UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4

Science and Ecosystem Support Division
Field Services Branch
980 College Station Road
Athens, Georgia 30605-2720

November 17, 2015

Ms. Renee Shealy, Chief
South Carolina Department of Health and Environmental Control
Bureau of Environmental Health Services
8231 Parklane Road
Columbia, SC 29223

SESD Project ID: 15-0347

Dear Ms. Shealy:

This letter is to forward to you the final report concerning the 2015 Technical Systems Audit (TSA) of the ambient air monitoring program operated by the South Carolina Department of Health and Environmental Control (SCDHEC). On July 13-17, 2015, EPA Region 4 Science and Ecosystem Support Division (SESD) personnel – Stephanie McCarthy, Richard Guillot, Ray Terhune, Michael Roberts, Michael Crowe, and Tim Slagle – conducted the audit. Ryan Brown attended the audit as a representative from the EPA Region 4 Air, Pesticides and Toxics Management Division (APTMD). The data collection period covered by the TSA was January 2012 – December 2014.

SESD is requesting your agency develop a plan to address the issues identified in this TSA report. Please respond back to us within 30 business days. If you have any questions regarding the attached audit report, please contact Stephanie McCarthy of my staff at (706) 355-8745.

Sincerely,

[redacted]

John Deatrick, Chief
Field Services Branch

Enclosure

cc (by email):	Myra Reece, SCDHEC	w/attachment
	Sandra Flemming, SCDHEC	w/attachment
	Scott Reynolds, SCDHEC	w/attachment
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United States Environmental Protection Agency
Region 4
Science and Ecosystem Support Division
980 College Station Road
Athens, Georgia 30605-2720

2015 Technical Systems Audit Report

South Carolina
Department of Health and Environmental Control
Ambient Air Monitoring Program

Columbia, South Carolina
Audit Conducted July 13-17, 2015

SESD Project Identification Number: 15-0347

Project Leader: Stephanie B. McCarthy
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Title and Approval Sheet

Title: **2015 Technical Systems Audit Report – South Carolina Department of Health and Environmental Control**

FINAL REPORT

Approving Official:

[redacted] 11/17/15

John Deatrick, Chief
Field Services Branch

Date

SESD Project Leader:

[redacted] 11-17-15

Stephanie B. McCarthy, Physical Scientist
Superfund and Air Section
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Date

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1.0 Executive Summary

Environmental Protection Agency (EPA) Region 4 Science & Ecosystem Support Division (SESD) personnel conducted a Technical Systems Audit (TSA) of the South Carolina Department of Health and Environmental Control (SCDHEC) ambient air monitoring program in July 2015. The purpose of the TSA was to evaluate the operation and performance of the SCDHEC air monitoring program, pursuant to 40 CFR Part 58, Appendix A, Section 2.5. Data from the 2012-2014 calendar years were reviewed for this TSA.

During the TSA, agency staff demonstrated technical expertise in operating, maintaining, and calibrating air monitoring equipment. Traceability and certification documentation for monitoring equipment was in good order.

However, the TSA revealed several significant findings which must be resolved. Foremost, the findings indicate that the design of SCDHEC's quality system is not sufficient to provide the independence and oversight required for its ambient air monitoring program. Quality assurance (QA) activities are currently being performed largely by the same staff members who help generate the agency's environmental data. Without an independent QA Officer or QA Section, there is no technical authority within the agency to ensure the agency's QAPPs and SOPs are being implemented as written. To that end, SCDEHC QAPPs and SOPs were found to be dated and did not reflect current activities or EPA guidance. Some revisions were reported to SESD auditors as pending; however, the internal approval of these documents had been delayed, possibly because the agency lacked an independent authority who could hasten the technical review of the subject matter. Siting evaluations for 40 CFR Part 58, Appendix E criteria have not been conducted on an annual basis, which is a quality assurance function. Resultantly, a large portion of monitoring sites were found to be in violation of regulatory requirements.

The findings of the TSA also reveal that data review activities performed by SCDEHC staff were not sufficiently rigorous to demonstrate that the ambient air data submitted to EPA's Air Quality System (AQS) database was properly quality assured. SCDHEC did not perform routine data assessments needed to ensure federal regulatory requirements and/or SCDHEC quality system specifications were satisfied for all pollutant methods. As a result of these issues, SCDHEC staff must revalidate the agency's 2012-2014 criteria pollutant data set. Upon completion of this revalidation, AQS should be updated with all necessary corrections, and data recertified in accordance with 40 CFR 58.15. The greatest impact will be to the agency's ozone and $PM_{2.5}$ data sets. Ozone data was found to be validated using outdated monitoring guidance which has resulted in the data not meeting current measurement uncertainty goals prescribed in 40 CFR Part 58. A large portion of $PM_{2.5}$ data did not meet the regulatory requirements specified in 40 CFR Part 50, Appendix L and, as such, must be invalidated.

The review of AQS data completeness and data quality indicator reports demonstrated systematic issues existing within the SCDHEC ambient air monitoring network, which are leading to an overall decline in data quality. SCDHEC has had difficulty achieving the 75% quarterly completeness requirement at numerous monitors/sites over the past three years. Data Evaluation and Concurrence reports, utilized by

agency staff during the annual data certification process, have flagged numerous monitors for non-concurrence, indicating these monitors did not meet one or more quality assurance requirements. SCDHEC must take corrective action measures to improve data completeness and overall data quality.

Finally, SCDHEC operates an air monitoring network consisting of approximately 34 monitoring stations with over 100 monitors deployed. However, a large portion of the agency's air monitoring network is designated as non-regulatory or special purpose in the AQS database. Significant resources are expended in order to maintain these special purpose monitors. Although such monitors are important, with limited resources and time available to staff, SCDHEC should reprioritize its efforts and focus on the maintenance and operation of those monitors required for National Ambient Air Quality Standards (NAAQS) decision-making purposes (i.e., SLAMS monitors). Downsizing the agency's non-regulatory or special purpose network may be necessary.

2.0 Introduction

On July 13-17, 2015, EPA Region 4 SESD personnel conducted a TSA of the SCDHEC ambient air monitoring program. The audit team included Stephanie McCarthy (lead auditor), Richard Guillot, Michael Crowe, Tim Slagle, and Michael Roberts from SESD's Field Services Branch, Superfund & Air Section, and Ray Terhune from SESD's Office of Quality Assurance. Ryan Brown, Environmental Engineer, attended the audit as a representative from the EPA Region 4 Air, Pesticides and Toxics Management Division (APTMD).

The purpose of the audit was to assess SCDHEC's compliance with established regulations governing the collection, analysis, validation, and reporting of ambient air quality data. Pursuant to 40 CFR Part 58, Appendix A, Section 2.5, TSAs are required to be conducted every three years. Data reviewed as part of this TSA included those generated during the 2012-2014 calendar years. Data was queried from EPA's AQS database prior to the on-site audit. SESD's Ambient Air Monitoring Technical Systems Audit Form, which focuses primarily on the criteria pollutants, was completed by SCDHEC staff prior to the on-site audit and is included as Appendix D of this report. In addition, the SESD Air Toxics Laboratory Technical System Audit Form and the National Air Toxics Trends Stations (NATTS) Monitoring Site Systems Audit Forms were also completed by SCDHEC staff prior to the onsite audit and are included as Appendices E and F.

The audit included a review of data, recordkeeping, documentation, and support facilities housed at the SCDHEC central office, located at 8231 Parklane Road, in Columbia, South Carolina. Seventeen monitoring stations operated by SCDHEC were visited during the audit as well. The SCDHEC air monitoring stations visited during the audit include the following listed below.

Common Site Name	**AQS Identification**
Trenton	45-037-0001
Cape Romain	45-019-0046
FAA	45-019-0048
Charleston Public Works	45-019-0049
York	45-091-0006
Parklane (NCore)	45-079-0007
Congaree Bluff	45-079-0021
Sandhill Experimental Station	45-078-1001
Johnson Controls (JCI) Railroad	45-041-8001
JCI Entrance	45-041-8002
JCI Woods	45-041-8003
Greenville ESC	45-045-0015
Clemson	45-077-0002
Coastal Carolina	45-051-0008
Cowpens	45-021-0002
Chesterfield (NATTS)	45-025-0001
Long Creek	45-073-0001

Due to time and resource constraints, this TSA focused on the field measurements used to demonstrate compliance with the NAAQS, as well as those measurements used in support of the NATTS air toxics monitoring program. This TSA did not focus on meteorological measurements or samplers utilized in the Chemical Speciation Network.

During the audit, the following SCDHEC personnel were interviewed.

- Scott Reynolds, Director, Division of Air Quality Analysis (DAQA)
- Robert Schilling, Program Manager, DAQA Air Analytical Section
- Kevin Watts, Program Manager, DAQA Audit and Calibration Section
- William Jenny, Program Manager, DAQA Technical Support Section
- Susan (Mitzi) Kennedy, DAQA Chemist
- Cheyrl Boone, DAQA Chemist
- Craig Burchell, DAQA Data Management
- Rick Patterson, DAQA Data Management
- Tommy Flynn, Program Manager, Air Data Analysis and Support (ADAS), Bureau of Air Quality (BAQ)
- Renee' Madden, Environmental Health Manager II, ADAS BAQ
- Joel Hodges, Environmental Health Manager I, ADAS BAQ

The following AQS reports were reviewed in preparation for this TSA.

- AMP 251: QA Raw Assessment Report (2012-2014)
- AMP 256: QA Data Quality Indicator Report (2012-2014)
- AMP 350: Raw Data Report (2012-2014)
- AMP 390: Monitor Description Report (2012-2014)
- AMP 430: Data Completeness Report (2012-2014)
- AMP 440: Maximum Values Report (2012-2014)
- AMP 480: Design Value Report (2012-2014)
- AMP 503: Extract Sample Blank Data (2012-2014)
- AMP 504: Extract QA Data (2012-2014)
- AMP 600: Certification Evaluation and Concurrence (2012-2014)

Additionally, the following SCDHEC documents were reviewed.

- *SCDHEC, Environmental Quality Control (EQC), Bureau of Environmental Services (BES), Division of Air Quality Analysis (DAQA), Quality Assurance Project Plan (QAPP): Ambient Air Quality Monitoring,* Revision 2, January 31, 2007
- *SCDHEC, EQC, BES, DAQA, QAPP: Ambient Air Quality Monitoring (*Sections 3 & 4 only), Revision 2.2, October 2014 (**Draft**)

- *SCDHEC, EQC, BES, DAQA, QAPP: For the $PM_{2.5}$ Ambient Air Monitoring Program*, Revision 3, January 2, 2007
- *SCDHEC, EQC, BES, DAQA, QAPP for the Chesterfield, South Carolina, National Air Toxics Trends Station (for July 1, 2010 – June 30, 2011),* February 12, 2008
- *SCDHEC, Section 12 Ambient Air Monitoring Standard Operating Procedure* (SOP), Revision 3.1, November 2013
- *SCDHEC, EQC, BES, DAQA, SOP for the Gravimetric Analysis for TSP, Hi-Vol+, and PM10 High Volume Filters (Appendix AX),* Revision 0.1, April 13, 2012 (**Draft**)
- *SCDHEC, EQC, Bureau of Health Services (BEHS), DAQA, SOP for Data Handling (Appendix I),* Revision 2, July 2014 (**Draft**)
- *SCDHEC, EQC, BEHS, DAQA, SOP for Automated Data Unit (Appendix G),* Revision 1, June 24, 2008 (**Draft**)
- *SCDHEC, EQC, BEHS, DAQA, SOP for Data Management and Verification for the Rupprecht and Patashnick (Thermo Fisher Scientific) Partisol-Plus 2025 Sequential Air Sampler (Appendix BF),* Revision 1, June 30, 2009 (**Draft**)
- *SCDHEC, EQC, BES, DAQA, SOP for the Rupprecht and Patashnick Model 2025 $PM_{2.5}$ Sampler Software Version 1.413 (Appendix AU),* Revision 1.1, November 4, 2009
- *SCDHEC, EQC, BES, DAQA, SOP for the Rupprecht and Patashnick Model 2025 $PM_{2.5}$ Sampler Software Version 1.413 (Appendix AU),* July 23, 2014 (**Draft**)
- *SCDHEC, EQC, BES, DAQA, SOP for Maintenance and Documentation of Balance Room Conditions (Appendix AV.2),* Revision 0, July 1, 2009 (**Draft**)
- *SCDHEC, EQC, BES, DAQA, SOP for $PM_{2.5}$ Laboratory Procedures (Appendix AV.1),* Revision 1.1, February 27, 2013
- *SCDHEC, EQC, BES, DAQA, SOP for Thermo Environmental Model 49 UV Photometric Ambient Ozone Monitor (Appendix AN),* Revision 2.1, April 7, 2011

3.0 Findings and Recommendations

The observations from this TSA were compared to EPA regulations, technical policies and guidance, and the SCDHEC quality system documentation.

Quality system deviations found through this TSA are classified into three categories: **Findings**, **Concerns**, and **Observations**. These quality system deviations are defined as follows:

Finding:	Departure from or absence of a specified requirement (regulatory, QMP, QAPP, SOP, etc.) or guidance deviation which could significantly impact data quality.
Concern:	Practices thought to have potential detrimental effect on the ambient air monitoring program's operational effectiveness or the quality of sampling or measurement results.

Observation:	An infrequent deviation, error, or omission which does not impact the output of the quality of the work product, but may impact the record for future reference.

For each of these categories, corrective action recommendations are provided. For any quality system deviation ranked as a finding, depending on the severity of the finding, a data deliverable(s) may be requested to show that the corrective action recommendation has been successfully implemented. In these cases, the TSA report will specify the deliverable(s) that will be required for AQS and/or submitted to SESD.

3.1 FIELD OPERATIONS

3.1.1 **Finding:** Twelve out of sixteen air monitoring stations evaluated for 40 CFR Part 58, Appendix E siting criteria were found to have gaseous analyzer and/or particulate sampler probes which did not meet established regulatory requirements for distance and spacing.

Discussion: 40 CFR Part 58, Appendix E details the probe and monitoring path siting criteria for ambient air quality monitors. As stated in Appendix E, Section 1, "Adherence to these siting criteria is necessary to ensure the uniform collection of compatible and comparable air quality data… Specific siting criteria that are phrased with a "must" are defined as requirements and exceptions must be approved through the waiver provisions." The Appendix contains multiple sections that detail the spacing and distance requirements for probe placement. The following paragraphs will summarize the issues observed during the SCDHEC TSA in relation to these requirements.

a) Trees can provide surfaces for SO_2, NO_2, and ozone adsorptions or reactions, as well as surfaces for particle deposition. Because of vegetation's ability to scrub pollutants, 40 CFR Part 58, Appendix E, Section 5 requires that 90% of a probe's monitoring path be at least 10 meters or more from the drip-line of trees. Regarding ozone (O_3) monitors, in particular, Section 5(b) of Appendix E states, "The scavenging effect of trees is greater for O_3 than for other criteria pollutants. Monitoring agencies must take steps to consider the impact of trees on ozone monitoring sites and take steps to avoid this problem." In the SCDHEC network, SESD auditors observed the following sites at which monitoring inlets or probes did not meet the minimum distance requirement: Long Creek, Cowpens, York, Chesterfield ($PM_{2.5}$ sampler only), Coastal Carolina, Charleston Public Works, FAA, and Congaree Bluff.

b) 40 CFR Part 58, Appendix E, Section 4 details the requirements for spacing from obstructions. In Section 4(a), it states, "Buildings and other obstacles may possibly scavenge SO_2, O_3, or NO_2, and can act to restrict airflow for any pollutant…The distance from the obstacle to the probe, inlet, or monitoring path must be at least twice the height that the obstacle protrudes above the probe, inlet, or monitoring path." Additionally, 40 CFR Part 58, Appendix E, Section 5(a) states, "Trees

can also act as obstructions in cases where they are located between the air pollutant sources or source areas and the monitoring site, and where the trees are of a sufficient height and leaf canopy density to interfere with the normal airflow around the probe, inlet, or monitoring path." The 2013 version of the EPA *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II* (QA Handbook) also discusses trees as obstructions in Section 7.1. The QA Handbook further explains the rationale behind the distance requirement: "It is important for air flow around the monitor to be representative of the general air flow in the area to prevent sampling bias." Trees were observed in the SCDHEC network as being obstructions at multiple locations. The SCDHEC sites found to be to be in violation of the obstruction requirements included: Long Creek, York, JCI Entrance, JCI Woods, Cape Romain, Charleston Public Works, FAA, Congaree Bluff, and Parklane (lead sampler only).

c) Table E-4 in 40 CFR 58, Appendix E, Section 11 presents a summary of the general requirements for probe and monitoring path siting criteria with respect to distances and heights. The table indicates that both gaseous pollutant and particulate matter samplers must have unrestricted airflow 270 degrees around the probe or sampler; or, 180 degrees if the probe is on the side of a building or a wall. This requirement for unrestricted air flow is in place to remove any wind circulation issues that may arise from nearby obstructions at the monitoring site. In the SCDHEC network, monitors cited with less than 270 degrees of unrestricted air flow around the sample inlet/probe included: Long Creek, Cowpens, York, and Congaree Bluff.

