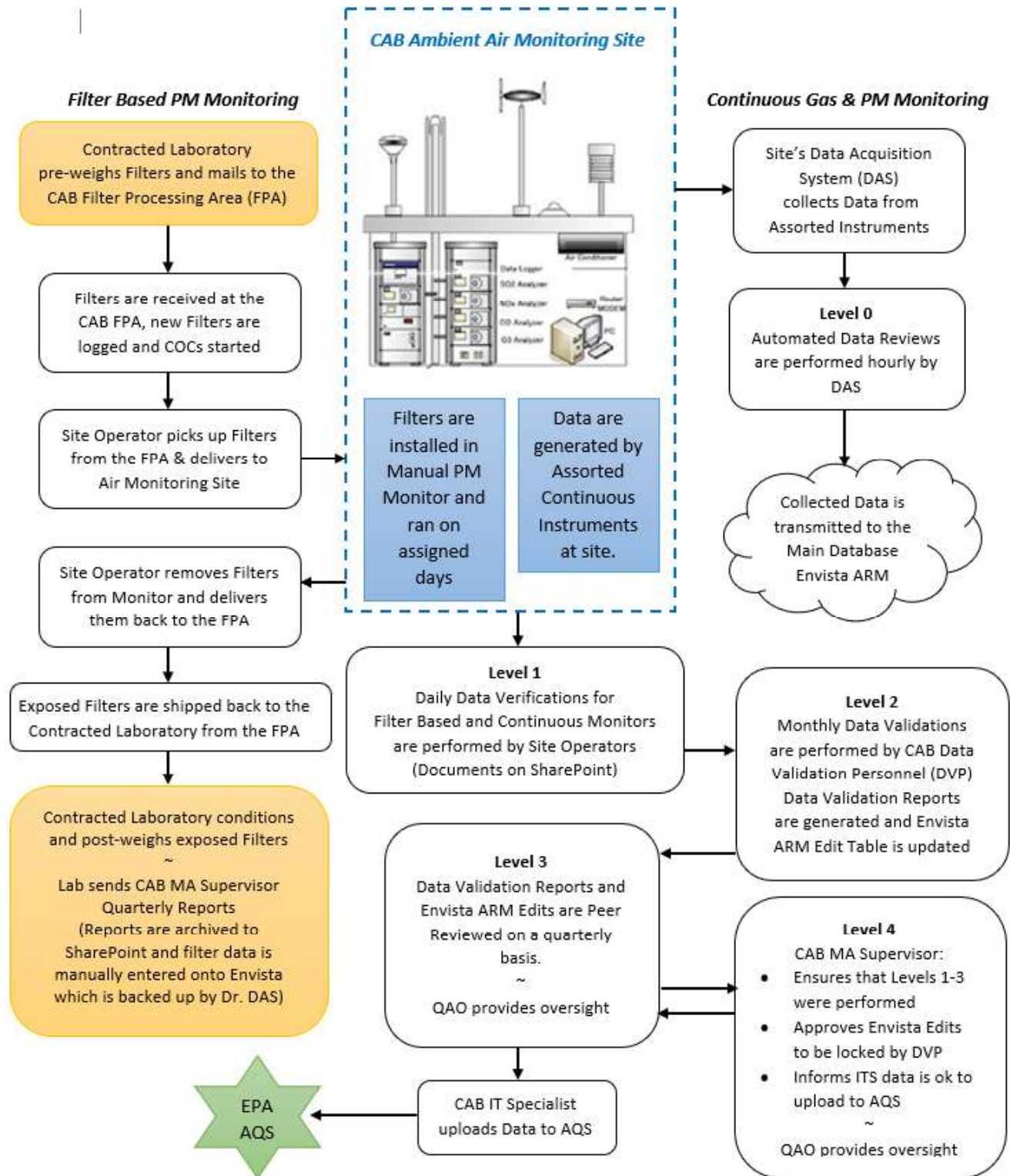
Critical Criteria (pink section): This criterion has been deemed critical to maintaining the integrity of a sample or group of samples. Observations that do not meet every criterion in this category should be invalidated unless there are compelling reasons and justifications for not doing so. Upon discovery of any failed Critical Criteria and the invalidation of data, steps are taken by CAB personnel to document and resolve issue(s). *Site Operators* document deficiencies in *Site and Equipment Logbooks*, and *Data Validators* record findings in their *Data Validation Reports*. Steps are taken to prevent further deviations from critical criteria. If an issue is persistent a *Corrective Action Notification* (CAN) may be required per CAN SOP (*Appendix I*)

Operational Criteria (yellow section): This criterion is important for maintaining and evaluating the quality of the data collection system. Violation of criterion in this category may be cause for data invalidation unless other quality control information demonstrates otherwise and is documented. Deficiencies are recorded in *Logbooks* and *Data Validation Reports* by appropriate CAB personnel. CANs are generated when deemed necessary.

Systematic Criteria (blue section): This criterion is important for the correct interpretation of data but does not usually impact the validity of a sample or sample group. If data quality objectives are not met in this category, it does not invalidate any of the samples, but may impact the uncertainty associated with attainment or non-attainment decisions, refer to *Section A.7.2* of this QAPP. Corrective action, if warranted, may be taken, to prevent reoccurrence. Deficiencies are documented as stated in previous categories.

Figure D-1 depicts the review, verification, and validation processes for the CAB air monitoring program. This figure does not include HECO and PGV, CAB only provides general oversight and does not perform data validation for these agencies.

Figure D-1 Data Management Pathways



D.1.1 Data Review

Data review is an ongoing process used to accept, reject, or qualify data in an objective and consistent manner. For continuous monitors and sensors these reviews are automated and are performed hourly by the *Data Acquisition System* (DAS). Tabular data, which includes metadata, is reviewed to provide instrument performance statuses for the monitoring sites. Data are checked for outliers and deviations from what is routinely observed at the site (e.g. extremely high or low values) relative to the rest of the data; zero, span, and 1-point QC failures. Some potential outliers are spikes in concentrations, data remaining the same for hours, or a sudden drop in concentration but still in the normal range of observed data. Outliers do not necessarily indicate the data is invalid; they serve to alert CAB personnel that there may be a problem. Corrective actions are performed as needed and all deviations and corrections are recorded in site and equipment logs.

D.1.2 Data Verification

Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, or contractual requirements. Data verification evaluates whether specific checks were performed against predetermined requirements such as an analytical method, procedure, or a contract. *Quality Controls* (QC) should ideally be evaluated daily, and the results documented by CAB personnel. QC failures are investigated and corrected as soon as practicable. Data verification shall be performed according to the Data Verification SOP (*Appendix I*) and relevant EPA guidelines. Failure to conform to Critical Criteria and/or Operational Criteria may result in data being invalidated or having a qualifier code assigned.

Data is evaluated for completeness and meeting critical and operational criteria per *EPA QA Handbook, Volume II, Appendix D*. For example, CAB personnel verify that all 1-point QC checks were performed a minimum of every two weeks for a monitor and found acceptable. If results are unacceptable (i.e., do not meet criteria), the data is flagged. For each type of parameter, Quality Controls include:

- Gas Analyzer: zero, span, and 1-point QC checks
- Particulate Monitor: temperature, pressure, and flow checks.