Recommendation: SESD staff visited approximately 50% of the sites in the SCDHEC ambient air monitoring network during the TSA; of those sites visited, 75% were found to have probes/inlets which did not meet regulatory requirements. Given the magnitude of this finding, combined with the knowledge that Appendix E violations can bias data concentrations (as explained above), SESD's recommendation to address this issue is twofold. First, with regard to field operations, SCDHEC must address these siting issues as quickly as possible, with all corrective action measures completed prior to the start of 2016 ozone season. The trees may be removed or trimmed, the probe line location(s) may be adjusted, or the sites may be relocated away from these obstacles. For some locations, however, SCDHEC may need to submit to EPA Region 4 APTMD a request for a waiver, in accordance with the provisions stated in 40 CFR 58, Appendix E, Section 10. Second, with regard to the data collected in the SCDHEC network, SESD recommends data associated with the violating probes (samplers/analyzers) be flagged in the AQS database. Because the length of time the sites have been out of compliance with the regulations cannot be precisely defined, SESD requires data flagging to begin with January 1, 2015, data, and flagged until such date/time as evidence provided to EPA demonstrates these siting issues have been corrected. The AQS QA qualifier flag code of "3" (i.e., field issue) should be applied to the impacted data. SESD requests copies of finalized AQS reports for the 2015 data set that show the application of this qualifier flag to the data from these sites/monitors. With particular regard to ozone data, which is the most susceptible to vegetative scrubbing, SESD will require ozone data to be invalidated in 2016 if the siting issues have not been rectified, or waivers granted.

3.1.2 **Finding:** The Teflon-coating on the probe cap at the Greenville ESC site was abraded.

Discussion: Studies have been conducted to determine the suitability of materials for use in ambient air monitoring sampling trains. Pursuant to 40 CFR Part 58, Appendix E, Section 9(a), for those analyzers which measure reactive gases, such as ozone, only inert materials – borosilicate glass, Teflon, or their equivalent – are allowed in the sampling train (from the inlet probe to the back of the analyzer). The probe cap utilized at the Greenville ESC site is part of the sampling train. SESD auditors observed that the Teflon-coating on this probe cap had begun to flake and peel (see Appendix G, Figure 1). Without the Teflon-coating completely covering the metal cap, the probe system at this site does not meet Appendix E requirements.

Recommendation: The cap at this site must be replaced immediately. *SESD acknowledges that SCDHEC replaced the probe cap on August 10, 2015, as documented in their response to the draft audit report (in a letter dated October 27, 2015).*

3.1.3 **Finding:** Thermo Environmental (Thermo) Model 49 ozone analyzers observed in the SCDHEC network were configured inappropriately.

Discussion: Thermo Model 49 ozone analyzers in use in the SCDHEC network are configured with the optional ozone generator feature. SCDHEC staff explained to SESD auditors during a site visit that the internal ozone generators are not used for required 1-point quality control (QC) checks, but rather for nightly span checks and remote diagnostics. The Thermo Model 49 instrument manual states that analyzers equipped with optional ozone generators are to have a zero air supply capable of supplying 2-5 LPM at 10 PSI (see Appendix H, Page II-7). The Thermo Model 49 user manual does state that zero air can be obtained from scrubbed ambient air. However, if using ambient air, the zero air assembly should include a set up where the ambient air is first dried using a PermaPure®-type dryer, then passed through a column of silica gel followed by a column of activated charcoal, then passed through a molecular sieve, and finally passed through a particulate filter (see Appendix H, Pages IV-2 through IV-4). SESD auditors observed zero air inlets of the Thermo Model 49 ozone analyzers supplied with a charcoal filter only, instead of a pressurized zero air supply or an assembly including silica gel, a molecular sieve, and a particulate filter.

Recommendation: In order to ensure accuracy of the nightly span checks, the Thermo ozone analyzer must be configured in accordance with the user manual's requirements.

3.1.4 **Finding:** Sample handling issues were observed at the JCI lead sites.

Discussion: SESD auditors observed the following issues while visiting the three JCI lead sites.

a) 40 CFR Part 50, Appendix B details the reference method for the determination of suspended particulate matter in the atmosphere (high-volume method). The appendix contains the field sampling requirements for operating the high-volume particulate samplers. (Please note the regulatory requirements regarding the analysis of high-volume particulate filters for lead is

covered in a separate Part 50 appendix. This finding focuses on the field component only.) Section 8.14 of 40 CFR Part 50, Appendix B states, "Fold the filter in half lengthwise so that only surfaces with collected particulate matter are in contact and place it in the filter holder (glassine envelope or manila folder)."

During the TSA, SESD auditors observed that when filters were removed from the samplers, they were folded along the short axes of the filters (as opposed to lengthwise), and then placed together on a clipboard for transport back to the office. SESD auditors also noted that, when handling the lead filters, the technician did not wear gloves or wash hands between the samples that were collected in succession. These filter handling procedures could cross-contaminate samples.

b) Inside the lead samplers, the areas surrounding the filter holders were observed to be dirty (see Appendix G, Figure 2). During the site visit, SCDHEC staff explained to SESD auditors that samplers are cleaned as needed, but indicated there was no routine cleaning schedule established for the samplers. SESD auditors also observed that one small brush was used to clean the filter holder gaskets on all samplers. This procedure poses a possible source of cross-contamination as well.

Recommendation: A different sample handling method that prevents cross-contamination must be developed. In accordance with 40 CFR Part 50, Appendix B, Section 8.14, the particulate filter is to be folded along the long axis of the filter. Once folded, the filter should be immediately placed in an individual glycine envelope or manila folder for transport and shipment to the laboratory.

SCDHEC must ensure that lead samplers are cleaned routinely (quarterly, at a minimum). The cleaning techniques must be developed that minimize the potential for cross-contamination. The agency's SOP must be revised to reflect the new procedures.

Additionally, SESD recommends refresher training for all staff involved in the lead monitoring network. Internal systems audits should be implemented (at least annually), where independent staff observe the routine operations and sample collection procedures performed by those personnel who are responsible for the field activities.

3.1.5 Concern: Sample train components observed at three sites were visibly dirty.

Discussion: The inside of the Teflon inlet at the Cape Romain site was observed by SESD auditors as noticeably dirty at the time of the audit. Quarter-inch compression fittings and threads on instrumentation at this site were observed to be dirty as well. The interior of the glass manifold in use at the Long Creek site was visibly dirty and contained a dead spider (see Appendix G, Figure 3). The interior of the Greenville ESC manifold was also observed by auditors to be visibly dirty (see Appendix G, Figure 4); a checklist found on site indicated the sample line had been cleaned a few weeks prior to the audit, but documentation was not clear as to when the manifold was last cleaned. These housekeeping findings are a concern because dirt, debris, and insects/insect webs

in sample train components have the ability to scrub pollutants, thereby biasing the data collected at the site.

Recommendation: The sample manifolds at Long Creek and Greenville ESC should be cleaned or replaced immediately. Inlets and fittings at Cape Romain should be cleaned as well. However, given this finding, SESD recommends that all manifolds and probe systems within the SCDHEC network be inspected and cleaned, if necessary.

3.1.6 Concern: The SCDHEC air monitoring network contains analyzers which are aged and may be contributing to data completeness issues.

Discussion: During the TSA, SCDHEC staff and SESD auditors discussed the agency's data completeness statistics for the 2012-2014 time period. (Please see Appendix A of this report for SCDHEC data completeness tables, developed using AQS reports.) SCDHEC staff explained to auditors that data was lost in some cases due to instrument malfunctions or instrumental drift. In recent years, as instruments began to malfunction more frequently, spare parts were not always available. Staff acknowledged that instrument age could be a contributing factor. SESD notes, on the TSA questionnaire completed by SCDHEC prior to the audit, SCDHEC documented that "age of instruments, limited staff time to provide oversight and focused review" had been determined to be the cause for the agency's declining data quality (see Appendix D).

The SCDHEC ambient air monitoring network is composed of a variety of instruments, including makes/models which are considerably dated (see Appendix D). For example, SCDHEC operates Thermo Model 49 ozone analyzers (i.e., the first generation model of this particular instrument series, which received equivalency status in 1980). Some makes/models of instrumentation in use are such that vendor-support is limited and/or replacement parts are limited or not available. Section 11 of the EPA QA Handbook (May 2013) states the following:

> *Every piece of equipment has an expected life span, and its use should be discontinued if its performance quality ceases to meet appropriate standards. For amortization purposes, EPA estimates a **7 year** lifespan for most monitoring instruments and a somewhat longer lifespan for more permanent types of equipment (instrument racks, monitoring shelters etc.)…* [Emphasis added]

The SCDHEC network contains more than 100 instruments. Equipment ages were not obtained for all instruments as part of this TSA. However, the age of standards in use by the agency were obtained. For example, the calibrator utilized by SCDHEC as the agency's Level 2 ozone standard (i.e., the standard of highest authority within the agency, against which all other calibrators are certified) is 19 years old.

Based on discussions with agency staff during the TSA, as well as the review of records completed on site, SESD auditors found that SCDHEC staff are expending a significant amount of time and resources to maintain the network's aged equipment. Staff should be commended for their technical knowledge and dedication towards maintaining this equipment. However, this focus on

maintaining the older equipment is not without drawbacks. Varieties of older instruments can only communicate with dataloggers in an analog-based manner, which prevents SCDHEC from upgrading to a digital (wireless) network and automating aspects of its monitoring program. As stated in Section 11 of the EPA QA Handbook, "Monitoring organizations may be able to prolong the life of equipment but in doing so they may run the risk of additional downtime, more upkeep and a greater chance of data invalidation, while losing out on newer technologies, better sensitivity/stability and the opportunities for better information management technologies."

Recommendation: SCDHEC should make the upgrade of its air monitoring equipment and standards a high priority. Equipment replacement schedules should be developed and implemented, as resources allow.

3.1.7 **Concern**: Performance acceptance testing on new equipment is limited or does not occur.

Discussion: Performance acceptance testing is a critical activity to ensure newly purchased equipment functions correctly and is capable of producing reliable measurements. It is important to conduct initial testing of procured equipment at the agency's main office or laboratory facility. Please see the EPA QA Handbook, Section 11.1, for more information. During the TSA, SCDHEC staff indicated limited testing on new equipment does occur in the maintenance shop; however, the testing is not consistent, nor consistently documented. Moreover, staff indicated that there have been times when a new instrument has been deployed without in-depth testing in the central office; under those circumstances, the performance testing has primarily occurred live in the field. It is important to note that, when a new instrument is tested "live" in the field, data loss may occur if it is later determined that the new instrument was not configured or operating appropriately.

SCDHEC staff stated that new equipment had been purchased within the last year; however, some of those new instruments remained boxed in their shipping containers. SCDHEC staff explained that, due to staffing and resource limitations, there had been no opportunity to extensively test the new equipment. Section 11 of the EPA QA Handbook discusses equipment inspection, testing, and maintenance. Newly procured equipment typically comes with a vendor warranty. The QA Handbook states: "If the analyzer does not perform to stated specifications, document the testing procedures and data and contact the manufacturer for corrective action." It is important to complete performance testing upon receipt of the new instrumentation, or shortly thereafter, in order to ensure any issues are detected while the purchase is still under warranty.

Recommendation: SCDHEC should conduct in-depth, multi-day testing on all new equipment in the agency's maintenance shop prior to field deployment. Moreover, new equipment should be tested while the equipment is still under warranty. SESD recommends SCDHEC acquire the resources necessary to build an equipment testing rack for the maintenance facility. An equipment testing rack could be used to conduct automated performance testing on multiple instruments simultaneously, saving the agency time, resources, and possibly data completeness in the future. Moreover, such an equipment rack could be used to conduct new employee training, or refresher

training for tenured staff, in the future – since the rack could be designed to mimic an air monitoring station in the field.

3.2 LABORATORY OPERATIONS ($PM_{2.5}$)

3.2.1 **Finding**: Analysts weighed $PM_{2.5}$ filters during times when the weigh room's environmental conditions did not meet the specifications required within 40 CFR Part 50, Appendix L, Section 8.2.

Discussion: The reference method for $PM_{2.5}$ (40 CFR Part 50, Appendix L) requires the following filter conditioning climate control:

> *Section 8.2.1 Mean temperature. 20-23° C;*
>
> *Section 8.2.2 Temperature control. ± 2° C over 24 hours;*
>
> *Section 8.2.3 Mean humidity. Generally, 30-40% RH; however, where it can be shown that the mean ambient relative humidity during sampling is less than 30 percent, conditioning is permissible at a mean relative humidity within 5 relative humidity percent of the mean ambient relative humidity during sampling, but not less than 20 percent;*
>
> *Section 8.2.4 Humidity control. ±5 percent over 24 hours.*

The SCDHEC Ambient Air Quality Monitoring and $PM_{2.5}$ QAPPs, as well as the SCDHEC $PM_{2.5}$ Laboratory Procedures SOP, contain these regulatory requirements. The $PM_{2.5}$ Laboratory Procedures SOP states in Section 8.1.5, "If specified conditions are not met, make necessary adjustments to the temperature and/or humidity to modify the environment. Allow at least 24 hours for the environment to stabilize." Moreover, Section 14.6 of the SOP contains a Laboratory Corrective Actions Table, which provides additional information regarding the necessary actions if the laboratory does not meet the regulatory specifications. A portion of that table is included below.

Activity	Deviation	Corrective Action
Pre- or postsampling filter conditioning	24 hour Mean Relative Humidity not between 30 and 40%	Repeat Conditioning until 24 hour mean relative humidity is between 30 and 40%
Pre- or postsampling filter conditioning	24 hour mean temperature not between 20 and 23°C	Repeat Conditioning until 24 hour mean temperature is between 20 and 23°C
Pre- or postsampling filter conditioning	24 hour relative humidity standard deviation >5%	Repeat Conditioning until 24 hour relative humidity standard deviation <5%
Pre- or postsampling filter conditioning	24 hour temperature standard deviation > 2°C	Repeat Conditioning until 24 hour mean temperature standard deviation < 2°C

Figure 1: Excerpt from $PM_{2.5}$ Laboratory Procedures SOP, Page 25

During the TSA, SESD auditors spot-checked data from a portion of the weigh sessions that occurred during the three-year time period of the TSA. During this data review process, auditors observed summary statistics for weigh sessions that did not meet the aforementioned regulatory requirements. The auditors observed exceedances of three of the four climate control criteria. Specifically, weigh sessions were observed where the 24-hour average temperature of the weigh lab was documented to be between 18-19°C (i.e., outside of the stated method/regulatory range). Some instances of 24-hour relative humidity percent averages beyond 40% were also noted. However, multiple weigh sessions were observed where the standard deviation (SD) of the relative humidity was documented to be greater than 5%. For example, seven out of 15 weigh sessions in January 2012 were recorded in the SCDHEC weighing spreadsheet with SD values ranging from 5.4 to 7.5 SD. (Such excursions were also noted in the SCDHEC 2015 weighing spreadsheet as well.)

Upon discussing these findings with the SCDHEC laboratory staff, SESD auditors were informed that SCDHEC staff has weighed filters when the 24-hour average temperature in the laboratory fell within 18-25°C. SCDHEC staff also acknowledged to SESD auditors that the SD statistics computed using the 1-minute data from their laboratory humidity/temperature sensors indicated variability in the weighing room exceeding EPA requirements. However, because the associated lab blank and/or duplicate weigh data was within limits, the SD values were not used to halt a weigh session. Therefore, the procedures established in Section 14.6 of the SCDHEC $PM_{2.5}$ Laboratory Procedures SOP (i.e., the corrective actions table above) were not followed.

Recommendations: Lab staff must adhere to regulatory requirements, as well as their own quality documents, and not weigh filters when the laboratory is exhibiting out of control conditions. In order to determine the extent of data affected by this finding, SCDHEC staff must review all $PM_{2.5}$ weighing spreadsheets from the 2012-2014 time period and identify those weigh sessions (batches)

during which the $PM_{2.5}$ filter conditioning requirements were not met. All $PM_{2.5}$ data resulting from those batches in which filters were weighed when the laboratory did not meet the specifications of 40 CFR Part 50, Appendix L, Section 8.2 must be invalidated. SESD requests a report detailing the results of this investigation and a summary of the impacted data (AQS 350 and 430 reports can serve this purpose).

Because SESD auditors also observed exceedances of these regulatory specifications in the 2015 data set during the TSA, SCDHEC staff must review the agency's 2015 $PM_{2.5}$ data for these criteria as well. The 2015 $PM_{2.5}$ data must be properly validated prior to the May 1, 2016, data certification deadline.

3.2.2 **Finding:** $PM_{2.5}$ data was found that did not meet the requirements of 40 CFR Part 50, Appendix L, Section 8.3.3.

Discussion: 40 CFR Part 50, Appendix L, Section 8.3.3 states, "Filters must be conditioned at the same conditions (humidity within ±5 relative humidity percent) before both the pre- and post-sampling weighings." As stated above in Finding 3.2.1, SESD auditors spot-checked data from a portion of weigh sessions that occurred during the three-year time period of the TSA. During that process, auditors observed summary statistics for weigh sessions that did not meet the pre- and post-sampling relative humidity requirement. Auditors noted that the weighing spreadsheets (in Excel) utilized by SCDHEC laboratory staff conditionally formatted (i.e., bolded) those values for which the pre- and post-sampling relative humidity difference was greater than 5.5; values between 5.0-5.4 were not observed as bolded. However, despite the conditional formatting in the spreadsheet, the data resulting from these sessions were not flagged or invalidated. The SCDHEC Ambient Air Quality Monitoring QAPP defines this requirement as a critical criterion. The $PM_{2.5}$ Laboratory SOP specifies the pre- and post-sampling relative humidity requirement in Sections 10.3.2 and 14.6.

Recommendation: SCDHEC staff must review all $PM_{2.5}$ weighing spreadsheets from the 2012-2014 time period. $PM_{2.5}$ data resulting from those batches in which filters were weighed when the laboratory did not meet the specifications of 40 CFR Part 50, Appendix L, Section 8.3.3 must be invalidated. SESD requests a report detailing the results of this investigation and a summary of the impacted data.

3.2.3 **Finding:** The SCDHEC weighing spreadsheet (Excel) does not time-stamp entries or make clear the chronology of laboratory procedures, in order to verify adherence to Method 2.12.

Discussion: SCDHEC utilizes Microsoft Excel to track all of the $PM_{2.5}$ weighing lab procedures and quality control results. A workbook is created for each calendar year that contains multiple worksheets. The "balance check" worksheet contains a time entry that is manually entered by the analyst at the beginning of a weigh session. The worksheet shows the results of working mass reference standard weight checks during each weigh session; however, there is no way to discern, from the spreadsheet design, if the mass reference standards were weighed in proper sequence.

The EPA Quality Assurance Guidance Document 2.12, *Monitoring $PM_{2.5}$ in Ambient Air Using Designated Reference or Class I Equivalent Methods* (i.e., Method 2.12), details the chronology of a weigh session in Section 7. For example, Method 2.12 explains that the mass reference standards are to be weighed at the beginning of a weigh session, after every tenth sample filter weighed, and at the end of the weigh session. The SCDHEC $PM_{2.5}$ Laboratory Procedures SOP contains these requirements in Sections 8.2.2-8.2.3. However, SESD auditors were unable to verify that weigh sessions were conducted using this sequence of events when reviewing the spreadsheet. There are no time-stamps to indicate when the mass reference standards were weighed, and because the weight standards are documented in a separate worksheet within the Excel workbook, the sequence of events is not transparent. Similarly, the worksheets for "Initial Weighs" and "Final Weighs" contain no time stamps or similar indicators to allow a data reviewer to verify that samples were weighed in accordance with the SCDHEC SOP or EPA Method 2.12. Utilizing the spreadsheets, a data reviewer is also unable to determine the length of time filters equilibrated prior to weighing.

It is to be noted that SESD auditors observed the lab analyst weigh a batch of filters during the TSA. The analyst was observed to follow proper protocol during the demonstration.

Recommendation: The SCDEHC weighing spreadsheet should be improved, in order to make activities in the laboratory more transparent to a data reviewer. A worksheet should be added, or an existing one modified, that would allow reviewers to easily see the timing and sequence of events during a weigh session. The equilibration periods for filters should be captured within the spreadsheet with dates and specific times as well.

3.2.4 **Concern:** The balance in use in the SCDHEC laboratory was observed to drift.

Discussion: A Sartorius microbalance is utilized within the SCDHEC gravimetric laboratory. The microbalance was purchased following the last EPA TSA and placed into service on August 31, 2012. During the TSA, SESD auditors visited the $PM_{2.5}$ weighing laboratory at various times across a period of three days. SESD auditors observed the microbalance display fluctuating on each day in which the lab was visited. An inactive microbalance whose zero fluctuates frequently, as observed by the SESD auditors, is usually an indicator of a static or grounding issue within the gravimetric laboratory, or can be an indicator that the microbalance is being impacted by drafts or vibrations.

During the TSA, the lab analyst demonstrated weighing procedures. SESD auditors observed that the microbalance was slow to settle after removing a filter and did not always return to a stable zero. The weigh room is small and contains a window air conditioning unit. The $PM_{2.5}$ microbalance is placed on a marble table underneath the air conditioning unit. Air flow within the laboratory may be contributing to balance instability. As recommended in EPA Method 2.12, Section 7.2, "Locate the microbalance away from potential sources of drafts such as doors, windows, aisles with frequent traffic, ventilation ducts, and equipment with fans or moving parts."

The weigh room also contains a balance for high-volume PM_{10} operations. SESD auditors observed that the portion of the weigh room designated for PM_{10} operations does not fall directly into the flow path of the air conditioning unit. Please note, due to the possibility of cross-contamination, EPA Method 2.12 suggests separate laboratory facilities (conditioning chambers) for $PM_{2.5}$ and other filter media.

Recommendation: SCDHEC should investigate and determine a cause of the balance instability observed during the audit. SESD suggests that SCDHEC staff consider rearranging the weigh room so that the $PM_{2.5}$ microbalance is not located underneath the flowpath of the air conditioning unit. The PM_{10} gravimetric laboratory operation is not required to be housed within the $PM_{2.5}$ weigh room, and therefore, could be relocated to another area within the SCDHEC facility, allowing more space for $PM_{2.5}$ operations.

3.2.5 Concern: SCDHEC laboratory staff do not wear lab coats or gloves when weighing samples.

Discussion: During the TSA, SESD auditors observed the weigh lab analyst unpack coolers, prepare filters for conditioning, and weigh sample filters. During these activities, auditors observed that the analyst did not wear gloves or use a laboratory coat to protect against particulates contaminating the filters. The weighing room is maintained as a "semi-clean room" to minimize the chance of particulate contaminating the filters. The practice of wearing gloves and a coat is considered best laboratory practice in reducing the chance of contamination directly from the analyst. See EPA Method 2.12, Section 7.4, for more information. SESD auditors questioned the SCDHEC lab analyst regarding the lack of gloves and a lab coat. The analyst responded that gloves caused discomfort, and that lab blanks were within specification. SESD auditors examined the lab blank data and acknowledge that the levels were within specifications

Recommendation: The use of gloves and lab coats minimizes the possibility of contamination and is considered a laboratory best practice. Therefore, SESD maintains that SCDHEC should use anti-static gloves and lab coats when handling $PM_{2.5}$ filters in the laboratory.

3.3 DATA MANAGEMENT

3.3.1 Finding: Ozone data were not validated in accordance with the SCDHEC Ambient Air Quality Monitoring QAPP. Ozone validation criteria utilized by SCDHEC did not conform to current EPA guidance.

Discussion: In the SCDHEC Ambient Air Quality Monitoring QAPP, Section 22 discusses data review, validation, and verification procedures. In this section, the QAPP states: "The tables included in this section that describe the criteria by which we evaluate and describe the quality of criteria pollutant data include the requirements, the guidance and the practice of the South Carolina Ambient Air Monitoring Program… Criteria that are deemed critical to maintaining the integrity of a sample or group of samples were placed on the Critical Criteria Table. Observations that do not meet each and every criterion… should be invalidated…" Table 22-1 of the SCDHEC QAPP

provides the critical criteria for all gaseous pollutants monitored in the SCDHEC network. The table states the acceptable range for the results of an ozone 1-point QC check to be ≤ 7% difference. Therefore, if following the QAPP, 1-point QC checks that exceed 7% difference should be invalidated. However, when reviewing precision data in the AQS database, an AMP 504 Extract report for the 2012-2014 time period showed more than seventy (70) 1-point QC checks with results greater than ±7% difference reported to the national database. SESD auditors learned during the TSA that SCDHEC staff do not invalidate ozone data unless it is found to be > ±25% difference.

In Section 7.6.1 of the SCDHEC QAPP, the data quality objective (goal) of the agency's ozone monitoring network is stated. The QAPP states for ozone: "Acceptable measurement uncertainty is defined for precision as an upper 90 percent confidence limit for the coefficient variation (CV) of 7 percent and for bias as an upper 95 percent confidence limit for the absolute bias of 7 percent." This data quality objective is taken from the formally promulgated ozone measurement uncertainty goal stated in 40 CFR Part 58, Appendix A, Section 2.3.1.2. From the 2013 QA Handbook, Section 3.3, "Since uncertainty is usually additive, there is much less tolerance for uncertainty for individual phases of a measurement system…since each phase contributes to overall measurement. As monitoring organizations develop measurement specific [quality objectives] they should think about being more stringent for individual phases of the measurement process since it will help to keep overall measurement uncertainty within acceptable levels." With that in mind, in order to meet the measurement uncertainty goal (i.e., CV) for ozone established in 40 CFR Part 58, Appendix A, Section 2.3.1.2, the general approach taken by monitoring agencies (and recommended in EPA guidance) is to validate data using an acceptance criteria of ±7% difference for the required biweekly 1-point QC (i.e., precision) checks. The 1-point QC check is required to be conducted between a concentration of 0.010 – 0.100 PPM for ozone, pursuant to 40 CFR Part 58, Appendix A, Section 3.2.1. Thus, the criteria established in Section 22 of the SCDHEC QAPP is appropriate to ensure the agency successfully meets the measurement uncertainty goal for ozone.

However, SESD auditors did observe an issue with the SCDEHC QAPP when reviewing the document in preparation for this TSA. The ozone measurement uncertainty goal was established on October 17, 2006 (71 FR 61303); the final rule became effective on December 18, 2006. SCDHEC incorporated the regulatory changes into the QAPP, which was finalized on January 31, 2007. But, SESD auditors observed that the QAPP did not consistently incorporate the new requirement throughout the document as a whole. For example, Section 7.7 of the SCDHEC QAPP states, "Measurement quality objectives are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs." The QAPP then provides measurement quality objective (MQO) tables for each pollutant, including ozone (see Tables 7-1 through 7-7). However, the MQOs stated in the tables are derived from the 1998 version of the EPA QA Handbook. In that version of the QA Handbook, acceptance criteria for precision at a single analyzer level was not specified; at the agency level, however, the overall precision of the ozone network was required to be < ±15% quarterly (95% confidence interval). Therefore, the ozone

data validation criteria from the 1998 QA Handbook was not designed to achieve the ozone DQO established in 2006. (The EPA QA Handbook was significantly revised in 2008 and again in 2013.)

During the TSA, SESD auditors learned that SCDHEC staff relied heavily on the agency's Ozone SOP, as opposed to the agency's QAPP. The SCDHEC *SOP for Thermo Environmental Model 49 UV Photometric Ambient Ozone Monitor (Appendix AN)* (i.e., Ozone SOP) contains two sentences near the end of the document that discuss the agency's data handling convention for this pollutant. In Section 15, the SOP states, "Data will be considered valid for each monitoring period, barring other problems, in which the following **span** is ≤±25% difference of the known concentration. The data will be considered invalid for a monitoring period in which the following **span** is >±25% difference of the known concentration" [emphasis added]. The SOP defines "span" in two different ways: as 180 PPB ± 20 PPB (per Section 13.1) or 80% of the full scale level (per Section 15.1.1). Using either of these definitions, the "span" concentration would not fall within the defined regulatory range for precision, for which the data is to be compared. In this manner, the Ozone SOP does not implement Section 22 of the SCDHEC QAPP (which would ensure successful achievement of the regulatory DQO for ozone). Unfortunately, during the last review of by SESD of the SCDHEC Ozone SOP (in November 2012), this inconsistency between the QAPP/SOP was not caught. (SESD notes here that the 1998 QA Handbook specified that if a *fixed* calibration was being used to calculate data, span drift should be held to ±15%; a span drift acceptance criteria of ±25% was allowed if the agency was updating the analyzer's calibration curve with each zero/span. However, both the ±25% span acceptance criterion and the analyzer calibration update with each zero/span were removed from the QA Handbook with the 2008 revision. In the SCDHEC network, *fixed* calibrations are used.)

When discussing the issue of the 25% difference criterion utilized in the SCDHEC network, SESD auditors learned that SCDHEC staff tightened their acceptance criteria in ~2013 to 15% difference, although the exact date of the change was not provided. However, upon discussions with Data Management Staff specifically, SESD auditors learned that not all staff reviewing data utilized the newer 15% difference acceptance criterion. Spreadsheets reviewed from 2014 still contained 25% difference as the passing/failing criterion; the spreadsheets were conditionally formatted based on 25%, so any results between 15-25% difference would appear as "passing." Moreover, documentation was found that indicated, over the course of the three-year period under review, three different SCDHEC staff members who reviewed data (and/or entered data into AQS) used either 10%, 15%, or 25% difference to invalidate ozone data during different situations. Therefore, the SCDHEC ozone data set, as a whole, had not been reviewed and validated in a consistent manner.

Finally, upon review of an AQS QA Data Quality Indicator Report for the 2012-2014 time period, the summary statistics indicated that, when combining the results of <u>all</u> precision checks for <u>all</u> ozone monitors in the entire SCDHEC network, the ozone data met the ozone DQO (i.e., 7% CV). However, when looking at ozone monitors at the individual site level (as opposed to an aggregated approach at the agency level), there were multiple sites (analyzers) during the 3-year period that did not meet the ozone DQO. For example, the Trenton site (45-037-0001) in 2012 was calculated

to have completed 87% of the required QC checks during the ozone season, which resulted in a CV upperbound (UB) of 14.13 with a bias UB of ± 10.85. Please see Appendix B of this report for a complete listing of these calculations. Ultimately, the statistics indicate imprecision in the collected data – which could be attributed to the inconsistency in data handling described above, compounded by the too wide acceptance limits (25% difference) utilized by the agency. Other reasons for the imprecision in the data set – such as performance instability associated with aged equipment – could also be a contributing factor.

Recommendation: SCDHEC must investigate the root cause(s) for the imprecision in their monitoring network, and take steps to remediate the issue(s). Additionally, SCDHEC must revalidate its 2012-2014 ozone data set using consistent acceptance limits. The data must be revalidated using a more stringent acceptance criterion. SESD recommends that SCDHEC review the data validation templates provided in the 2013 version of the QA Handbook and establish new warning and control limits to guide the agency's data validation process. SESD notes that the acceptance criterion established in Section 22 of the SCDHEC QAPP (±7% difference) is sufficient for this purpose.

SCDHEC should consult with SESD to determine the acceptance limits which will be implemented for this ozone revalidation process, as well as future validation procedures. The SCDHEC QAPP and Ozone SOP must be revised to reflect the new validation criteria and procedures.

Upon completion of the ozone revalidation, SESD requests copies of finalized AQS AMP 251, 256, 350, and 430 reports for the 2012-2014 ozone data set.

3.3.2 **Finding:** Ambient air monitoring data were reviewed using AQS reports prior to the TSA. The examination of these reports indicated that the data may not have been appropriately validated.