Quality Control (QC) checks should ideally be evaluated daily, and the results documented by CAB personnel. QC failures are investigated and corrected as soon as practicable.

When 75% data completeness is not achieved, CAB MA utilizes 40 CFR Part 50, Appendix N, make-up sample policy for PM, or data substitution for gases (SO₂, 50 App T; NO₂, 50 App S) after discussion with EPA.

D.1.3 Data Validation Methods

Data validation is a sample specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e. verification) to determine the analytical quality of the specific data set and its intended use. Validation goes beyond verification in that judgement is used in determining whether a data point is valid when aggregated with all QC checks. For example, if all critical criteria are met, yet operational criteria fail (e.g., calibration, use of expired standards, or NPAP/PEP audits failed) judgement is rendered by the validator to determine data usability. The decision to either accept or invalidate the

data is documented in monthly *Data Validation Reports*. Data summaries, monthly maintenance logs, QC logs, and site/equipment logbooks are used in data validation and to support documentation. Data validation goals are to:

- Produce a database with values that are validated to a level that meets or exceeds the CABAMP requirements.
- Evaluate the consistency of data collected.
- Compare data to identify error, bias, and outliers.

D.1.4 Data Verification & Validation Levels

All tabulated data collected by both continuous and manual air monitors goes through several reviews that include independent verification and validation processes. A tiered data review approach is implemented through specifically described levels. There are 5 levels established for review, verification, and validation. Our goal in this section is to clearly define these levels. Levels are basically described as:

- **Level 0:** This is an initial review by the Data Acquisition System (DAS) or Sampler. Function is continuous to hourly. Loggers automatically scan data and apply pre-programmed codes and flags.
- **Level 1:** This is a review and verification process performed by CAB Site Operators. Function is performed daily to weekly. Level 1 is the most important review since this is the earliest point CAB personnel checks data. Early detection of issues prevents data loss. Data is verified to confirm QC checks were performed per established specifications. Corrections are made where null codes are added or edited, and missing data can be replaced with data from secondary data loggers on Envista ARM as deemed necessary.
- **Level 2:** This is a review and validation process performed by CAB MA Data Validation personnel. Function is performed monthly. Data reviews and verifications from Levels 0 and 1 are reviewed further. This is a level where it is determined if data can be used for decision making processes. Data Validation Reports are generated, and further null code corrections or qualifier codes are added to the Envista ARM database. Validation Reports document the quality of data relative to its intended use.
- **Level 3:** This is a Peer Review by CAB MA personnel who are not involved with Level 2 data validations. This function is performed Quarterly. Data Validation Reports and Envista ARM null/qualifier code corrections/applications are scrutinized for accuracy, completeness, and correlation. The CAB MA Supervisor provides guidance and the QAO may have recommendations for revisions.
- **Level 4:** The CAB MA Supervisor grants final approval of all validation levels. This function is performed quarterly. The supervisor instructs DVP to lock edited tables on Envista ARM then approves data for upload to AQS by the CAB IT Specialist. The QAO may provide further oversight and recommendations prior to data upload.

While Levels 0 and 1 are performed continuously and daily to weekly, respectively, Levels 2, 3, and 4 are completed according to the schedules outlined in *Tables D-2* and *D-3* of this QAPP. To meet the AQS submission deadline of ninety (90) days after the quarter,

the CAB Data Validation Personnel (DVP) validates all data from the continuous monitors by the dates in *Table D-2* and from manual particulate samplers by the dates in *Table D-3*. After *Data Validation Reports* are generated, the database on the Envista ARM Edit Table is corrected for null code inconsistencies and qualifier codes are applied if necessary. Peer and QAO reviews are performed independently, recommendations for corrections are documented and emailed to the CAB MA Supervisor and DVP. When data needs no further correction, the CAB MA Supervisor informs DVP to lock their edits on Envista ARM. Levels 1 to 4 are tracked on the CAB Operations SharePoint site when DVP and the CAB MA Supervisor initial their respective levels as they are completed, per site and month/quarter. CAB IT personnel monitor tracking tables to find out when data is ready for upload into AQS. All of the above processes ensure that the data produced is of sufficient quality and is acceptable to be entered into the AQS.

Table D-2 Continuous Data Validation Timeline

| Results for: | Data Validation Reports available for CAB MA Supervisor review | Upload to AQS ¹ on or before: |
|--------------|--|--|
| January | March 1 | June 30 for 1 st quarter results |
| February | April 1 | |
| March | May 1 | |
| April | June 1 | September 30 for 2 nd quarter results |
| May | July 1 | |
| June | August 1 | |
| July | September 1 | December 31 for 3 rd quarter results |
| August | October 1 | |
| September | November 1 | |
| October | December 1 | March 31 for 4 th quarter results |
| November | January 1 | |
| December | February 1 | |

¹ Excluding verification/validation, see Table B-14 for QC checks that are reported on the same schedule

Table D-3 Manual Data Review Timeline

| Results for: | Data Validation Reports available for CAB MA Supervisor review | Upload to AQS ¹ on or before: |
|---------------------|--|--|
| January to March | June 1 | June 30 for 1 st quarter results |
| April to June | September 1 | September 30 for 2 nd quarter results |
| July to September | December 1 | December 31 for 3 rd quarter results |
| October to December | March 1 | March 31 for 4 th quarter results |

¹ Excluding verification/validation, see Table B-14 for QC checks that are reported on the same schedule

Communication within CAB is ongoing, through regular staff meetings; Supervisors, the QAO, operators, and data validators discuss such topics as; active corrective actions notifications that need resolution, emails from field technicians regarding monitoring equipment, and logbook reviews. These topics may be further reviewed by higher level validators, as they may impact data quality.

D.1.4.1 Data Verification & Validation of Continuous Monitors, Levels 0 to 4

Before the CAB approves data to be uploaded to AQS, a Level 0 automated review is generated, Level 1 verifications are performed, then Levels 2-4 validations are completed. All levels are conducted by the DAS and CAB MA personnel according to the roles and responsibilities outlined in *Section A.4, Table A-1* of this QAPP.

Level 0: This is an initial process that involves an automated review of all logger and sampler data tabulations collected. The DAS identifies data and applies codes for:

- Indoor Temperature exceedances.
- Hours with less than 45 minutes of data, for all parameters.
- Automated QC checks.
- Excessive negative values outside of acceptable protocols.
- Missing data.

Level 1: The previous level is scrutinized, and further data verifications are performed on a daily to weekly basis. These tasks and are conducted by:

- CAB Site Operators as a routine task of data collection and site operation.
- CAB personnel are assigned to check all sites and issue Daily Data Verification Requests for issues that need immediate investigation.

See SOPs for specific details on Station Verifications and Data Verification Requests (*Appendix I*). Verification is defined as the confirmation through objective evidence that specified requirements, such as those in this QAPP and its associated SOPs, have been fulfilled. Data verification by site operators includes the following elements:

- **completeness:**
 1. Ensures that data quality objectives were performed.
 2. Confirms that QC checks were performed, and elements checked as specified in the *QA Handbook, Appendix D, Validation Templates*. Brackets data when failures are found per data validation SOPs (Appendix 1).
 3. All documentation is available (hardcopy and electronic), that includes: raw data, logbook entries, field sheets, chain of custody forms, calibration sheets, QC check logs, and maintenance logs.
 4. All missing data and records are documented. Missing data is replaced with secondary chart or monitor data, if available
 5. Verifies that instrument downtimes are due to QC checks, calibrations, audits, repairs, etc.
- **correctness:**
 1. Required records are properly and accurately completed.
 2. Incomplete records are documented.
 3. Verifies that the Level 0 automatically assigned null codes are correct.
- **consistency:**
 1. All the processes were performed and documented in a uniform manner according to applicable SOPs.
 2. Ensures that all results appear “as expected” and that all anomalous or unusual data points are flagged and/or documented, such as sticking or repeating values.
- **conformance:**
 1. All processes were performed as specified in this QAPP.
 2. All deviations to the QAPP are documented.

During the verification process, all deviations shall be documented in site logbooks and in edits made on the Envista ARM edit table. Site logbooks and the Envista ARM Edit Table are accessible on the CAB Operations SharePoint site and Envista ARM. All Level 1 data verifications are tracked on the CAB Operations SharePoint site in an electronic log, found in following location:

FIELD OPERATIONS > DATA > DV Log-Level 1
per Year, Site, and Parameter

Entries are made by site operators under the appropriate *Year, Month, and Site*. Entries shall include the *Days Verified* and *Site Operator's Initials*. DVP and Supervisors may view this log at any time to find out when data is ready for next level of data validation.

Another task in the Level 1 data verifications is to conduct daily reviews of the ambient air monitoring network by using Envista ARM. The Envista ARM software enables the viewing of data and operations. Reviews are conducted each workday morning, they are not to verify or validate data, but mainly to check for any NAAQS exceedances so they can be promptly reported (as required in *40 CFR 50*), and to check for data excursions or monitor downtime so that any public concerns can be addressed. Daily data verifications include the following elements:

- checking for any NAAQS exceedances.
- checking for missing data and downtime occurrences.
- checking for data outliers, anomalies, and unusual data patterns.
- checking for any deviations from QC criteria.
- reviewing the Envista public webpage at:
<http://health.hawaii.gov/cab/hawaii-ambient-air-quality-data>
- reviewing the Hawaii Short-term SO₂ webpage at:
<http://www.hiso2index.info>
- reviewing EPA's AirNow Hawaii webpage at:
<http://airnow.gov>

Any possible exceedances are recorded in the CAB Operation SharePoint site on a *NAAQS Exceedance Verification* table. This table is found on the SharePoint site as follows (*Figure D-2*):

CABMAS HOME > DATA > NAAQS Exceedance Verification

Daily data verifications of the network are performed by CAB MA Data Review Staff on a rotational basis. Requests for information are e-mailed to the appropriate CAB MA staff (i.e., site operators, AQET personnel), such personnel shall provide information on findings discovered during data verifications. Responses should ideally be within twenty-four (24) hours or as soon as possible, see *Appendix I* for the CAB Data Review SOP. Dispute resolution, if necessary, is performed according to the procedure described in *Section A-4*. Prompt verifications serve multiple purposes, at minimum:

1. Identify and explain any problems or issues that may cause public concern.
2. Ensures that problems are identified and corrected as soon as possible to limit data invalidation.
3. Verifying NAAQS exceedances as they occur allows the CAB to promptly notify the public, as required in *40 CFR 50.14*.

Figure D-2: NAAQS Exceedance Verification Log on CAB Operations SharePoint

SLD

NAAQS Exceedance Verification

- Data reviewer will email staff NAAQS exceedance or questionable data and complete the table on Share Point.
- Station operators verify the concentration and complete the table on Share Point.
- Verified exceedances are posted on the CAB website.

new item

Group by Quarter Group by Location ***

| | Date | Time Base | Time Range | Location | Parameter | Conc. | Exceedance? | Units | Verified By | Date Verified | Public Notice | Remarks | Edit |
|-----------------------------------|---------|------------|------------|----------|-----------|-------|-------------|-------|-------------|---------------|---------------|-----------------|------|
| 4 Year-Qtr. : 2023-Q1 (33) | | | | | | | | | | | | | |
| 1/1/2023 | 24-Hour | | KL25 | PM2.5 | 57 | | ug/m3 | | | 1/19/2023 | | Fireworks. | |
| 1/1/2023 | 24-Hour | | SI2 | PM2.5 | 42 | | ug/m3 | | | 1/19/2023 | | Fireworks. | |
| 1/10/2023 | 1-Hour | 0600-0700 | HL11 | SO2 | 92 | | ppb | | | 1/19/2023 | | 1/5/resumption. | |
| 1/10/2023 | 1-Hour | 0800-0900 | KS27 | SO2 | 85 | | ppm | | | 1/19/2023 | | | |
| 1/10/2023 | 1-Hour | 0800-0900 | MV23 | SO2 | 132 | | ppb | | | 1/19/2023 | | | |
| 1/11/2023 | 1-Hour | 0400-0500 | PA16 | SO2 | 236 | | ppb | | | 1/19/2023 | | | |
| 1/11/2023 | 1-Hour | 0500-0600 | NA33 | SO2 | 131 | | ppb | | | 1/19/2023 | | | |
| 1/11/2023 | 1-Hour | 0700-0800 | OV20 | SO2 | 213 | | ppb | | | 1/19/2023 | | | |
| 1/12/2023 | 1-Hour | 0900-1000 | OV20 | SO2 | 120 | | ppb | | | 1/20/2023 | | | |
| 1/12/2023 | 1-Hour | 0900-1000 | PA16 | SO2 | 109 | | ppb | | | 1/20/2023 | | | |
| 1/13/2023 | 1-Hour | 0200-0300 | NA33 | SO2 | 178 | | ppb | | | 1/23/2023 | | | |
| 1/13/2023 | 1-Hour | 0200-0300 | PA16 | SO2 | 288 | | ppb | | | 1/23/2023 | | | |
| 1/14/2023 | 1-Hour | 0200-0300 | OV20 | SO2 | 78 | | ppb | | | 1/23/2023 | | | |
| 1/14/2023 | 1-Hour | 10800-0900 | PA16 | SO2 | 293 | | ppb | | | 1/23/2023 | | | |
| 1/15/2023 | 1-Hour | 0400-0500 | NA33 | SO2 | 95 | | ppb | | | 1/23/2023 | | | |
| 1/15/2023 | 1-Hour | 0400-0500 | PA16 | SO2 | 176 | | ppb | | | 1/23/2023 | | | |
| 1/18/2023 | 1-Hour | 0500-0600 | PA16 | SO2 | 135 | | ppb | | | 1/23/2023 | | | |
| 1/19/2023 | 1-Hour | 0500-0600 | PA16 | SO2 | 161 | | ppb | | | 1/25/2023 | | | |
| 1/20/2023 | 1-Hour | 0500-0600 | HL11 | SO2 | 104 | | ppb | | | 1/25/2023 | | | |
| 1/21/2023 | 1-Hour | 0200-0300 | PA16 | SO2 | 92 | | ppb | | | 1/25/2023 | | | |