Discussion: During the onsite visit, SESD auditors spent approximately two days with SCDHEC staff reviewing the 2012-2014 criteria pollutant data sets submitted to the EPA AQS database. SESD auditors spot-checked these data sets prior to the onsite visit and noted numerous examples in AQS where data appeared anomalous or did not meet established acceptance criteria (per the EPA QA Handbook and/or the SCDHEC QAPP). For these examples, SESD auditors and SCDHEC staff mutually reviewed all supporting files and documentation during the TSA in order to assess data validity, as well as determine how the data reporting errors occurred. SCDHEC staff acknowledged during the audit that corrections were required in the AQS database.

In order to minimize the length of the TSA report, the following bullet list will provide a general summary of the types of data validation issues observed in the SCDHEC data set, as opposed to individually detailing each data example discussed and investigated during the TSA.

- Raw (i.e., concentration) data and QA/QC data were found in AQS that should have been invalidated and null coded.
- QA/QC data were found that had not been entered into the AQS database.

- Raw data had been invalidated in AQS, but supporting on-site records indicated the impacted data were actually valid.
- When a QA/QC check failed, data were invalidated from the time of the failure forward until corrective actions were completed; however, data were not always invalidated back to the last acceptable (i.e., passing) QA/QC check, which is also required.
- Documentation was found which indicated Data Management Staff each used different acceptance criteria to validate data. (See Finding 3.3.1 for an example.)
- Acceptance criteria used to validate data did not adhere to the SCDHEC QAPP or current EPA guidance. SCDHEC applied a 25% span difference acceptance limit to all gaseous pollutant data, including SO_2, NO_2, and CO. This conflicts with the tables established in Section 22 (Data Validation) of the SCDEHC QAPP. SCDHEC applied a 10% acceptance limit for continuous $PM_{2.5}$ flow rate checks (as opposed to the 4% recommended by EPA). SCDHEC applied a 15% acceptance limit for high-volume flow rate checks (as opposed to the 7% recommended by EPA).

Recommendation: Given the extent of data handing errors discovered during SESD's cursory review, and confirmed onsite during the TSA, a full re-evaluation of the agency's 2012-2014 criteria pollutant data set by SCDHEC staff must be completed. SESD recommends the review of ozone and $PM_{2.5}$ data be given highest priority. SESD also recommends SCDHEC begin its revalidation with 2014 data. Upon completion of this process, SESD requests copies of finalized AQS AMP 251, 256, 350, and 430 reports for the 2012-2014 criteria pollutant data set.

3.3.3 Finding: SCDHEC sites have not met quarterly data completeness requirements.

Discussion: The requirements for quarterly data completeness for each criteria pollutant are defined in 40 CFR Part 50. In general, monitors are required to obtain 75% data completeness each quarter. Please see Appendix A for charts developed by SESD staff that show quarterly and annual data completeness calculations for all sites/analyzers in the SCDHEC network. The data used to generate these charts was obtained from the AQS database (specifically, AMP 430 reports were utilized).

Upon review of the data completeness statistics for the SCDHEC network over the 2012-2014 time period, SESD auditors observed that 17 active monitors designated as "SLAMS" (i.e., State and Local Air Monitoring Station) had one or more quarters where the 75% data completeness requirement was not met. For monitors designated as "non-regulatory" or "SPM" (i.e., special purpose monitor) in AQS, there were 42 active monitors which had one or more quarters in which 75% data completeness was not obtained.

SESD notes that these statistics may be due to improper set-up of sites/monitors in the AQS database. However, from the data review activities that occurred during the TSA, auditors observed a significant amount of data loss due to malfunctioning equipment or other issues. SESD further notes that, upon completion of the required re-validation of the 2012-2014 criteria pollutant data sets (as described in Findings 3.2.1-3.2.2 and 3.3.1-3.3.2 above), these statistics will change.

Recommendation: SCDHEC must investigate the cause(s) for data loss in its network and take corrective action measures to remediate the issue(s) such that data completeness improves in the future. Although non-regulatory and SPM monitors are important, SESD recommends that SCDHEC prioritize such that corrective action measures focus on ensuring the successful, continuous operation of the agency's SLAMS network.

SESD recommends that SCDHEC review the set-up of all monitors in AQS and ensure they are configured appropriately. After revalidating the 2012-2014 data sets, SESD requests copies of finalized AMP 430 reports for the SCDHEC network.

3.4 QUALITY ASSURANCE

3.4.1 Finding: SCDHEC lacks an independent Quality Assurance Officer or Quality Assurance Section dedicated to its ambient air monitoring program.

Discussion: In accordance with 40 CFR 31.45, if the grantee's project [State or local agency] involves environmentally-related measurements or data generation, the grantee shall develop and implement a quality assurance program. Additionally, pursuant to 40 CFR Part 58, Appendix A, Section 2.2, the monitoring organization must provide for a quality assurance management function, which must have technical expertise to conduct independent oversight of the agency's air monitoring program. Specifically, this Appendix A requirement states:

> *The quality assurance management function must have sufficient technical expertise and management authority to conduct independent oversight and assure the implementation of the organization's quality system relative to the ambient air quality monitoring program and should be organizationally independent of environmental data generation activities.*

Additionally, 40 CFR Part 58, Appendix A, §2.1.3 states, "The monitoring organization's quality system **must** have adequate resources both in personnel and funding to plan, implement, assess and report on the achievement of the requirements of this appendix and its approved QAPP" [emphasis added].

With these requirements in mind, the organizational structure of the SCDHEC Division of Air Quality Analysis (DAQA), housed within the Bureau of Environmental Health Services, does not meet the concept of independence prescribed in regulation. Although DAQA is organizationally structured such that it is independent from the primary air program office (i.e., the Bureau of Air Quality), the ambient air monitoring program itself lacks independence – quality assurance activities are being performed largely by the same staff members who help generate the agency's environmental data. Within DAQA, there is no monitoring staff member(s) dedicated solely to quality assurance activities. In this manner, there is no technical authority within the agency to ensure the SCDHEC Ambient Air Quality Monitoring QAPP is being implemented as written. There is no staff member(s) whose primary responsibilities include ensuring SCDHEC air monitoring QAPPs and SOPs are current, adhere to EPA regulations and guidance, and reflect the

true activities of the agency. DAQA does not conduct any internal systems audits of its monitoring program, which is a key activity to ensure the QAPP is being implemented. Due to limited time and resources, there is minimal peer-review on data that is manually generated (such as precision and accuracy data). Also, there are limited data assessments performed on a routine basis to ensure data quality. For example, during the discussions regarding SCDHEC's documented responses on the TSA Questionnaire (see Appendix D), staff members stated they no longer review data quarterly; therefore, needed corrective actions that would reveal themselves through quarterly data assessment are not being performed.

Findings 3.1.1 through 3.1.5, 3.2.3 through 3.2.5, 3.4.2, and 3.5.1 of this report illustrate areas where the lack of an independent QA Officer or QA Section is impacting the agency. During visits to field sites for performance audits or other reasons, a QA Officer or staff member from a QA Section could review the monitoring stations for housekeeping, safety, documentation, or Appendix E issues. An independent QA Officer could also periodically review the operations of the SCDHEC staff who collect samples, conduct QC checks on monitors, or conduct laboratory activities as a way of ensuring SOPs are being followed. In turn, the QA Officer could be charged with updating QAPPs and SOPs to reflect the work of the agency, as needed, as well as ensure that all procedures are in compliance with federal and state regulations and policies.

With regard to data validation, Findings 3.2.1, 3.2.2, 3.3.1, and 3.3.2 further illustrate the need for additional resources directed towards quality assurance. Regulatory requirements were not met in the SCDHEC $PM_{2.5}$ program. Also, validation errors were found in the other criteria pollutant data sets, particularly ozone, which have resulted in the need for the agency's 2012-2014 data to be revalidated and recertified. Independent data validation and assessment is an imperative component of quality assurance oversight.

Ultimately, the majority of the findings detailed in this TSA report could have been identified internally – and resolved – if a functioning quality system were established within the SCDHEC air monitoring program. Independent, technical staff are an integral part of a functioning quality system.

Recommendation: SCDHEC must allot resources to plan, implement, assess and report on both the achievement of the requirements of 40 CFR Part 58, Appendix A (i.e., quality assurance), and the agency's ambient air monitoring QAPPs. To that end, SCDHEC would greatly benefit from an additional staff member, at a minimum, to serve as the agency's independent QA officer for DAQA. SESD strongly recommends this additional staff member have technical expertise in ambient air monitoring programs. As resources allow, SESD recommends additional personnel be assigned quality assurance responsibilities within DAQA as well.

3.4.2 **Finding:** SCDHEC QAPPs and SOPs are outdated and need revision. New SOPs need to be developed.

Discussion: All monitoring organizations must develop a quality system that is described and approved in quality management plans (QMPs) and quality assurance project plans (QAPPs). The EPA QA/R-5 document, *Requirements for Quality Assurance Project Plans,* further states, "Detailed copies of the methods and/or SOPs must accompany the QA Project Plan either in the text or as attachments." Therefore, SOPs are required elements of a QAPP. As stated in 40 CFR Part 58, Appendix A, Section 2.1.2:

> *The QAPP is a formal document describing, in sufficient detail, the quality system that must be implemented to ensure that the results of work performed will satisfy the stated objectives. The quality assurance policy of the EPA requires every environmental data operation (EDO) to have a written and approved QAPP prior to the start of the EDO. It is the responsibility of the monitoring organization to adhere to this policy. The QAPP must be suitably documented in accordance with EPA requirements.*

The SCDHEC Ambient Air Quality Monitoring QAPP was revised in 2007. The SCDHEC NATTS QAPP was revised in 2008. In years past, QAPP revisions were not required on a specific frequency; they were contingent upon major changes within the national monitoring program (such as NAAQS/regulatory changes) or within the air monitoring agency itself (such as an agency reorganization, the outsourcing of an analytical process, or a revision of the agency's internal data validation criteria). Beginning with fiscal year 2015, EPA Region 4 grant commitments changed to require state & local air agencies to update (revise) QAPPs every 5 years.

Major changes – both regulatory and within the SCDHEC organization – have occurred since the SCDHEC QAPPs were last revised. For example, new NAAQS have been promulgated for lead, SO_2, and NO_2 since the time of the last revisions. Additionally, SCDHEC began participation in the NCore program and established the trace-level monitoring at the Parklane site. However, the SCDHEC Ambient Air Quality Monitoring QAPP does not provide specific details or acceptance criteria regarding the trace-level monitors – and a separate NCore QAPP was not developed. Similarly, SCDHEC is conducting source-oriented lead monitoring at the JCI sites, which resulted from a special agreement with industry. Yet, the objectives of the lead study, as well as any special procedures SCDHEC may be implementing because of it, are not covered under the Ambient Air Quality Monitoring QAPP – and a separate lead QAPP for this special study was not developed.

With regards to SOPs, EPA grant commitments require SOPs to be reviewed annually and revised when needed. SOPs for new instruments are required to be developed within 6 months of start-up. In the documented responses to the TSA Questionnaire, SCDHEC staff listed the agency's SOPs and revision dates, which included titles for more than 70 documents (see Appendix D). Of those listed, more than 30 cited did not include a revision or approval date. However, of the remaining SOPs, approximately 40 documents were found to be 5 or more years old; 19 were found to be more than 10 years old. SCDHEC staff explained that SOPs listed for newer makes/models of air monitoring equipment had not been written yet. However, those instruments (such as the Teledyne API Model 400E ozone monitor and the Thermo Environmental Model 2025i particulate sampler) had been deployed in the field for more than 6 months.

Section 2 of this report lists the SOPs reviewed by SESD auditors in preparation for this TSA and discussed during the audit. For some of those SOPs, SESD auditors observed that the stated procedures do not accurately reflect the current work completed by staff. Some SOPs reviewed contained dated acceptance criteria that no longer meets EPA requirements (please see Finding 3.3.1). Other SOPs reviewed (such as the agency's data handling SOPs) did not contain sufficient information to ensure that staff completed activities in a consistent manner.

It is to be noted that SCDHEC staff members interviewed during the TSA indicated that multiple SOPs had been revised, but were awaiting internal approval by upper management.

Recommendation: The SCDHEC Ambient Air Quality Monitoring QAPP and NATTS QAPP need to be revised. NCore activities and quality assurance criteria should be rolled into the Ambient Air Quality Monitoring QAPP, or else a separate NCore QAPP developed. A QAPP is needed for the JCI lead study. Existing SOPs need to be updated to represent the current procedures and acceptance criteria employed by SCDHEC, as well as address the areas where improvement is needed (identified within the body of this report). SOPs for newer instrumentation need to be developed. SESD requests SCDHEC develop a specific schedule for QAPP and SOP revisions, detailing the order of priority, and projecting submission dates to EPA. SESD requests a copy of the schedule once it's developed.

3.4.3 **Finding:** Siting evaluations of air monitoring stations have not been conducted on an annual basis in order to verify compliance with 40 CFR Part 58, Appendix E.

Discussion: Air monitoring agencies are required to submit to EPA each year an annual network plan (ANP) document. Pursuant to 40 CFR 58.10(a), "The plan shall include… evidence that siting and operation of each monitor meets the requirements of appendices A, C, D, and E of this part, where applicable." In order to verify that the siting of each monitor meets the Appendix E requirements for the ANP, air agency staff should visit all air monitoring stations annually and complete an Appendix E review of the probes. In preparation for this audit, SESD staff reviewed the *State of South Carolina Network Description and Ambient Air Network Monitoring Plan Calendar Year 2016* document (i.e., SCDHEC's most recent ANP). The ANP indicates that the SCDHEC network consists of approximately 104 monitors located at 34 air monitoring stations. In the document, dates for site evaluations and QA checks for Appendix E criteria were provided. SESD staff inquired as to the definitions of the terms used in the ANP during the TSA. SCDHEC staff indicated that "Site Evaluation" included an in-depth review of the site for all Appendix D & E criteria, whereas a "QA Check" meant a site visit where only a few Appendix E criteria were verified. Additionally, where the ANP used the term "Pending", it indicated that the date for a full site evaluation and/or QA check was unknown. With that in mind, the SCDHEC ANP 2016 document indicated that some sites had not had a "Site Evaluation" completed since 2002; more than 10 sites said "Pending." However, all sites, with the exceptions of the 3 JCI sites and the newly established Coastal Carolina site, had received a "QA check" between the years 2011-2013. With that in mind, some sites within the SCDHEC network had not been evaluated for Appendix E criteria in four years.

SCDHEC currently has an Appendix E (siting criteria) waiver for the Greenville ESC air monitoring station. SESD auditors visited the site and found that it does meet Appendix E criteria. During the audit, DAQA staff were aware of issues with siting criteria at the York, Long Creek, and Parklane sites, as well as Bushy Park (which was not visited by SESD auditors).

SCDHEC staff from the Bureau of Air Quality (BAQ) have recently begun revising the agency's siting evaluation SOP, as well as completing some Appendix E evaluations and audits. BAQ staff interviewed were aware of some sites in the network not meeting siting criteria. The staff indicated that their goal was to complete site visits and Appendix E evaluations of all sites in the SCDHEC network over the next two years.

Recommendation: SESD recommends SCDHEC staff conduct annual siting evaluations, with the results formally documented. All Appendix E criteria should be verified during these on-site evaluations.

3.4.4 **Concern:** SCDHEC does not have equipment dedicated solely for quality assurance purposes (i.e., performance audits).

Discussion: SCDHEC is unique from other air monitoring agencies in Region 4 in that the agency lacks a set of independent monitoring equipment dedicated solely to the purpose of conducting performance audits. With regards to conducting the required performance audits of the agency's monitoring network, 40 CFR Part 58, Appendix A, Section 3.2.2.3 states, "The gas standards and equipment used for evaluations must not be the same as the standards and equipment used for calibration or calibration span adjustments. For SLAMS sites, the auditor should not be the operator or analyst who conducts the routine monitoring, calibration, and analysis." In the SCDHEC network, the staff member who conducts the routine calibrations may be the same staff member who conducts the audits. Also, the multi-gas calibrators and photometers used by SCDHEC staff to conduct routine calibrations are selected from the same group of instruments used to conduct audits. The SCDHEC network has only a small number of calibrators/photometers to service its entire gaseous pollutant network. The Audit and Calibration Section Program Manager spends a great deal of time and effort each week preparing schedules for section staff to ensure a rotation of equipment such that the calibrator that last adjusted an analyzer is not used to audit it. A review of records while on site did not reveal any occurrences where the wrong calibrator was used for an audit. The program manager should be commended for his planning, tracking, and ability to ensure appropriate follow-through by staff. However, this situation does present a vulnerability to SCDHEC should the rotation/schedule get "off track" at any point in the future. An "audit" conducted with the same calibrator that calibrated an analyzer is not a true audit; should this happen, audit data would not be valid, and the time and resources used to conduct the "audit" would be for naught.

Recommendation: To streamline this process, as well as save time and effort by both the Audit and Calibration section staff and the program manager, SESD recommends that SCDHEC staff set

aside specific calibrators to be used for auditing purposes only, or procure new calibrators for this sole purpose. Establishing dedicated equipment for conducting performance audits will ensure regulatory requirements are always met, and prevent any future situations where QA data may be lost because of an equipment rotation issue.

3.4.5 **Concern:** SCDHEC codes the results of biweekly precision checks as both 1-point QC data and audit data in the AQS database.

Discussion: 40 CFR Part 58, Appendix A, Section 3.2.1 requires a 1-point QC check to be performed at least once every 2 weeks on each automated analyzer used to measure SO_2, NO_2, O_3 and CO. SCDHEC is unique from other air monitoring agencies in Region 4 in that these QC checks are performed manually every two weeks using different calibrators. Sites in the SCDHEC network typically lack a stationary (on-site) multi-gas calibrator or photometer. Because of that, calibrators are transferred from site to site by the Audit and Calibration Section staff every two weeks in order to conduct the required QC checks. See Concern 3.4.4 above. The scheduling and rotation of equipment described above also occurs with regards to the QC checks.

Due to the unique way SCDHEC conducts its biweekly QC checks, the checks are, in essence, audits – because independent equipment has been used. When asked how SCDHEC staff distinguish QC (i.e., precision) and QA (i.e., audit) data for reporting purposes to AQS, staff explained that there is no real distinction. For each biweekly QC check (conducted by generating a zero and two upscale concentrations), SCDHEC will submit the concentration tested in the lower range (i.e., between 0.01 – 0.100 PPM, pursuant to 40 CFR Part 58, Appendix A, Section 3.2.1) as the precision data results, and the concentration tested in the upper range (i.e., the span check) as the audit results. When SCDHEC staff conduct multi-point verifications each quarter, the additional concentration levels generated during the verifications are also reported as audit data. In this manner, SCDHEC is also unique in Region 4 in its data reporting conventions.

The purpose of the 1-point QC check is to determine the repeatability (i.e., precision) of the analyzer. To truly test its repeatability, the instrument should be tested in a repeatable manner each time – in other words, using the same calibrator. The manner in which SCDHEC conducts QC (precision) checks does not allow the agency to successfully track performance-related trends with individual monitors. Typical control charts cannot be developed using the precision data, because of the atypical manner in which it was generated.

The purpose of the independent audits required in 40 CFR Part 58, Appendix A, Section 3.2.2 is to determine the accuracy of the analyzer (and its data). Typically, air monitoring agencies conduct one performance audit annually on each analyzer (i.e., the required minimum), although some agencies may conduct quarterly performance audits on each analyzer. The audits are conducted using dedicated, independent equipment. The data set produced is intended to be an independent set of QA data. Therefore, the manner in which SCDHEC reports the precision and span concentrations from required biweekly QC checks blurs the line between quality control and quality assurance.

Recommendation: In order to improve regional consistency in ambient air monitoring data sets, SESD recommends SCDHEC refrain from entering span concentrations generated during biweekly QC checks as audit data. SESD also recommends that SCDHEC set aside dedicated equipment to conduct performance audits of ambient air monitoring equipment (see Concern 3.4.4 above). SESD further suggests that SCDHEC consider restructuring its rotation of calibrators/photometers such that the same calibrator can be used repeatedly to test an analyzer, therefore generating a set of QC data that can determine the analyzer's precision and be used to track short and long-term trends.

3.4.6 Concern: Data certification reports indicate multiple SCDHEC monitors are not recommended for concurrence in AQS.

Discussion: Certification Evaluation and Concurrence (AMP 600) AQS reports are required to be generated as part of the annual data certification process (40 CFR 58.15) and submitted to EPA Region 4. Upon reviewing AQS AMP 600 reports for the 2012-2014 time period, SESD auditors observed that multiple monitors were not recommended for concurrence each year. When a monitor is not recommended for concurrence, it means that the monitor has not met one or more of the quality assurance requirements for that specific monitor/pollutant, and, resultantly, AQS has flagged that data set. Using the AMP 600 reports, SESD auditors observed that 20 monitors were not recommended for concurrence in 2012; 22 monitors were not recommended in 2013, and 18 monitors were not recommended in 2014. These monitors that did not meet the QA requirements included lead, $PM_{2.5}$, SO_2, and NO_2. At the time SESD auditors pulled the AQS reports, the data certification deadline established in 40 CFR 58.15 had passed for 2014 data; therefore, all data sets reviewed should have contained certified (complete) data.

SESD auditors observed that, if monitors are set up correctly in AQS, then the size of the SCDHEC non-regulatory and SPM network combined is greater than the agency's SLAMS monitoring network. The majority of monitors recommended for non-concurrence in AQS were designated as SPMs. However, some monitors not meeting quality assurance requirements were designated as SLAMS.

The reasons these monitors were flagged in AQS for non-concurrence included the following quality assurance deficiencies:

- Annual data completeness <70%;
- Flow rate audit completeness <65% (i.e., did not obtain the required number of valid audits);
- 1-point QC check completeness <65% (i.e., did not obtain the required number of valid QC checks);
- Flow rate audit bias > 9%;
- 1-point QC precision >25%;
- Lead analysis criteria not met;
- Collocation criteria not met; and,

- Two or more "yellow" (i.e. warning) evaluations found per monitor (e.g., age of QAPP combined with analyzer precision >10%).

The reasons summarized in this list further support Finding 3.3.2 – data validation acceptance criteria used in the SCDHEC network is not stringent enough to ensure quality objectives are met. The measurement uncertainty goals established for criteria pollutant monitors (both reactive gaseous and particulate) are defined in 40 CFR Part 58, Appendix A, Section 2.3. Data not meeting DQOs indicates a systematic issue(s) within an agency. Please see Section 15.4 of the EPA QA Handbook (May 2013) for more information regarding the vulnerabilities and potential implications of this issue. As stated in the QA Handbook, "Monitoring organizations not meeting DQOs should make every effort to discover the reasons for the measurement uncertainties in their monitoring networks."

Finding 3.3.3 discusses the data completeness issues observed and investigated during this TSA. Please note, Finding 3.3.3 specifies the number of monitors in the SCDHEC network found to not meet *quarterly* completeness requirements. The monitors identified in the AMP 600 reports with data completeness issues were those that did not achieve 70% data recovery *annually*. As previously discussed, Findings 3.1.6 and 3.1.7 may be contributing to data completeness issues in the SCDHEC network. However, it should also be noted that, given the limited quantity of calibrators and photometers available in the SCDHEC network (relative to its overall size), a malfunctioning calibrator or photometer could also impact SCDHEC's ability to obtain the required number of valid QA/QC checks during a year. (See Concerns 3.4.4 and 3.4.5.)

SESD notes that the specific number of lead monitors not meeting QA requirements (and therefore, not recommended for concurrence) in the AMP 600 reports may be incorrect due to improper set-up of sites/monitors in the AQS database. Regardless of the specific number, however, the AQS reports show that the SCDHEC lead network (at NCore and the JCI sites) has not met one or more quality assurance criteria each year.

Recommendation: SCDHEC must investigate the cause(s) for declining data quality in its ambient air monitoring network and take corrective action measures. SESD recommends SCDHEC prioritize their routine operations as well as corrective action measures to ensure all regulatory and quality assurance requirements are met for the SLAMS network.

SESD recommends that SCDHEC review the set-up of all monitors in AQS and ensure they are configured appropriately. If SCDHEC determines that AQS coding errors have caused the issues observed within the AMP 600 and 430 reports, then additional AQS training for SCDHEC staff may be warranted.

Any modification to data in AQS after it has been originally certified pursuant to 40 CFR 58.15 requires a recertification of the data. As the findings in this report require SCDHEC to revalidate its 2012-2014 criteria pollutant data set, recertification of these data sets will also be required.

SESD requests copies of the AMP 600 AQS reports that are submitted to APTMD, once the data recertification activities have been finalized.

3.5 AIR TOXICS MONITORING PROGRAM

3.5.1 Field Operations

The Chesterfield air monitoring station, designated as a rural site in the NATTS program, was audited during this TSA. Field operations were evaluated using the EPA NATTS site evaluation checklist. Please see Appendix F for SCDHEC's responses to the NATTS site evaluation checklist.

The following information summarizes the concerns and observations noted by SESD auditors during the Chesterfield site visit.

3.5.1.1 **Concern:** The PUF heads used for PAH sampling are installed into the PUF sampler with a temperature logger attached using a bungee cable (see Appendix G, Figure 5). The temperature logger is used to record temperature throughout transport to/from the field site. SCDHEC staff do not cool exposed PUF samples when collected from the field.

Recommendation: The PAH sampling cabinet should be inert; therefore, attaching a bungee cable to the PUF head, which remains attached during sampling, should be discouraged. Additionally, EPA Compendium Method TO-13A, specifically in Sections 6.2.5 and 6.2.7, explains that during sample transport and analysis, heat, ozone, nitrogen dioxide, and UV light may cause sample degradation. Therefore, in accordance with TO-13A and the NATTS TAD (Section 4.5.2.1, April 2009 version), during transport, field samples should be shipped back to the laboratory chilled (~4°C) using blue or dry ice.

3.5.1.2 **Concern:** VOC samples are pressurized, which goes against the NATTS Technical Assistance Document (TAD).

Recommendation: VOC samples should not be pressurized.

3.5.1.3 **Concern:** SCDHEC staff do not use gloves when handling high-volume PM_{10} filters collected for metals analysis. The use of gloves prevents possible contaminations from the hands of the operator and is considered a best practice.

Recommendation: SCDHEC should use powder-free latex gloves when handling high-volume PM_{10} filters.

3.5.1.4 **Observation:** A fire extinguisher was not found on site.

Recommendation: A fire extinguisher should be placed within the Chesterfield shelter.

3.5.1.5 **Observation:** Mistakes observed in the site logbook were corrected with a single line through the incorrect entry, but no initials or date of the correction were noted.

Recommendation: SCDHEC should improve its logbook documentation. For transparency, corrections in logbooks should always contain the signature or initials of the person making the correction, as well as the date the correction was recorded.

3.5.1.6 **Observation:** Chain-of-custody forms for carbonyl samples contained the average flow, but did not contain the initial and final flow rates.

Recommendation: SCDEHC staff should record the initial and final flow rates for the carbonyl samples.

3.5.2 Laboratory Operations

The results of the audit conducted in the SCDHEC laboratory indicate that a Quality Assurance Officer is needed for the laboratory to provide adequate data review, internal audits, document review, and oversight of laboratory activities. The majority of the laboratory's SOPs need revision. Additionally, the audit revealed several method-specific deviations that must be addressed. Please see Appendix C of this TSA report for detailed findings regarding the laboratory audit.

4.0 Conclusions

SCDHEC staff demonstrated technical knowledge in operating, maintaining, and calibrating air monitoring equipment during this TSA. The commitment and dedication of staff towards that purpose was evident. Traceability records for annual equipment certifications were in good order. The records indicated no expired standards had been utilized during the three years reviewed.

However, findings were identified during this TSA which will result in qualification (flagging) or invalidation of a large portion of the SDHEC 2012-2014 ambient air monitoring data set. The findings which have prompted these data modifications include:

- 75% of the field sites visited were found to be in violation of 40 CFR Part 58, Appendix E requirements;
- $PM_{2.5}$ samples were weighed when the environmental conditions of the gravimetric laboratory were outside of regulatory limits;
- Criteria pollutant data, including ozone, were not validated in accordance with current EPA guidance or the SCDHEC QAPP;

- The agency's QAPPs and SOPs do not reflect the agency's current work activities and, in some cases, do not adhere to current EPA guidance;
- The SCDHEC quality system does not provide the necessary oversight and independence to ensure the agency's ambient air monitoring network meets regulatory requirements; and,
- SCDHEC lacks resources and personnel needed to support the size of its current ambient air monitoring network.

SESD auditors visited half of SCDHEC's field sites during this TSA. Of those sites visited, 75% were found to have probes/inlets which did not meet regulatory siting criteria. Additionally, SCDHEC staff were aware of other sites (not visited by SESD auditors during the TSA) that did not meet siting criteria either. This indicates that the majority of the agency's monitoring network may not be collecting comparable, representative ambient air monitoring data: obstructions interfere with proper data collection and atmospheric reactions caused by vegetation bias sample results low. Within the air monitoring shelters visited, SESD auditors observed manifolds and sample train components which were visibly dirty, which can also negatively impact the resulting sample concentrations. SCDHEC must take immediate measures to rectify these siting and housekeeping issues, as well as invest in a long-term strategies which will ensure probe systems continuously comply with regulatory requirements.

A review of SCDHEC $PM_{2.5}$ gravimetric laboratory operations revealed that laboratory staff did not adhere to the agency's QAPP and SOP, resulting in filters being weighed when the laboratory's environmental conditions did not meet the specifications of 40 CFR Part 50, Appendix L, Section 8.2. Data reviewed indicated the weigh room's temperature was often below the range prescribed by the regulatory method. The review of records also indicated that relative humidity control within the laboratory was problematic. Due to this variability, filters were weighed when the laboratory did not meet the method's pre- and post-relative humidity requirements. SESD auditors observed a large number of sample batches impacted by these deviations. The lack of independent, quality assurance oversight most likely perpetuated this issue. Resultantly, SCDHEC must review its $PM_{2.5}$ data set (2012-present) and invalidate all samples in which the gravimetric laboratory did not meet the temperature and relative humidity requirements established in 40 CFR Part 50, Appendix L.

The current SCDHEC quality system is not functioning in such a way where data quality is routinely and systematically investigated and verified. Agency staff acknowledged that they no longer complete routine data assessments which could be used to identify trends or issues needing corrective actions. Staff are spread thin, and without additional resources, data assessments have been sacrificed. Moreover, documentation found on site revealed that the limited staff involved in data validation and AQS reporting activities reviewed data using inconsistent techniques and acceptance criteria. Further, a significant portion of SCDHEC's ambient data set were not validated in accordance with the agency's QAPP or current EPA guidance. The lack of oversight by an independent QA Officer has contributed to these data validation errors. SESD strongly recommends that SCDHEC overhaul its present system and create a new one which includes independence, oversight, and the necessary resources to ensure data generated meets regulatory and quality assurance requirements. To that end, SESD is willing to provide SCDEHC assistance and training.

Many of SCDHEC's QAPPs and SOPs are overdue for revision. The Ambient Air Quality Monitoring and NATTS QAPPs are dated and do not reflect current agency activities. The same holds true for the agency's SOPs. SESD recommends that SOPs be reviewed internally on an annual basis, to proactively assess whether the SOPs correctly implement the agency's QAPP and EPA regulatory requirements. SESD also observed that numerous SOPs had not been developed for instrumentation currently deployed in the SCDHEC monitoring network. SOPs for new equipment are required to be developed within 6 months of start-up, as a condition of the 105 grant for which SCDHEC accepts on a yearly basis. Therefore, SESD is requesting SCDHEC develop a detailed QAPP/SOP revision schedule and timeline, and begin submitting those documents to SESD for approval.

The quantity of performance standards (e.g., multi-gas calibrators and photometers) available to DAQA staff is limited. Because of this, SCDHEC is forced to continuously recycle its performance standards in order to conduct required QA/QC checks. The method in which this is being achieved blurs the line between quality control and quality assurance – and generated data sets cannot be utilized to their fullest capacity. Additionally, because of the lack of equipment, staff is forced to intricately schedule its activities each week – and that schedule is impacted if a single calibrator malfunctions. Moreover, the measurement uncertainty associated with the agency's few calibrators is transferred, in essence, to the entire SCDHEC gaseous analyzer network – as measurement uncertainty grows (due to issues such as performance instability which increases with instrument age), the resulting data set is impacted. Furthermore, the lack of personnel prevents SCDHEC from testing the limited number of new instruments recently purchased – the staff's focus has been directed towards salvaging the older monitors in the network. Additional personnel and equipment resources are needed in order to lift these burdens from DAQA staff, which in turn would promote a more successful air monitoring program, and produce data sets of higher quality.