Level 2: The Validation of data collected by CAB is assigned to *Data Validation Personnel* (DVP) independent of data collection and site operation. This process is designed to ensure that reported values meet the quality goals of the environmental data operations. This task, performed monthly by CAB MA DVPs, is an analytic and sample specific process that extends beyond data verification to determine the quality of data relative to its end use. This level determines the validity of data by using the guidance specified in the *QA Handbook, Appendix D, Validation Templates* and according to the Data Validation SOP (*Appendix I*). The DVP performs the following primary elements for this level of validation:

- Evaluates Levels 0 and 1 reviews and verifications pertaining to all noted deviations.
- Scrutinizes site documents, individual parameter data, and instrument logs.
- Examines all available logbook entries for the sites and equipment.
- Analyzes all calibrations and QC checks. Validator applies criteria outlined in EPA validation templates during this analysis. Brackets data when failures are found per data validation SOPs (*Appendix 1*).
- Monthly matrix sheets of hourly data, per site, per parameter are generated. Each hour is examined. These sheets are annotated to document everything that occurred during the month. Qualifier and Null codes are verified and corrected, as necessary. All site documents are cross reference during this process.
- *Data Validation Reports* are generated per site, per month in a printable PDF format. Reports contain; matrix sheets, calibration summaries, QC check summaries, and all logbook entries for the site and equipment are summarized.
- Edits and comments are applied to the Envista ARM Edit Tables according to findings documented in the *Data Validation Reports*.
- Evaluation of the data to ensure that MQOs were met, including evaluation of tolerable error limits specified in *Section A.7.1.3* of this QAPP.

For this level, completion is determined when the *Data Validation Reports* (DVRs) and Envista ARM Edit Table entries are completed by DVP. DVP save their respective DVRs on the CAB Operation SharePoint site in the following location:

CABMAS HOME > DATA > Data Validation > CAB Data Validation Reports >
in files per Year and Site ID

DVP initial the boxes in the *DV Log-Level 2* found on the CAB Operations SharePoint site in the same section the DVRs are located. There are tracking logs created per year, for each level (1-4), site, and month/quarter. The CAB MA Supervisor is also notified by email, from DVP, when DVRs are completed and posted on the SharePoint site, the QAO is copied on these emails.

Level 3: This task is performed quarterly and consists of a Peer Review by CAB MA personnel. This level provides an additional layer of data validation where reviewers scrutinize the Level 2 DVRs and Envista ARM Edits to ensure they correlate and show no discrepancies. Further, per CAB MA Supervisor guidance and QAO oversight, decisions are made to determine if the requirements for the specified intended uses of data are

fulfilled, as described in this QAPP. This is accomplished through the examination and confirmation of objective evidence. Upon receipt of the DVRs and completion notification of Envista ARM edits by DVP, the *Peer Review Personnel* (PRP) perform the following primary elements for this level of validation:

- Reviews the Level 2 Data Validation Reports for completeness and accuracy.
- Data Validation Reports may be sent back to DVP for corrections, if necessary.
- Confirms that the Envista ARM Edit Table entries are accurate and complete.
- Issues *Corrective Action Notifications* (CAN), as necessary.
- Creates a Data Validation Review Summary for each site that is posted on the CAB Operations SharePoint site with the DVRs.
- Consults QAO when necessary for oversight and recommendations.

For this level, completion is determined when PRP submit Data Validation Review Summaries to the CAB MA Supervisor for approval. Upon approval, PRP initial boxes in the *DV Log-Level 3*, which is located on the CAB Operations SharePoint site. On this log, PRP also indicate the review status for each summary with a “yes” or “no” to answer the “All Okay?” question on log. A “no” response may require DVP to make corrections to their DVR or Edit Table. Recommendations for corrections are sent by email to the CAB MA Supervisor and DVP. When corrections are complete, PRP will change review status to “yes” on log.

Level 4: This level is performed quarterly by the CAB MA Supervisor with QAO oversight. Independent oversight by the QAO follows the roles and responsibilities outlined in *Section A.4, Table A-1* of this QAPP. If no further recommendations are presented by the QAO, the CAB MA Supervisor initiates the “locking” of edit tables on Envista ARM. Once this is achieved, data is approved for upload to AQS. The QAO and CAB MA Supervisor perform the following primary elements for this level:

- Ensures previous Levels are completed and no further evaluations are necessary.
- Monitors calibration standards used for QC for expired certifications.
- Looks for inconsistencies and anomalies that were overlooked.
- Identifies outstanding CANs. The QAO is the CAN point of contact that monitors this process to completion.
- CAB MA Supervisor grants final approval of data validations. Instructs DVP to LOCK their respective edit tables to finalize edits in Envista ARM Validation Settings (per SOPs, *Appendix I*).
- CAB MA Supervisor informs CAB IT Specialist that data is ready for upload to AQS.

For this level, completion is determined when the Envista ARM Validation Settings are updated by DVP to LOCK edited data. The CAB MA Supervisor instructs DVP when data can be locked. DVP initial boxes in the DV Log-Level 4 located on the CAB Operations SharePoint site. This is the final level before data is uploaded to AQS. The CAB IT Specialist monitors the *DV Log-Level 4* tracking sheet to see when data is ready for upload to AQS, then initials sheet under “Uploaded” when data is on AQS.

**Table D-4 Continuous Criteria & NCore Pollutant
Review, Verification, Validation Levels**

| Level | Objective | Action By | Frequency | Comments |
|-------|--|--|-----------|--|
| 0 | Automated QC Check | Envista ARM | Hourly | |
| | Excessive negative values below acceptable protocols | | | |
| | Indoor temperature exceedances | | | |
| | Hourly data capture with < 45 minutes | | | Internal data completeness goal ≥ 90% |
| 1 | Distinguish measurements from measurement errors or interferences | Site Operators | Daily | Data reviewed during site visit or remotely via Envista ARM client. Views tabular & graphical data. |
| | Verifies Level 0 automated QC checks | | | On the Envista ARM Edit Table: |
| | Verify Critical & Operational Criteria (parameter specific) | | | <ul style="list-style-type: none"> • Verify Flags for QC checks, change AQS codes as needed, per <i>QA Handbook Vol II</i> requirements |
| | 1-pt. QC and Zero/span checks (for Gas) | | | <ul style="list-style-type: none"> • Replace missing data with secondary logged data, if available |
| | Temp, Press, Leak, and Flow checks (for PM) | | | <ul style="list-style-type: none"> • Add AQS codes, if needed. |
| | Checks for missing data | | | <ul style="list-style-type: none"> • Flag suspect data with AQS null codes |
| | Verify instrument downtimes for: QC checks, calibrations, audits, repairs, etc. | | | Log is filled in as verifications are completed |
| | Verify outliers or anomalies | | | |
| | Completes <i>DV Log-Level 1</i> on CAB Operation SharePoint site | Assigned CAB MA Personnel | Daily | Issues Daily Data Verification Requests |
| | Checks NAAQS exceedances | | | There are 3 public websites: Envista (public) Hawaii Short-term SO ₂ EPA AirNow Hawaii |
| | Checks for missing data and deviations | | | |
| | Identifies outliers, anomalies, and unusual patterns | | | |
| | Checks for deviations from QC criteria | | | |
| | Reviews data on public websites | | | |
| 2 | Evaluate Levels 0 and 1 reviews and verifications. Verify AQS codes. | CAB MA Data Validation Personnel (DVP) | Monthly | |
| | Examine all documentation per site, for all parameters at site: Logger & Instrument data Site & Equipment logs Maintenance logs QC logs Calibration Reports Audits (if performed) Asst. Envista ARM reports | | | DVP follows Data Validation SOP to gather documentation, generate Data Validation Reports, and Edit Envista ARM |
| | Verify daily hourly data capture ≥ 18/24 hours for valid day | | | Internal data completeness goal ≥ 90% |
| | Review missing data, outliers, and anomalies. | | | Replaces missing data if not done in Level 1 and if available, checks and corrects AQS codes |

| Level | Objective | Action By | Frequency | Comments |
|-------|--|---|-----------|---|
| 2 | Review min/max values | CAB MA Data Validation Personnel (DVP) | Monthly | |
| | Review Daily Data Verifications | | | |
| | Verify sticking or excessively negative values | | | |
| | Invalidate data if NO + NO ₂ > NO _x | | | |
| | Review CANs (if any), include in DVR | | | Verify corrective actions taken to satisfactory completion |
| | Generate monthly Data Validation Reports (DVR) per site. | | | DVP save DVRs onto the CAB Operations SharePoint site and notifies the CAB MA Supervisor by email when reports are complete (QAO is also copied on emails) |
| | Performs Edit on Envista ARM to correct and add Null/Qualification codes | | | Envista tracks the times, dates, and staff that perform edits DVP initial <i>DV Log-Level 2</i> when DVRs and Envista edits are completed |
| 3 | Verify that Levels 0, 1, and 2 were evaluated accurately and consistently | CAB MA Peer Review Personnel (PRP) with QAO oversight | Quarterly | |
| | Reviews Level 2 Data Validation Reports. | | | Verify completeness and accuracy of data |
| | Issues Corrective Action Notices (if necessary) | | | |
| | Confirms DVP edits on Envista ARM | | | |
| | <i>CAB Peer Review Personnel</i> (PRP) compare DVRs to Envista ARM data base | | | Considers QAO comments and recommendations |
| | PRP confirm if Level 2 DVRs and Envista ARM edits are okay. Gives a status of "yes" or "no" on <i>DV Log-Level 3</i> tracking sheet | | | PRP initial <i>DV Log-Level 3</i> tracking sheet when Data Validation Review Summaries are complete |
| | PRP create Data Validation Review Summaries. Informs the CAB MA Supervisor and DVP by email when summaries are available | | | Summaries are posted with DVRs on the CAB Operations SharePoint site |
| 4 | CAB MA Supervisor ensures all previous levels are complete | CAB MA Supervisor With QAO oversight | Quarterly | QAO Provides recommendations and comments to MA Supervisor before data is uploaded to AQS |
| | QAO monitors calibration standards | | | QAO maintains logs on CAB Operations SharePoint site |
| | QAO oversees the CAN process | | | QAO serves as Point of Contact |
| | CAB MA Supervisor notifies DVP when to LOCK data in Envista ARM Validation Settings and initials <i>DV Log-Level 4</i> when the quarter's data is ready for AQS upload | | | Envista tracks the times, dates, and staff that LOCK data |
| | CAB ITS monitors <i>DV Log-Level 4</i> to see when data is ready to upload to AQS | | | ITS initials <i>DV Log-Level 4</i> when data is Uploaded to AQS |
| | | | | |

D.1.4.2 Verification & Validation of PM_{2.5} Manual Monitoring Methods, Levels 0 to 4

Level 0: This verification is performed by EPA/contractors and CAB personnel assigned to manage the *Filter Processing Area* (FPA). Verification tasks shall include visual inspection, physical and chemical characteristic testing, filter thickness, and tensile strength determination of the filters. Refer to *Table D-5* for details.

When pre-weighed filters are received from contract laboratories at the FPA they are processed according to the Filter Handling SOP (*Appendix I*). The following tasks are performed:

- Filters are visually inspected over a fluorescent light for damage.
- Each filter received is recorded on the PM_{2.5} FRM Filter Tracking Log (log sheet is found on the CAB Operations SharePoint site).
- Chain of Custody (COC) forms are created for each filter received.

Level 1: CAB site operators pick up filters from the FPA and transport them to their assigned air sites. Filters run on a 1 in 3 day cycle. After each filter is run through the monitors, the following information must be recorded and verified by the site operator on COC forms, site logs, and filter package labels:

- Filter number
- Actual sample date
- Filter deployed within 30 days after pre-weigh.
- Station identification
- Start and stop collection times (sampler time should correlate with Time.gov).
- Filter recovered within 7 days 9 hours from sample date.
- Filter temperatures checked and recorded (sample temperatures are maintained at temperatures below the average ambient temperature during sampling or 4 °C and below, but not frozen, for average sampling temperatures < 4 °C).
- Elapsed time.
- Sample volume
- Sample flow rate (sample flow rate, variability within acceptable limits: one point flow rate verification).
- Any calibrations, repairs, instrument downtimes.
- Any outliers or anomalies.
- Possible contamination.
- Environmental conditions and observations.

Site operators also download the *Sample Run* (SR) reports from the monitors, contains meta data. SR reports are archived by site operators onto the CAB Operations SharePoint site. Copies of these SR reports are emailed to the CAB MA Supervisor who in turn forwards them to the contracted laboratory. Operators are responsible for reviewing all aspects of the collection process for outliers, anomalies, and problems that may affect data quality. AQS null codes and qualifiers are assigned as necessary on the Envista ARM edit table. Throughout this process, the Filter Handling and Air Monitor SOPs (*Appendix I*) are followed by site operators.

The contract laboratory performs the Level 0 verifications of the elements outlined in *Table D-5*. Post-weighing of filters, the CAB MA Supervisor receives quarterly data reports from the contracted laboratory. These reports are archived on the CAB Operations SharePoint site, which is accessible by all CAB personnel. Assigned CAB MA personnel ensure that the results from the PM_{2.5} filter runs are entered onto the Envista ARM database per appropriate SOP (*Appendix I*). There should be coordination between EPA/contractors and CAB to highlight missing information from reports, *per 40 CFR, part 50, Appendix L, Table L-1, "Summary of Information to be Provided by the Sampler"*.