AQS data completeness reports indicate that SCDHEC has had difficulty achieving the 75% quarterly completeness requirement at numerous monitors/sites over the past three years. AQS reports also illustrate that individual monitors within the network are not achieving the measurement uncertainty goals specified in 40 CFR Part 58. The AQS Data Evaluation and Concurrence reports, utilized by agency staff during the annual data certification process required by 40 CFR 58.15, have flagged numerous monitors for non-concurrence, indicating these monitors did not meet one or more quality assurance requirements. These AQS reports (i.e., AMP 430 and 600) combined strongly indicate systematic issues exist within the SCDHEC ambient air monitoring network that is leading to a decline in data quality. As stated in Section 15.4 of the EPA QA Handbook (May 2013), "Data not meeting DQOs does not necessarily invalidate this data but it means that those using the information for NAAQS decisions or for other objectives have a higher probability of making an incorrect decision…These types of errors can have serious financial and health risk consequences." As such, SCDHEC must identify the cause(s) for these issues and resolve them quickly. The discussions with staff during the TSA, in conjunction with on-site records review, indicate that aged equipment and lack of personnel are contributing factors.

The review of AQS reports in conjunction with this TSA further indicate that more than half of the SCDHEC ambient air monitoring network is designated as non-regulatory or SPM in the national database. During the TSA, SESD auditors found that significant resources were being expended to upkeep these non-regulatory monitors; yet, data completeness computations and precision statistics indicate that

those resources have yielded low returns. Although non-regulatory and SPM monitors are important, with limited resources and time available to staff, SESD urges SCDHEC to focus its efforts towards the revitalization of its SLAMS network. SPMs deemed lower priority should be considered for discontinuance. Downsizing can shift the resources needed to operate SPMs (e.g., personnel, time, and equipment) towards the operation and upkeep of the SLAMS network, which should bolster both data completeness and data quality. APTMD can assist SCDHEC in identifying lower priority monitors in its monitoring network.

Finally, as a result of these combined findings, SCDHEC staff must revalidate the agency's 2012-2014 criteria pollutant data set. Ozone and $PM_{2.5}$ data should be given highest priority during this process. Upon completion of this revalidation, AQS should be updated with all of the corrections, and the data should be recertified in accordance with 40 CFR 58.15.

SESD requests to be notified as to the progress and status of the required data revalidation. Once completed, please submit a formal narrative to SESD that details the steps taken during the revalidation process, as well as an explanation of the findings. SESD requests SCDHEC submit finalized AQS reports (specifically, AMP 251, 256, 350, 430, and 600 reports) for all data sets as part of the formal submission.

SCDHEC must develop a corrective action plan and timeline to address the issues identified in Section 3 of this TSA report and respond back to SESD within 30 business days of receipt of this report. Please note that the corrective actions do not have to be completed by this date, only a plan to address the findings. If SCDHEC anticipates that the development of the corrective action plan will not be completed within 30 business days, please contact SESD to amend the submittal date.

APPENDIX A

South Carolina
Data Completeness Summary
Quarterly & Annual Results
LIMS ID#: 15-0347

City	Site/Monitor	Poll	MT	2012					2013					2014				
				1	2	3	4	Ann	1	2	3	4	Ann	1	2	3	4	Ann
Columbia	45-079-0019-14129-1	Pb	SLAMS	0	--	--	--	0	--	--	--	--	--	--	--	--	--	--
Dentsville (Hayne Lab)	45-079-9007-12128-1	Pb	Non-Reg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	45-079-9007-14129-1	Pb	SPM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jci entrance	45-041-8002-14129-3	Pb	SPM	--	--	--	--	--	--	--	--	0	0	80	27	40	13	39
	45-041-8002-12128-3	Pb	SPM	--	--	--	--	--	--	--	--	0	0	0	0	0	0	0
Dentsville(Parklane)	45-079-0007-88101-3	$PM_{2.5}$	SPM	--	--	--	--	--	0	0	0	0	0	0	0	0	0	0
Due West	45-001-0001-44201-1	O_3	SLAMS	--	99	95	92	96	--	94	98	99	96	--	99	99	98	99
Jackson	45-003-0003-44201-2	O_3	SLAMS	--	99	99	99	99	--	98	99	99	99	--	99	99	94	98
Big Creek	45-007-0005-44201-1	O_3	SLAMS	--	99	97	99	98	--	99	99	99	99	--	99	99	99	99
Bushy Park	45-015-0002-44201-1	O_3	SLAMS	--	99	99	97	99	--	99	99	93	98	--	97	99	94	98
North Charleston	45-019-0003-42401-1	SO_2	SLAMS	--	--	--	99	98	88	99	99	99	96	99	99	99	99	99
	45-019-0003-42401-2	SO_2	SLAMS	92	71	96	98	89	68	97	94	94	88	98	98	--	--	98
	45-019-0003-42401-3	SO_2	SLAMS	--	--	--	--	--	--	--	--	--	--	--	--	97	96	97
	45-019-0003-81102-3	PM_{10}	SLAMS	99	99	98	99	99	98	98	91	99	97	99	99	99	99	99
Cape Romain	45-019-0046-44201-1	O_3	SLAMS	--	95	95	99	96	--	99	82	98	92	--	99	99	99	99
Charleston	45-019-0049-88101-1	$PM_{2.5}$	SLAMS	98	99	97	96	97	96	92	89	79	89	72	97	72	77	79
Chesterfield	45-025-0001-88101-1	$PM_{2.5}$	SLAMS	84	97	58	70	77	87	97	87	90	90	90	100	97	97	96
Pee Dee	45-031-0003-44201-1	O_3	SLAMS	--	97	94	100	96	--	96	99	99	98	--	99	99	99	99
Trenton	45-037-0001-44201-1	O_3	SLAMS	--	99	85	99	93	--	80	99	99	91	--	98	99	97	98
Florence	45-041-0003-88101-1	$PM_{2.5}$	SLAMS	90	80	90	83	86	90	94	93	81	89	87	100	100	100	97
Taylors	45-045-0009-88101-1	$PM_{2.5}$	SLAMS	94	97	87	83	90	--	--	--	--	--	--	--	--	--	--
Greenville	45-045-0015-42401-1	SO_2	SLAMS	--	--	--	--	--	--	--	--	--	--	90	97	99	97	96
	45-045-0015-42602-1	NO_2	SLAMS	--	--	--	--	--	--	--	--	--	--	95	74	74	95	85
	45-045-0015-14129-1	Pb	SLAMS	100	--	--	--	100	--	--	--	--	--	--	--	--	--	--
	45-045-0015-81102-1	PM_{10}	SLAMS	98	99	98	98	98	99	96	99	84	94	98	85	99	98	95
	45-045-0015-88101-1	$PM_{2.5}$	SLAMS	88	97	98	98	95	92	92	100	89	93	76	91	98	96	90
Simpsonville	45-045-0016-44201-1	O_3	SLAMS	--	97	94	99	96	--	99	99	99	99	--	99	99	99	99
	45-045-0016-88101-1	$PM_{2.5}$	SLAMS	81	100	90	97	92	100	74	87	81	85	100	83	68	87	87
	45-045-0016-88101-2	$PM_{2.5}$	SLAMS	77	100	87	83	87	93	94	97	100	96	80	63	84	81	77
Famoda Farm	45-045-1003-44201-1	O_3	SLAMS	--	99	97	99	98	--	99	85	99	93	--	99	99	97	99
Seven Oaks (Irmo)	45-063-0008-88101-1	$PM_{2.5}$	SLAMS	95	79	95	96	91	100	97	99	96	98	68	98	88	83	84
Cayce - City Hall	45-063-0010-81102-1	PM_{10}	SLAMS	72	35	97	96	75	99	99	99	99	99	97	99	95	99	97
Clemson	45-077-0002-44201-1	O_3	SLAMS	--	99	99	99	99	--	99	99	100	99	--	99	99	100	99

South Carolina
Data Completeness Summary
Quarterly & Annual Results
LIMS ID#: 15-0347

City	Site/Monitor	Poll	MT	2012					2013					2014				
				1	2	3	4	Ann	1	2	3	4	Ann	1	2	3	4	Ann
Dentsville (Parklane)	45-079-0007-12128-2	Pb	SLAMS	81	94	94	94	95	100	80	100	100	95	0	0	0	0	0
	45-079-0007-14129-2	Pb	SLAMS	100	100	100	100	100	100	86	100	100	97	86	100	100	100	97
	45-079-0007-42101-1	CO	SLAMS	88	99	56	99	85	99	77	99	98	93	83	98	99	99	95
	45-079-0007-42401-1	SO_2	SLAMS	98	99	83	99	95	99	99	99	98	99	99	99	99	99	99
	45-079-0007-42401-2	SO_2	SLAMS	78	68	82	98	82	79	32	98	96	77	97	97	--	--	97
	45-079-0007-42401-3	SO_2	SLAMS	--	--	--	--	--	--	--	--	--	--	--	--	97	97	97
	45-079-0007-44201-1	O_3	SLAMS	--	90	70	98	83	--	99	99	99	99	--	99	99	99	99
Columbia	45-079-0019-81102-2	PM_{10}	SLAMS	97	86	99	99	95	99	99	76	99	93	98	99	68	99	91
	45-079-0019-88101-1	$PM_{2.5}$	SLAMS	89	95	100	99	96	99	89	67	91	87	88	92	97	99	94
	45-079-0019-88101-2	$PM_{2.5}$	SLAMS	100	100	75	100	93	93	80	80	94	87	93	93	93	69	87
Sandhill	45-079-1001-44201-1	O_3	SLAMS	--	92	91	99	93	--	99	99	98	99	--	98	99	99	99
North Spartanburg	45-083-0009-44201-1	O_3	SLAMS	--	91	99	99	96	--	99	83	99	92	--	88	99	98	94
Spartanburg	45-083-0011-88101-1	$PM_{2.5}$	SLAMS	98	95	91	89	93	92	99	91	95	94	92	93	92	90	92
York	45-091-0006-42401-2	SO_2	SLAMS	73	53	97	98	80	79	97	98	97	93	86	97	--	--	91
	45-091-0006-42401-3	SO_2	SLAMS	--	--	--	--	--	--	--	--	--	--	--	--	93	44	68
	45-091-0006-44201-1	O_3	SLAMS	--	99	99	99	99	--	99	99	99	99	--	99	95	92	96
North Charleston	45-019-0048-88101-2	$PM_{2.5}$	Non-Reg	93	93	56	93	84	87	67	100	81	84	100	87	100	94	95
Cowpens	45-021-0002-44201-1	O_3	Non-Reg	--	99	98	96	98	--	99	99	93	98	--	98	99	99	99
Georgetown	45-043-0011-81102-1	PM_{10}	Non-Reg	76	99	99	99	93	94	99	97	99	97	98	95	98	88	95
Greenville	45-045-0015-12128-1	Pb	Non-Reg	20	--	--	--	20	--	--	--	--	--	--	--	--	--	--
	45-045-0015-42602-1	NO_2	Non-Reg	62	45	67	68	61	99	99	99	82	95	--	--	--	--	--
Seven Oaks (Irmo)	45-063-0008-42401-2	SO_2	Non-Reg	78	54	94	90	79	99	65	94	94	88	95	98	--	--	96
Long Creek	45-073-0001-44201-1	O_3	Non-Reg	--	66	92	99	82	--	99	77	97	89	--	99	98	85	97
Fort Mill Army NG	45-091-8002-44201-1	O_3	Non-Reg	--	--	96	86	93	--	99	99	97	99	--	--	--	--	--
North Charleston	45-019-0003-42401-1	SO_2	SPM	98	99	96	--	--	--	--	--	--	--	--	--	--	--	--
	45-019-0003-42602-2	NO_2	SPM	99	96	39	96	83	88	99	99	99	96	88	99	99	99	96
Cape Romain	45-019-0046-42401-2	SO_2	SPM	86	95	95	98	94	99	99	99	97	98	98	99	38	98	83
	45-019-0046-42401-4	SO_2	SPM	85	68	92	97	85	98	97	94	91	95	96	97	--	--	96
	45-019-0046-42401-5	SO_2	SPM	--	--	--	--	--	--	--	--	--	--	--	--	37	96	66
	45-019-0046-42602-1	NO_2	SPM	96	83	61	96	84	66	65	99	92	81	91	77	72	95	84
North Charleston	45-019-0048-88101-1	$PM_{2.5}$	SPM	100	93	98	99	98	96	97	90	74	89	79	95	99	85	89
Chesterfield	45-025-0001-44201-1	O_3	SPM	--	98	90	99	94	--	99	99	99	99	--	99	99	99	99
	45-025-0001-81102-1	PM_{10}	SPM	80	80	94	100	89	93	93	80	94	90	67	87	100	100	89
	45-025-0001-81102-2	PM_{10}	SPM	87	87	81	93	87	87	87	93	94	90	80	87	100	100	92
Ashton	45-029-0002-44201-2	O_3	SPM	--	99	98	99	98	--	94	99	97	97	--	98	99	98	98

South Carolina
Data Completeness Summary
Quarterly & Annual Results
LIMS ID#: 15-0347

City	Site/Monitor	Poll	MT	2012					2013					2014				
				1	2	3	4	Ann	1	2	3	4	Ann	1	2	3	4	Ann
Trenton	45-037-0001-88101-1	$PM_{2.5}$	SPM	97	97	81	97	93	97	94	87	100	94	93	93	100	87	93
JCI Railroad	45-041-8001-12128-1	Pb	SPM	100	93	69	100	90	47	73	93	94	77	--	--	--	--	--
	45-041-8001-12128-2	Pb	SPM	--	50	88	87	83	100	100	--	0	100	0	0	--	0	0
	45-041-8001-14129-1	Pb	SPM	100	93	69	100	90	47	67	93	94	75	0	47	73	6	31
	45-041-8001-14129-2	Pb	SPM	--	25	50	40	43	67	60	--	0	59	33	80	40	25	44
JCI Entrance	45-041-8002-12128-1	Pb	SPM	100	100	81	100	95	100	100	87	94	95	0	0	0	0	0
	45-041-8002-12128-2	Pb	SPM	--	25	94	87	83	100	87	100	100	96	--	--	--	--	--
	45-041-8002-14129-1	Pb	SPM	100	100	81	100	95	100	100	87	94	95	0	47	87	31	41
	45-041-8002-14129-2	Pb	SPM	--	0	50	40	40	40	40	100	100	61	73	80	47	38	59
JCI River/Woods	45-041-8003-12128-1	Pb	SPM	86	80	81	100	90	73	33	80	100	72	--	--	--	--	--
	45-041-8003-12128-2	Pb	SPM	--	25	94	73	77	100	67	--	0	85	0	0	0	0	0
	45-041-8003-14129-1	Pb	SPM	86	80	81	100	87	73	33	80	100	72	0	53	53	69	44
	45-041-8003-14129-2	Pb	SPM	--	25	50	33	40	60	40	--	0	45	60	80	40	38	54
Greenville	45-045-0015-42101-1	CO	SPM	56	15	0	--	30	--	--	--	--	--	--	--	--	--	--
	45-045-0015-42401-1	SO_2	SPM	82	99	99	99	95	99	99	99	68	91	--	--	--	--	--
	45-045-0015-42401-2	SO_2	SPM	79	71	97	98	86	98	97	93	61	87	35	96	--	--	66
	45-045-0015-42401-3	SO_2	SPM	--	--	--	--	--	--	--	--	--	--	--	--	98	95	96
	45-045-0015-88101-3	$PM_{2.5}$	SPM	--	--	--	--	--	--	--	--	--	--	95	70	99	28	68
Seven Oaks (Irmo)	45-063-0008-42401-1	SO_2	SPM	93	99	97	91	95	99	99	99	99	99	97	99	98	98	98
	45-063-0008-42401-3	SO_2	SPM	--	--	--	--	--	--	--	--	--	--	--	--	97	96	96
Cayce	45-063-0009-81102-1	PM_{10}	SPM	98	99	88	--	97	--	--	--	--	--	--	--	--	--	--
Long Creek	45-073-0001-42401-1	SO_2	SPM	63	93	70	65	73	99	99	99	68	91	98	99	99	90	97
	45-073-0001-42401-2	SO_2	SPM	54	40	0	65	40	68	98	37	67	68	97	98	--	--	97
	45-073-0001-42401-3	SO_2	SPM	--	--	--	--	--	--	--	--	--	--	--	--	97	89	93
	45-073-0001-88101-3	$PM_{2.5}$	SPM	--	--	--	--	--	--	--	--	--	--	--	98	99	82	93
Wolf Creek	45-077-0003-44201-1	O_3	SPM	--	78	99	99	90	--	83	62	100	77	--	94	99	99	97
Dentsville (Parklane)	45-079-0007-12128-4	Pb	SPM	69	81	88	81	84	93	80	93	94	90	0	0	0	0	0
	45-079-0007-14129-4	Pb	SPM	73	87	88	87	84	93	80	93	94	90	0	0	0	0	0
	45-079-0007-88101-1	$PM_{2.5}$	SPM	90	83	100	97	93	97	87	93	87	91	100	100	100	100	100
Congaree Bluff	45-079-0021-42401-1	SO_2	SPM	95	96	99	99	97	99	99	98	99	99	58	--	--	96	68
	45-079-0021-42401-2	SO_2	SPM	90	73	97	98	89	98	97	77	86	89	37	0	--	--	18
	45-079-0021-42401-3	SO_2	SPM	--	--	--	--	--	--	--	--	--	--	--	--	0	17	9
	45-079-0021-44201-1	O_3	SPM	--	96	98	99	97	--	99	97	98	98	--	96	99	97	97
Sandhill	45-079-1001-42602-1	NO_2	SPM	88	47	94	95	81	95	92	89	89	91	--	--	--	--	--
York	45-091-0006-42401-1	SO_2	SPM	99	99	99	99	99	99	99	99	99	99	88	99	95	44	81
Catawba Longhouse	45-091-8001-44201-1	O_3	SPM	--	98	94	97	96	--	99	96	97	97	--	--	--	--	--

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM

DATA QUALITY INDICATOR REPORT

One Point Quality Control

Jun. 8, 2015

Pollutant: 44201 (Ozone) **PQAO:** South Carolina Department Health And Environmental Control (0971) **App A?** N

Year	Region	State	Site IDs	POC	MT	Begin Date	End Date	# Required	# Observation	% Complete	CV UB	Bias UB
2012	04	SC	45-021-0002	1	SP	01-APR-12	31-OCT-12	15	14	93	3.11	+ 4.96
2012	04	SC	45-073-0001	1	SP	01-APR-12	31-OCT-12	15	14	93	4.39	+/- 4.30
2012	04	SC	45-091-8002	1	SP	20-JUL-12	31-OCT-12	7	4	57	5.39	+/- 3.74
2012			**SUMMARY**			01-APR-12	31-OCT-12	37	32	86	3.74	+ 3.99
2013	04	SC	45-021-0002	1	SP	01-APR-13	31-OCT-13	15	14	93	4.53	+/- 4.21
2013	04	SC	45-073-0001	1	SP	01-APR-13	31-OCT-13	15	14	93	6.77	+/- 5.12
2013	04	SC	45-091-8002	1	SP	01-APR-13	31-OCT-13	15	12	80	5.48	+/- 4.16
2013			**SUMMARY**			01-APR-13	31-OCT-13	45	40	89	4.93	+/- 3.94
2014	04	SC	45-021-0002	1	SP	01-APR-14	31-OCT-14	15	15	100	4.96	+ 5.98
2014	04	SC	45-073-0001	1	SP	01-APR-14	31-OCT-14	15	14	93	3.51	+ 3.02
2014			**SUMMARY**			01-APR-14	31-OCT-14	30	29	97	4.28	+ 4.41
SUMMARY			**SUMMARY**			01-APR-12	31-OCT-14	112	101	90	4.17	+/- 3.79

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM

DATA QUALITY INDICATOR REPORT

One Point Quality Control

Jun. 8, 2015

Pollutant: 44201 (Ozone) **PQAO:** South Carolina Department Health And Environmental Control (0971) **App A?** Y

Year	Region	State	Site IDs	POC	MT	Begin Date	End Date	# Required	# Observation	% Complete	CV UB	Bias UB
2012	04	SC	45-001-0001	1	S	01-APR-12	31-OCT-12	15	15	100	5.66	+/- 4.55
2012	04	SC	45-003-0003	2	S	01-APR-12	31-OCT-12	15	15	100	5.30	+/- 4.30
2012	04	SC	45-007-0005	1	S	01-APR-12	31-OCT-12	15	13	87	6.07	+/- 4.93
2012	04	SC	45-015-0002	1	S	01-APR-12	31-OCT-12	15	15	100	4.66	+/- 4.02
2012	04	SC	45-019-0046	1	S	01-APR-12	31-OCT-12	15	14	93	4.01	+/- 3.02
2012	04	SC	45-025-0001	1	SP	01-APR-12	31-OCT-12	15	14	93	7.43	+/- 5.88
2012	04	SC	45-029-0002	2	SP	01-APR-12	31-OCT-12	15	15	100	3.38	+/- 2.58
2012	04	SC	45-031-0003	1	S	01-APR-12	31-OCT-12	15	14	93	2.68	+/- 2.19
2012	04	SC	45-037-0001	1	S	01-APR-12	31-OCT-12	15	13	87	14.13	+/- 10.85
2012	04	SC	45-045-0016	1	S	01-APR-12	31-OCT-12	15	15	100	5.09	+/- 4.37
2012	04	SC	45-045-1003	1	S	01-APR-12	31-OCT-12	15	15	100	2.96	+ 4.39
2012	04	SC	45-077-0002	1	S	01-APR-12	31-OCT-12	15	15	100	3.15	+ 3.47
2012	04	SC	45-077-0003	1	SP	01-APR-12	31-OCT-12	15	13	87	3.61	+/- 3.57
2012	04	SC	45-079-0007	1	S	01-APR-12	31-OCT-12	15	13	87	4.94	+ 5.63
2012	04	SC	45-079-0021	1	SP	01-APR-12	31-OCT-12	15	15	100	4.26	+/- 3.76
2012	04	SC	45-079-1001	1	S	01-APR-12	31-OCT-12	15	14	93	4.29	+/- 3.57
2012	04	SC	45-083-0009	1	S	01-APR-12	31-OCT-12	15	15	100	7.80	+/- 6.14
2012	04	SC	45-091-0006	1	S	01-APR-12	31-OCT-12	15	14	93	8.00	+/- 6.04
2012	04	SC	45-091-8001	1	SP	04-MAY-12	31-OCT-12	12	11	92	3.62	+/- 3.36
2012			**SUMMARY**			01-APR-12	31-OCT-12	282	268	95	4.59	+/- 3.60
2013	04	SC	45-001-0001	1	S	01-APR-13	31-OCT-13	15	13	87	3.72	+ 5.52
2013	04	SC	45-003-0003	2	S	01-APR-13	31-OCT-13	15	15	100	3.02	+/- 2.32
2013	04	SC	45-007-0005	1	S	01-APR-13	31-OCT-13	15	14	93	4.91	+/- 4.19

DATA QUALITY INDICATOR REPORT

One Point Quality Control

Jun. 8, 2015

Pollutant: 44201 (Ozone) **PQAO:** South Carolina Department Health And Environmental Control (0971) **App A?** Y

Year	Region	State	Site IDs	POC	MT	Begin Date	End Date	# Required	# Observation	% Complete	CV UB	Bias UB
2013	04	SC	45-015-0002	1	S	01-APR-13	31-OCT-13	15	15	100	3.97	- 3.39
2013	04	SC	45-019-0046	1	S	01-APR-13	31-OCT-13	15	14	93	2.50	+/- 1.91
2013	04	SC	45-025-0001	1	SP	01-APR-13	31-OCT-13	15	14	93	4.23	+/- 3.85
2013	04	SC	45-029-0002	2	SP	01-APR-13	31-OCT-13	15	15	100	4.44	+ 4.14
2013	04	SC	45-031-0003	1	S	01-APR-13	31-OCT-13	15	15	100	3.26	+/- 2.57
2013	04	SC	45-037-0001	1	S	01-APR-13	31-OCT-13	15	14	93	4.37	+ 3.90
2013	04	SC	45-045-0016	1	S	01-APR-13	31-OCT-13	15	15	100	4.56	+/- 3.81
2013	04	SC	45-045-1003	1	S	01-APR-13	31-OCT-13	15	14	93	3.13	+/- 2.55
2013	04	SC	45-077-0002	1	S	01-APR-13	31-OCT-13	15	15	100	3.23	+/- 2.72
2013	04	SC	45-077-0003	1	SP	01-APR-13	31-OCT-13	15	9	60	8.88	+/- 6.99
2013	04	SC	45-079-0007	1	S	01-APR-13	31-OCT-13	15	15	100	4.84	+/- 4.01
2013	04	SC	45-079-0021	1	SP	01-APR-13	31-OCT-13	15	14	93	4.52	+/- 3.50
2013	04	SC	45-079-1001	1	S	01-APR-13	31-OCT-13	15	15	100	3.21	+/- 2.90
2013	04	SC	45-083-0009	1	S	01-APR-13	31-OCT-13	15	13	87	4.49	+/- 3.68
2013	04	SC	45-091-0006	1	S	01-APR-13	31-OCT-13	15	15	100	4.78	+/- 3.91
2013	04	SC	45-091-8001	1	SP	01-APR-13	31-OCT-13	15	14	93	5.56	+/- 4.36
2013			**SUMMARY**			01-APR-13	31-OCT-13	285	268	94	3.59	+/- 2.91
2014	04	SC	45-001-0001	1	S	01-APR-14	31-OCT-14	15	13	87	8.68	+/- 7.55
2014	04	SC	45-003-0003	2	S	01-APR-14	31-OCT-14	15	15	100	4.37	+/- 3.47
2014	04	SC	45-007-0005	1	S	01-APR-14	31-OCT-14	15	11	73	2.74	- 2.48
2014	04	SC	45-015-0002	1	S	01-APR-14	31-OCT-14	15	14	93	5.34	+/- 4.02
2014	04	SC	45-019-0046	1	S	01-APR-14	31-OCT-14	15	14	93	8.26	+/- 6.25
2014	04	SC	45-025-0001	1	SP	01-APR-14	31-OCT-14	15	12	80	4.48	+/- 3.62

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM

DATA QUALITY INDICATOR REPORT

One Point Quality Control

Jun. 8, 2015

Pollutant: 44201 (Ozone) **PQAO:** South Carolina Department Health And Environmental Control (0971) **App A?** Y

Year	Region	State	Site IDs	POC	MT	Begin Date	End Date	# Required	# Observation	% Complete	CV UB	Bias UB
2014	04	SC	45-029-0002	2	SP	01-APR-14	31-OCT-14	15	15	100	3.58	+/- 2.77
2014	04	SC	45-031-0003	1	S	01-APR-14	31-OCT-14	15	13	87	4.13	+/- 3.67
2014	04	SC	45-037-0001	1	S	01-APR-14	31-OCT-14	15	13	87	8.44	+/- 7.20
2014	04	SC	45-045-0016	1	S	01-APR-14	31-OCT-14	15	15	100	7.17	+/- 6.04
2014	04	SC	45-045-1003	1	S	01-APR-14	31-OCT-14	15	15	100	4.00	+/- 3.26
2014	04	SC	45-077-0002	1	S	01-APR-14	31-OCT-14	15	15	100	6.03	+/- 4.90
2014	04	SC	45-077-0003	1	SP	01-APR-14	31-OCT-14	15	14	93	4.42	+/- 3.54
2014	04	SC	45-079-0007	1	S	01-APR-14	31-OCT-14	15	12	80	6.32	+/- 5.70
2014	04	SC	45-079-0021	1	SP	01-APR-14	31-OCT-14	15	13	87	4.49	+/- 4.32
2014	04	SC	45-079-1001	1	S	01-APR-14	31-OCT-14	15	15	100	5.53	+ 4.23
2014	04	SC	45-083-0009	1	S	01-APR-14	31-OCT-14	15	14	93	5.76	+/- 5.29
2014	04	SC	45-091-0006	1	S	01-APR-14	31-OCT-14	15	11	73	4.39	+/- 4.12
2014			**SUMMARY**			01-APR-14	31-OCT-14	270	244	90	4.62	+/- 3.67
SUMMARY			**SUMMARY**			01-APR-12	31-OCT-14	837	780	93	4.19	+/- 3.28

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4

Science and Ecosystem Support Division
980 College Station Road
Athens, Georgia 30605-2720

August 10, 2015

MEMORANDUM

SUBJECT: Office of Quality Assurance Laboratory Audit Report; South Carolina Department of Health and Environmental Control – Division of Air Quality Analysis

FROM: Ray Terhune, Chemist
Quality Assurance Section

TO: Stephanie McCarthy,
Superfund and Air Section Lead Auditor

This memorandum has the Office of Quality Assurance Laboratory Audit Report for the South Carolina Department of Health and Environmental Control – Division of Air Quality Analysis Laboratory located in Columbia, South Carolina as an attachment. The report provides an assessment of the analyses and procedures performed by the Laboratory for various US Environmental Protection Agency Air Toxics Program pollutants.

One (1) Attachment

OFFICE OF QUALITY ASSURANCE LABORATORY AUDIT REPORT
South Carolina Department of Health and Environmental Control – Division of Air Quality Analysis Laboratory
July 14 - 15, 2015

1.0 Introduction

Per the Air, Pesticides and Toxics Management Division, an Air Toxics and Total Suspended Particulate (TSP) lead Audit of the South Carolina Department of Health and Environmental Control – Division of Air Quality Analysis (SCDAQA) Laboratory was performed on July 14th and 15th , 2015 for toxic air components (Metals, Carbonyls, Polyaromatic Hydrocarbons and Volatile Organic Compounds) and TSP lead, by Ray Terhune with the U. S. EPA, Region 4, Science and Ecosystem Support Division (SESD), Office of Quality Assurance and Michael Roberts with the U.S. EPA, Region 4, SESD, Field Services Branch, Superfund and Air Section.

The SCDAQA Laboratory provided numerous documents to the EPA assessors for evaluation, prior to and during the assessment. This information provided sample data packages, Standard Operating Procedures (SOPs) and other reports which represent the various aspects of laboratory operations.

The laboratory facility had sufficient laboratory space for the analytical instrumentation and personnel necessary to perform the analyses of interest. The SCDAQA Laboratory Manager and Laboratory staff were briefed by the USEPA assessors in an opening meeting on the morning of July 14, 2015, where an overview of the assessment schedule was given.

It should be noted that the laboratory staff were exceptional in their cooperation, knowledge and promptness in providing any necessary information during the assessment.

2.0 Laboratory Assessment

Prior to performing the on-site assessment of the laboratory, the SCDAQA Laboratory provided a list of analytical methods, SOPs and various Quality Control (QC) documentation utilized for air project samples. The purpose of reviewing these documents was to determine whether the data generated for the sites was of sufficient quality which will in turn be used for decision making purposes. Based on the work being performed by the laboratory, the assessors determined that the following key operational elements were satisfied:

- Final Reports submitted by the laboratory provided appropriate data for quality assurance review and completeness;
- Analytical methods used by the laboratory were consistent, with a few exceptions, with methods required by the Air Program;
- Sample log-in and chain-of-custody procedures were being adhered to;
- Laboratory equipment was adequate however during the on-site evaluation , some of the instrumentation was not in good working order for performing the required analyses at the time of the assessment;

- Most quality assurance and quality control parameters were complete and within acceptable control limits as established by laboratory methodologies and/or the NATTS Technical Assistance Document (TAD) referenced in the Laboratory QA Manual and the SOPs;
- Laboratory analysts and/or technicians that performed the sample preparation and testing procedures within the laboratory were interviewed, verifying that they had the appropriate training and experience necessary for performing the test methods; and,
- Laboratory Data Management System and report generation areas had the necessary systems and checks for assembling project data deliverables.