Table D-5 Level 0 Verification for PM_{2.5} Filters by Contract Laboratory

| Requirement | Frequency | Acceptance Criteria |
|--|------------------------------------|--|
| Filter Conditioning Environment | | |
| Post-sampling weighing | All filters | < 10 days from sample end date if shipped at ambient temperature, or < 30 days if shipped below average ambient. (or 4 °C and below, but not frozen, for average sampling temps < 4 °C) from sample end date |
| Equilibration | All filters | 24 hours minimum |
| Temperature Range | All filters | 24 hour mean 20 - 23 °C |
| Temperature Control | All filters | ± 2 °C Standard Deviation over 24 hr. |
| Humidity Range | All filters | 24-hr mean 30% - 40% RH or < 5% sampling RH but > 20% RH |
| Humidity Control | All filters | ± 5% Standard Deviation over 24 hr. |
| Pre-/Post-sampling RH | All filters | difference in 24-hr means < ± 5% RH |
| Balances | All filters | located in filter conditioning environment |
| Blanks | | |
| Lot Blanks | 9 per lot | ± 15.1 µg difference |
| Field Blanks | 10% or 1 per weighing session | ± 30.1 µg difference |
| Laboratory Blanks | 10% or 1 per weighing session | ± 15.1 µg difference |
| Verification/Calibration | | |
| Balance Calibration | Annually | Manufacturers' specifications |
| Temperature Calibration | Once every 6 months | ± 2 °C |
| Humidity Calibration | Once every 6 months | ± 2% |
| Bias | | |
| Balance Audit | Once per year | ± 3 µg for unexposed filters |
| Balance Check | Beginning, every 10th samples, end | ± < 3% µg |
| Calibration Standards | | |
| Working mass standards | Every 3 - 6 months | 2.1 µg |
| Primary mass standards | Annually | 2.1 µg |
| Precision | | |
| Duplicate filter weighing | Once per weighing session | ± 15 µg difference |
| Field Activities | | |
| Sample Recovery | All filters | < 7 days 9 hours from sample end date |

All Level 1 data verifications are tracked on the CAB Operations SharePoint site in an electronic log, found in following location:

FIELD OPERATIONS > DATA > DV Log-Level 1
per Year, Site, and Parameter

Entries are made by site operators under the appropriate *Year, Month, Site, and Parameter*. In this case the parameter is “*PM2.5 FT*” (FT= filter). Entries shall include the *Days Verified* and *Site Operator's Initials*. DVP and Supervisors may view this log at any time to find out when data is ready for next level of data validation.

Level 2: CAB DVP performs the validations of the manual PM_{2.5} data and documentation generated throughout the filter monitoring process, monthly. A *Data Validation Report* (DVR) is generated per the Validation of FRM PM_{2.5} Data SOP found in *Appendix I* of this QAPP.

The following elements are validated:

- Station operator's logbook entries and Envista ARM edits (confirms that AQS codes used on edit table are accurate and consistent)
- Scheduled sampling days (did they follow EPA calendar, were any days missed)
- Level 1 verifications, ensure data quality control requirements were met
- COC forms, check for completeness.
- Filter Temperatures records checked (sample temperatures are maintained at temperatures below the average ambient temperature during sampling or 4 °C and below, but not frozen, for average sampling temperatures < 4 °C).
- Sample Run Reports (are they normal with no anomalies)
- Performance requirements by contracted laboratory (*Table D-5*)
- QC forms from CAB site operators and contracted laboratory
- Compare data with data from collocated continuous monitors.
- Semi-annual CAB MA audits
- Unusual events and CANs
- Review report from contract laboratory
- Create quarterly data validation report that incorporates portions of contract laboratory report, a CAB checklist, comparative analysis, QC/Calibration results, and logbook entries.

For this level, completion is determined when the quarterly *Data Validation Report* (DVR) and Envista ARM Edit Table entries are completed by DVP. DVP save their respective DVRs on the CAB Operation SharePoint site in the following location:

CABMAS HOME > DATA > Data Validation > CAB Quarterly Filter DVRs >
in files per Year

DVP initials the boxes in the *DV Log-Level 2* found on the CAB Operations SharePoint site in the same section the DVRs are located. There are tracking logs created per year, for each level (1-4), site, and month/quarter. In this case, the filter validations are separate from the continuous validations. Validations of *Filter* (FT) based data will be identified as the “*Site ID FT*” on the *DV Log-Level 2*. The CAB MA Supervisor is also notified by email, from DVP, when the quarterly filter based PM_{2.5} DVRs are completed and posted on the SharePoint site, the QAO is copied on these emails.

Level 3: The CAB MA Supervisor oversees Peer Review Personnel (PRP) as they scrutinize the quarterly filter based PM_{2.5} DVRs generated by DVP. The primary elements for this level of validation are:

- Reviews the Level 2 Data Validation Reports for completeness and accuracy.
- Issues *Corrective Action Notifications* (CAN), as necessary.
- Confirms that the Envista ARM Edit Table corrections are accurate and complete.
- QAO may provide further oversight and recommendations.
- Data Validation Reports may be sent back to DVP for corrections, if necessary.
- PRP create quarterly Data Validation Review Summaries that may identify findings that need to be address by DVP.

For this level, completion is determined when PRP submit Data Validation Review Summaries to the CAB MA Supervisor for approval. Upon approval, PRP initial boxes in the *DV Log-Level 3*, which is located on the CAB Operations SharePoint site. The continuous and filter based site IDs are separate, therefore, initials are entered in the box identified as “Site ID FT” on the *DV Log Level 3*. PRP also indicate the review status for each summary with a “yes” or “no” to answer the “All Okay?” question on log. A “no” response may require DVP to make corrections to their DVR or Edit Table. Recommendations for corrections are sent by email to the CAB MA Supervisor and DVP. When corrections are complete, PRP will change review status to “yes” on log.

Level 4: The CAB MA Supervisor Approves data for upload to AQS. The QAO may provide additional reviews, guidance, and recommendations. Primary elements for this level are:

- Ensures previous Levels are completed and no further evaluations are necessary.
- QAO monitors calibration standards used for QC for expired certifications.
- QAO Checks for inconsistencies and anomalies that were overlooked.
- QAO Identifies outstanding CANs and oversees the CAN process. Serves as point of contact and is responsible for ensuring the process functions properly.
- Final approval is given by the CAB MA Supervisor for the DVP to lock edit tables on Envista ARM.
- CAB MA Supervisor informs CAB IT Specialist that data is ready for upload to AQS.

For this level, completion is determined when the Envista ARM Validation Settings are updated by DVP to LOCK edited data. The CAB MA Supervisor instructs DVP when data can be locked. DVP initial boxes in the *DV Log-Level 4* located on the CAB Operations SharePoint site. The continuous and filter based sites IDs are separate, therefore, initials are entered in the box identified as “Site ID FT” on the *DV Log Level 4*. This is the final level before data is uploaded to AQS. The CAB IT Specialist monitors the *DV Log-Level 4* tracking sheet to see when data is ready for upload to AQS, then initials sheet under “Uploaded” when data is on AQS.

Table D-6 Filter Based PM_{2.5} FRM Data Verification and Validation Levels

| Level | Objective | Action By | Frequency | Comments |
|-------|--|---|-----------------|---|
| 0 | Certification of Filter Testing <ul style="list-style-type: none"> Physical characteristics Chemical characteristics Filter thickness and tensile strength | EPA Contractor | Annually | 40 CFR Part 50 App L Section 6 (PM _{2.5}) |
| | Inspection upon receipt of Filters <ul style="list-style-type: none"> Correct type and size Pinholes Coloration Particles or imperfections (frayed edges, spots) | CAB Personnel at Filter Processing Area | Every Two Weeks | Filters are received and processed per CAB Filter Handling SOP (<i>Appendix I</i>) |
| 1 | Distinguish samples from sample errors of interferences | CAB MA Site Operator | 1 in 3 Days | Performed during site visit |
| | Critical Criteria (PM _{2.5} Field Activities) <ul style="list-style-type: none"> Sample recoveries Sample periods Average flow rate Variability in flow 1 pt. flow rate verification | | | Per QA Handbook Vol II App D requirements |
| | Verify the Chain of Custody forms | | | Check COCs for completeness |
| | Verify calibrations, audits | | | |
| | Verify outliers and anomalies | | | |
| 2 | Validates Level 1 verification and ensures QC requirements | CAB MA Data Validation Personnel (DVP) | Monthly | |
| | Verify site operator's edits/notes | | | AQS codes consistent and correct |
| | Verify scheduled sampling day is valid | | | Internal data completeness goal is ≥ 90% |
| | Verify all filter temperatures were recorded | | | Temperatures must be monitored after sample is collected |
| | Verify Level 1 AQS codes | | | Makes corrections on Envista ARM as needed. |
| | Verify QC Checks & Standards | | | |
| | Review CANs for outliers or anomalies | | | Verify corrective actions taken to satisfactory completion |
| | Creates a quarter filter based <i>Data Validation Report</i> (DVR) per site by using quarterly reports sent by the contract laboratory. | | | DVP save quarterly DVRs onto the CAB Operations SharePoint site and notifies the CAB MA Supervisor by email when reports are complete (QAO is copied on emails) |
| | Completes <i>DV Log-Level 2</i> on the CAB Operations SharePoint site | | | |
| 3 | Validates Levels 0, 1, and 2 checks accuracy and consistency | CAB MA Peer Review Personnel (PRP) with QAO oversight | Quarterly | Reviews DVP DVRs |
| | Checks for inconsistencies between DVRs and Envista ARM | | | |
| | QAO provides recommendations | | | |
| | Review exceptional events | | | |
| | Review audit completeness | | | EPA AMP reports |

| Level | Objective | Action By | Frequency | Comments |
|--------------|--|--------------------------------------|-----------|---|
| 3 (cont.) | PRP create Data Validation Review Summaries. Informs the CAB MA Supervisor and DVP by email when summaries are available. | | | Summaries are posted with DVRs on the CAB Operations SharePoint site. |
| 4 | CAB MA Supervisor ensures all previous levels are complete | CAB MA Supervisor with QAO oversight | Quarterly | QAO provides recommendations and comments to MA Supervisor before data is uploaded to AQS |
| | QAO monitors Standards used for QC and calibrations | | | |
| | CAB MA Supervisor notifies DVP when to LOCK data in Envista ARM Validation Settings and initials <i>DV Log-Level 4</i> when the quarter's data is ready for AQS upload | | | |
| | QAO oversees the CAN process | | | QAO serves as Point of Contact |
| | CAB ITS monitors <i>DV Log-Level 4</i> to see when data is ready to upload to AQS | | | ITS initials <i>DV Log-Level 4</i> when data is Uploaded to AQS |

Detailed procedures to process, compile, and analyze filter data are found in the *CAB SOP DV-002, v-1.0, PM2.5 FRM Filter-Based Data Validation Procedure* found in *Appendix I* of this QAPP.

D.2 Reconciliation with User Requirements

Reconciliation with the DQO involves reviewing routine and QA/AC data to determine whether the DQOs have been attained and whether the data are adequate for their intended use, this is known as a *data quality assessment* (DQA). The EPA documents *Data Quality Assessment: A Reviewer's Guide* (EPA QA/G-9R) and *Data Quality Assessment: Statistical Methods for Practitioners* (EPA QA/G-9S) provide guidance on the DQA process. These documents can be found, respectively, on the EPA website at:

<https://nepis.epa.gov/>

Search for: EPA/240/B-06/002 and EPA/240/B-06/003 (respectively)

The CAB conducts annual data assessments, and results are maintained in the network and station files. Each parameter for Criteria pollutants and NCore, at every station, are analyzed for percent completeness, mean and maximum concentrations, trend analyses and monitor relationships. This in-depth data analysis provides information for the annual network review to determine, in part, if the monitor meets the intended purpose and objective. The CAB Data Assessment SOP is found in *Appendix I*.

The CAB also reviews statistical summaries in the AMP256 QA Data Quality Indicator Report to determine where there might be discrepancies, data gaps, instrument performance or completeness issues and where improvement is needed.

D.2.1 Five Steps of the Data Quality Assessment Process

The *Guidance for Data Quality Assessment: A Reviewers Guide* (EPA QA/G-9R) and *Statistical Methods for Practitioners* (EPA QA/G9S), describes the DQA process which consists of five steps that are conducted at least annually by the CAB:

Step 1: Review DQOs and Sampling Design

- DQO outputs are reviewed to assure that they are still applicable.
- Sampling design and data collection documentation are reviewed for consistency with the DQOs noting any potential discrepancies.
- The annual network review is used as a tool in this evaluation step.

Step 2: Conduct a Preliminary Data Review

- QA reports, basic statistical analyses, and graphical data presentations are generated and reviewed to identify trends, patterns, relationships, potential anomalies, and data gaps.
- Basic statistical analyses include:
 - percent completeness (quarterly and annually).
 - mean concentrations.
 - median concentrations.
 - standard deviations.
 - maximum concentrations.
 - minimum concentrations.
 - coefficient of variation.
 - interquartile range.
 - skewness and kurtosis.

Step 3: Select the Statistical Test

- The most appropriate procedure for summarizing and analyzing the data is selected based upon DQO performance and acceptance criteria, sampling design, and preliminary data review.
- The key assumptions that validate the statistical procedures are identified (e.g., null, and alternative hypotheses tests).

Step 4: Verify the Assumptions of the Statistical Test

- The underlying assumptions are evaluated to determine if they remain valid or if departures are acceptable given the actual data and other information.
- The assumptions behind the statistical test include those associated with the development of the DQOs in addition to bias and precision assumptions.
 - *Data Quality Objective Assumptions:* In the development of DQOs, it is assumed that annual standards are more restrictive than the 24-hour, 8-hour, 3-hour or 1-hour standards, as applicable, until proven otherwise.
 - *Normal Distribution for Measurement Error:* The EPA guidance document *EPA QA/G9S* provides statistical tools for creating normal probability plots. The reasonableness of assuming that measurement errors are normally distributed is evaluated using these tools. Data completeness evaluations are performed each quarter to ensure that the confidence is sufficient on the smallest number of required sample values. Measurement imprecision is established at 10% coefficient of variation for each monitor, 7% for O₃, if any exceed 10% or 7% as applicable, determinations may need to be made regarding the sensitivity of the DQOs to larger levels of imprecision. If any

assumptions are violated, the implication is that the decision error rates are unknown, even if the bias and precision limits are achieved and the DQOs are reevaluated.

Step 5: Draw Conclusions from the Data

- Calculations required for statistical tests are performed to document the inferences drawn resulting from these calculations.
- The performance of the sampling design is evaluated. Any deviation from the sampling plan for each pollutant at each site is documented. Data patterns and relationships are evaluated, and anomalous data are identified and documented.
- If any assumptions are violated, then it is assumed that the level of confidence associated with the test is suspect and will have to be further investigated.

D.2.2 DQA Tools

The EPA produces statistical assessments that the CAB utilizes in conducting a DQA. These include AQS reports (e.g., AMP 256 and AMP 600) and annual Box and Whisker plots.

AQS AMP 256 QA Data Quality Indicator Report

Annually, the CAB reviews the AMP256 report. The report provides an assessment of data completeness as well as precision and bias. It also includes a summary of the annual performance evaluations, particulate sampler flow rate verifications and audits, and NPEP results for PM_{2.5}. In addition to the report summary, details of these data quality indicators can be further analyzed in a spreadsheet when downloaded as a work file. If the review determines that corrective action is required, a CAN is generated per SOP (*Appendix I*). The report is accessed at the login AQS site:

<http://www.epa.gov/aqs>

AQS AMP 600 Data Certification and Concurrence Report

This report is the basis of the annual data certification. The CAB reviews this report annually for data gaps and accuracy. The final report is included in the data certification submitted to the EPA.

Annual Box and Whisker Plots

This is a graphical display of precision and bias data to assist in determining if there is a need for corrective action. Annually, after the EPA receives the data certification, AQS develops the Annual Box and Whisker Plots for the criteria gaseous pollutant data certified in May. Box and Whisker reports are accessed for the previous year's data and graphically depict the precision and bias information generated in the AMP256 report. The graphical display can identify sites that are biased or variable.

Data Assessment Statistical Calculator

This tool calculates the precision, bias and statistics that can be compared against the validation template criteria in *Appendix VIII*. See *Section C.1.7* of this QAPP for details on this tool. In addition to annual statistics, the DASC can be used by CAB at any time to check and track data quality. The DASC can be found at:

https://www.epa.gov/sites/default/files/2020-10/dasc_11_3_17.xls

D.2.3 Data Certification

Quarterly Data Submission

Each quarter, CAB compiles the results of all precision, bias, and accuracy tests performed during the quarter. These compilations are submitted as reports to AQS, reports shall be consistent with data reporting requirements specified for air quality data as set forth in *40 CFR Parts 58.16, 58.20, and 40 CFR Part 58 Appendix A, Section 5.*

Annual Data Certification

The CAB Program Manager, by April 20 of each year certifies that all the previous year's data collections, quality control tasks, verifications, etc., were performed according to the requirements of this QAPP. The data covered shall include all data from SLAMS, NCore, and SPMS monitoring stations as follows: *Federal Reference Method (FRM)* or *Federal Equivalent Method (FEM)* monitors for CO, NO₂, SO₂ (hourly and 5-minute average data), O₃, PM₁₀, and PM_{2.5}. The report, prepared by CAB, shall include a review of AQS data completeness and shall use the U.S. EPA AQS data summary reports as follows:

- AMP 600 – Certification Evaluation and Concurrence
- AMP 450NC – Quick look All Parameters (Non-Criteria)
- AMP 430 – Data Completeness Report

D.2.4 AQS Submittal

All validated ambient air monitoring data shall be submitted to AQS as stated in *40 CFR Part 58.15*. CAB shall report all ambient air monitoring and associated quality assurance data and information specified by the *AQS Users Guide* in the AQS format. In this QAPP, *Section B.10.4, Table B-22* provides the units and the number of decimal places that, at a minimum, are required for reporting to AQS for the criteria pollutants. These decimal places are used for comparison to the NAAQS and are displayed in AQS summary reports.

After CAB quarterly review and approval, the data shall be certified by CAB and submitted according to the schedule in *40 CFR 58.16*; refer *Section D.1, Table D-2* of this QAPP.

The data is submitted to EPA AQS via the Exchange Network on the 20th of the month when data is due. All data shall be approved by the CAB MA Supervisor prior to submittal. The *Exchange Node* is a computer dedicated to exchanging the data between the state and EPA. The node is administered by the *Senior Information Technology Specialist* of the HDOH Environmental Information Office. Further information about Exchange Network and AQS can be found at the website:

<http://www.exchangenetwork.net/data-exchange/aqs/>

CAB shall assign personnel to verify routine and QC data reported into AQS matches that in Envista ARM, followed by corrective action when necessary.

D.2.5 Action Plan Based on Data Quality Assessment

A thorough DQA process shall be conducted by CAB annually. For this process, HDOH accepts that the assumptions for developing the DQOs have been met. If not, the impact of the violation on the bias and precision limits is determined by the DQO process.

If the data from at least one of the monitors or sites violates the DQI bias and/or precision limits, then a CAN is generated per SOP (*Appendix I*), an investigation is conducted to uncover the cause of the violation. If all the monitors in the network of a similar type or pollutant violate the DQI, the cause may be at the agency level (operator 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 (site operator, site problems). Tools for determining the cause include reviewing:

- Data from a collocated network
- Data from performance audits
- QC trails

Some courses of action include:

- Determining the level of aggregation at which DQOs are violated - The DQA process shall identify which monitors are supplying questionable data, since the DQOs were developed at the monitor level. To determine the corrective action level, it must be determined whether the violations of the DQOs are unique to one site, multiple sites, a network of similar monitors, or are caused by a broader problem. An example of a broader problem would be a particular monitor demonstrating poor QA results on a national level. The AQS generates QA reports summarizing bias and precision statistics at the national and PQA 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 9 - If a violation of the bias and precision DQIs are found, CAB will remain in close contact with the Region 9 office both for assistance and for communication.
- Extensively reviewing quarterly data and CANs until DQOs are achieved – CAB shall review the quarterly QA reports and the QC summaries until the bias and precision limits are attained.

References

40 CFR Part 50, *National Primary and Secondary Ambient Air Quality Standards*

40 CFR Part 50 Appendix B, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)

40 CFR Part 50 Appendix C, Measurement Principle and Calibration Procedure for the Measurement of Carbon Monoxide in the Atmosphere (Non-Dispersive Infrared Photometry)

40 CFR Part 50 Appendix D, Measurement Principle and Calibration Procedure for the Measurement of Ozone in the Atmosphere

40 CFR Part 50 Appendix F, Measurement Principle and Calibration Procedure for the Measurement of Nitrogen Dioxide in the Atmosphere (Gas Phase Chemiluminescence)

40 CFR Part 53, *Ambient Air Monitoring Reference, and Equivalent Methods*

40 CFR Part 53, Ambient Air Monitoring Reference and Equivalent Methods 40 CFR Part 58, Ambient Air Quality Surveillance

40 CFR Part 58, *Ambient Air Quality Surveillance*

40 CFR Part 58 Appendix A, *Quality Assurance Requirements for SLAMS, SPMs, and PSD Air Monitoring*

40 CFR Part 58 Appendix C, *Ambient Air Quality Monitoring Methodology*

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*

EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume I, A Field Guide to Environmental Quality Assurance. EPA/600/R-94/038a

EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume II, *Ambient Air Quality Monitoring Program Quality System Development*. EPA-454/B-17-001

EPA Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV, Meteorological Measurements Version 2.0 (Final). EPA-454/B-08-002, March 2008.

EPA Quality Assurance Guidance Document, Quality Assurance Project Plan: PM_{2.5} Chemical Speciation Sampling at Trends, NCore, Supplemental and Tribal Sites. EPA-454/B-12-003, June 2012, with addendum dated 5/15/2014.

EPA Guidance for Quality Assurance Project Plans (QAPPs). EPA/240/R-02/009

EPA Requirements for Quality Assurance Project Plans (QAPPs). EPA/240/B-01/003