The laboratory utilized USEPA approved preparation and test methods for air toxics and TSP Lead. The following EPA methods were assessed during the audit:

- Volatile Organic Compounds (VOCs), by EPA Compendium Method TO-15
- Formaldehyde (and other carbonyl compounds), by EPA Compendium Method TO-11A
- Polyaromatic Hydrocarbons (PAHs), by EPA Compendium Method TO-13A
- Metals, by EPA Compendium Methods IO-3.1 and IO-3.5 (using EPA method 200.8)
- TSP-lead, by Manual Equivalent Method EQL-0380-044 (analysis by GFAA)

3.0 Assessment Findings and Recommendations

The USEPA auditors evaluated the entire laboratory process from sample log-in through sample reporting. Any noted assessment findings require corrective actions and approximate timeframes for implementation. Corrective actions are not required for recommendations. However, the implementation of the recommendation would enhance the quality and security of the data being generated for the air program and other clients.
During the assessment process, EPA assessors identified several findings and recommendations which are detailed below. The following is a discussion of these findings and recommendations of this assessment are categorized as “general” and on a method by method basis:

3.1 General Comments:

It should be noted that the staff and management of the laboratory were responsive and helpful in providing any information, documentation and other requests by the assessors. Their transparency and honesty in noting any errors or issues are greatly appreciated along with their immediate attempts to correct any issues noted.

3.1.1 A Quality Assurance Officer is needed to provide adequate data review, internal audits, document review/approval and to provide oversight for the Air Laboratory. This is required in the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, and the State Quality Management Plan.

3.1.2 There is a need for analyst backup for most of the Air Toxics/TSP analyses. Only one analyst is trained and qualified to perform VOCs, and one other for PAHs and Carbonyls. Metals is also in need of a back-up analyst for sample prep and TSP Lead analysis. This could be accomplished through cross training but there should be sufficient depth in the department to cover all the analyses in case of a loss in personnel.

3.1.3 The majority of the Laboratory's SOPs and other associated Documents should be revised as soon as possible. As noted in the report, there were several instruments that were in repair, being decommissioned or upgraded. The SOPs did not reflect these changes nor did they provide procedural changes that had taken place earlier and were noted elsewhere in this document. Please update all SOPs to reflect current procedures and instrumentation.

3.1.4 Two analyses, Volatile Organic Compounds (VOCs) by Method TO-15 and Polyaromatic Hydrocarbons (PAHs) by Method TO-13a were in the process of major upgrades in equipment and instrumentation. Due to the lack of current procedural information, such as SOPs and instrumentation operation, a future assessment of these analyses is highly recommended. This should be scheduled at a time when the instrumentation, procedures and initial quality requirements are in place but before reportable data is produced.

3.1.5 Due to the down time for the VOC instrument many sample canisters are going to exceed their recommended holding time. It is highly recommended that a contract lab be available to analyze sample canisters or any other analysis samples that may exceed their holding time.

3.1.6 Traceability of all standards and reagents for VOCs, PAHs and Carbonyls need improvement to ensure a more efficient traceability system. The current procedures did not provide adequate information in the form of attached documentation or direct lot numbers on the instrument runs to adequately trace lot numbers back to vendor's lot numbers.

3.1.7 Pump pipettes were checked each day for accuracy with class A graduated cylinders. However, this was not documented. NOTE that the TSP Lead analyst immediately corrected this issue.

3.2 Method Specific Findings and Comments

VOCs (Method TO-15)

3.2.1 **Finding:** Canister leak checks were not made at the method required 30 psig. Leak checks were made at a lower pressure and appear to maintain continuity but this is not following the method requirements. Leak checks for canisters were not measured with a calibrated pressure gauge.

Corrective Action: Canister leaks should be conducted at 30 psig. Refer to section 8.4.1.2 of Method TO-15.

3.2.2 **Finding:** The laboratory SOP, section 8.3.1 indicated that replicates should be "within 30% of each other". This is assumed to be "relative percent difference" (RPD).

Corrective Action: Method TO-15 requires in Section 11.1.1., that RPD for replicates should be ≤ 25% RPD. The SOP should be revised to reflect method requirements.

3.2.3 **Finding:** Section 9.2.4 of the SOP indicated an acceptable r^2 (correlation coefficient) of > 0.995.

Corrective Action: r^2 is not the correlation coefficient, r is the correct mathematical term. Please correct in the next revision of the SOP.

3.2.4 **Finding:** Method Detection Limits (MDLs) for the old instrument were spiked at too high a concentration and gave an artificially low MDL.

Corrective Action: 40 CFR 136 Appendix B notes that a MDL study result must be > than 0.1x of the spiked value. Example, 0.2 ppbv for a spiked concentration cannot calculate to a MDL lower than 0.02 ppbv. Another MDL study should be made with a lower concentration for a spike. Future MDLs for the new instrumentation should conform to this requirement and it should be noted in the SOP.

PAHs (Method TO-13a)

3.2.5 **Finding:** Surrogate Spikes were made after the cartridge assemblies return to the lab.

Corrective Action: Method TO-13a, section 10.4.1 requires that spikes be made prior to assembly of the puff cartridge and be made directly on the filter and puff.

3.2.6 **Finding:** Samples were not cooled to ≤ 4°C during shipment and/or transport. The field operators place the cartridges in containers at ambient temperature for transport.

Corrective Action: Method TO-13a, Section 11.3.4.10 requires cooling the samples to ≤ 4°C with blue during shipment.

3.2.7 **Finding:** Soxhlet Extraction was with hexane solvent only.

Corrective Action: Method TO-13a, section 12.2.1 requires a 90% hexane / 10% Ethyl Ether mixture. The laboratory did a comparison of this variation and noted that the results were comparable. Discussion with OAQPS is in order to determine if this is an acceptable modification.

3.2.8 **Finding:** The laboratory did not prepare and analyze an LCS with every batch. These were analyzed occasionally.

Corrective Action: A Laboratory Control Spike (LCS) is required for every batch of 20 samples or less. Refer to Method TO-13a, Section 13.3.7.2.

3.2.9 **Finding:** The MDL study for this analysis was not performed in accordance with 40 CFR 136 Appendix B. The study was performed from standards which did not go through the sample preparation process.

Corrective Action: An MDL study is performed with low level blank spikes taken through the entire sample preparation process as required in 40 CFR 136 Appendix B. A new MDL study should be performed using the correct procedures and be detailed in a SOP revision.

3.2.10 **Recommendation**: It is highly recommended that a mid-level standard be analyzed at the end of an analysis run to bracket samples with passing standards.

<u>Carbonyls (Method TO-11)</u>

3.2.11 Finding: The laboratory SOP allows for the initial calibration curve to have a correlation coefficient ≥ 0.995 as acceptable.

Corrective Action: Method TO-11, section 11.4.3 requires a Correlation Coefficient for each analyte ≥ 0.999. It was noted for the current curve verification for formaldehyde that a CORR of 0.998 was accepted. This probably has little effect on any data but it is not following method requirements.

3.2.12 Finding: MDL studies were not prepared correctly. The lowest standard was analyzed seven times and the MDL was determined from those results.

Corrective Action: As noted above (**Finding 3.2.9**), the MDL study must be prepared by the same procedure samples are prepared.

Air Toxics Metals (Method IO-3.5)

3.2.13 Comment: Filter surface areas were different than the procedures dictated in sample preparation method, IO-3.1. Section 6.2.1.1 states "*Cut a 1" x 8" strip from the 8" x 10" filter"* However, the laboratory was calculating the surface area and comparison of the strips analyzed correctly. There were slight differences in the final results due to some rounding but it was not significant.

3.2.14 Comment: The laboratory is sending their digestates to the water metals laboratory for analysis. This laboratory uses EPA Method 200.8 which is a drinking water/wastewater method. However, the treatment of the sample digestates is similar to IO-3.5. However, it is misleading to note that the analysis is IO-3.5 even though the QC is similar. Detailed comparison of the acceptable QC of the two methods has not been made so there may be some discrepancies.

TSP Lead (Method EQL-0380-044)

No specific findings or comments were noted at this time.

END OF DOCUMENT

United States Environmental Protection Agency

Ambient Air Monitoring Technical System Audit Form

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1) General

Organization Name:
- South Carolina Department of Health and Environmental Control
- Environmental Quality Control, Bureau of Environmental Services
- Division of Air Quality Analysis

Address:
- 8231 Parklane Road

City, State, and Zip Code:
- Columbia, SC 29223

Phone:
- (803) 896-0902

a) Program Organization

*Agency Director:
- Myra Reece, Bureau Chief
  SC DHEC, EQC, Bureau of Air Quality

Ambient Air Monitoring (AAM) Network Manager:
- Scott Reynolds, Director
  SC DHEC, EQC, Bureau of Environmental Health Services, Division of Air Quality Analysis

Quality Assurance Manager:
- Sandra Flemming
  SC DHEC, EQC, Bureau of Environmental Health Services, Stat Quality Assurance Management Officer

QA Auditors:
-

Field Operations Supervisor / Lead:
- Scott Reynolds

Laboratory Supervisor:
- Robert Schilling

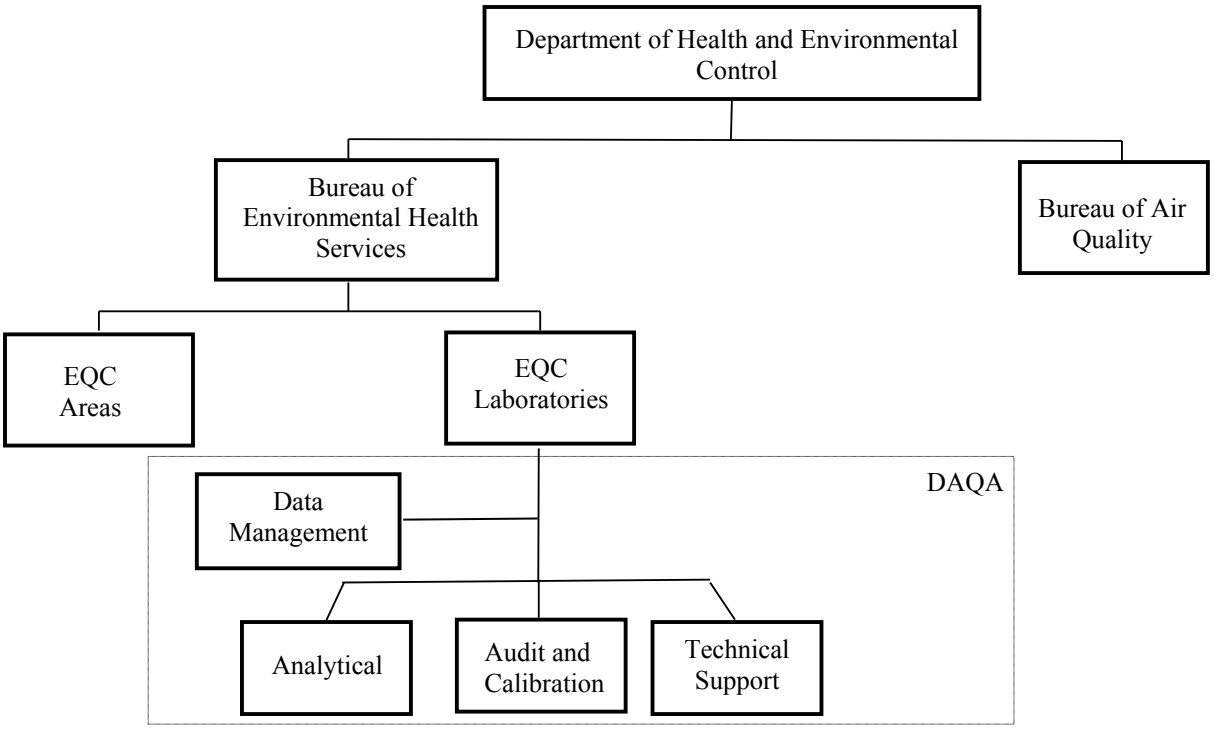
QA Laboratory Manager:
-

Data Management Supervisor / Lead:
- Scott Reynolds/Craig Burchell

AQS Submitter:
- Craig Burchell

'Agency' is defined for this document as the Air Program within the South Carolina Department of Health and Environmental Control consisting of the Bureau of Air Quality and the Bureau of Environmental Services, Division of Air Quality Analysis and Environmental Health Services Regional staff

Insert an Organizational Chart (or provide a hard copy during the audit):



Flow Charts:

BEHS, DAQA staff only

List available personnel and select their primary duties:								
Name	Network Design and Siting	QC Activities	QA Activities	Equipment Repair & Maintenance	Data & Data Management	Financial Management	Site Operation (PM, Gaseous, Met)	Other Non-Ambient Air Monitoring Duties
Schilling, Robert		X	X	X	X			
Boone, Cheryl K.		X						
Green, Kenneth C		X						
Kennedy, Mitz		X						
Watts, Laura		X						
VACANT (LAB)								
Burchell, Craig P.		X	X		X			
Patterson, Rick		X	X		X			
VACANT(Data)								
Jenny, William E.				X				
Parnell, Mike				X				
Sturkie, Dave				X				
Webber, Derreck				X				

List available personnel and select their primary duties:								
Name	Network Design and Siting	QC Activities	QA Activities	Equipment Repair & Maintenance	Data & Data Management	Financial Management	Site Operation (PM, Gaseous, Met)	Other Non-Ambient Air Monitoring Duties
Watts, Kevin G.		X	X					
Allen, William		X						
Little, Doug		X						
Ross, Carolyn		X						
West, Eve		X						
VACANT(A&C)		X						
Randolph, Tammy						X		
Reynolds, J. Scott	X		X		X	X		

In your agency, are site operators responsible for running all of the instruments at their assigned sites, certain instruments (ex. O_3) at multiple sites, or a combination of the two?

- Neither. The Agency does not designate 'Site Operators'. Regional personnel have responsibilities for installation, collection and shipping of ambient air samples within their area of responsibility.

List personnel who have authority or are responsible for:		
Activity	Name	Title
QA Training Field/Lab		Appropriate Section Manager
Grant Management	Scott Reynolds	Director, DAQA
Purchases Greater than $500	Scott Reynolds	Director, DAQA
Equipment and Service Contract Management	Scott Reynolds	Director, DAQA
Staff Appointment	Scott Reynolds	Director, DAQA
Monitoring Operations	Scott Reynolds	Director, DAQA

Questions	**Yes**	**No**	**Comments**
Does your agency utilize any contractors in your air monitoring program? If no, skip to the next table.	*	X	Consistent with QMP, any contractors would be bound by associated project QAPP requirements. * DAQA currently using EPA contract for Speciation and some Lead analysis.
Who is responsible for oversight of contract personnel?	NA		
What steps are taken to ensure contract personnel meet training and experience criteria?	NA		
Does the contractor follow an EPA approved QAPP?			NA
- Where/how is this documented?			
How often are contracts reviewed and/or renewed?			

Comment on the need for additional personnel, if applicable:

List your district offices and associated staff below(State Agencies Only)

Name	Address	Staff

Regional Air Personnel List – March 2015

Upstate Region - Anderson, Greenwood and Walhalla (old REGION 1) – Area Director: Chris McCluskey:

- Anderson BEHS Counties: Anderson, Oconee
220 McGee Road Phone: (864) 260-5585 Fax: (864) 222-3923 **Air Program Lead:** Bryan Ball
Anderson, SC 29625

- Greenwood BEHS Counties: Abbeville, Greenwood, Laurens, McCormick
1736 South Main Street Phone: (864) 227-5915 Fax: (864) 942-3680 **Air Program Lead**: Mark Harvley
Greenwood, SC 29646 Air Program Personnel: Samuel
Madden

Upstate Region - Greenville and Spartanburg (old REGION 2) – Area Director: Natalie Kirkpatrick

- Greenville BEHS Counties: Greenville, Pickens
200 University Ridge Phone: (864) 372-3273 Fax: (864) 282-4371 **Air Program Lead:** Kevin Poore
Greenville, SC 29601 Air Program Personnel: Sabrina Prince

- Spartanburg BEHS Counties: Cherokee, Spartanburg, Union
151 E. Wood Street Phone: (864) 596-3327 Fax: (864) 596-3920 **Air Program Lead:** Johnny Hall
Spartanburg, SC 29303 Mailing Address: POB 4217 Spartanburg SC 29203 Air Program Personnel: Clint Carroll

Midlands Region - Columbia, Lancaster and Rock Hill (old REGION 3) – Area Director - Harry Mathis:

- Lancaster BEHS Counties: Chester, Lancaster, York
2475 DHEC Road Phone: (803) 285-7461 Fax: (803) 285-5594 **Air Program Lead:** Paul Edinger
Lancaster, SC 29720 Air Program Personnel: Steve Moseley

- Columbia BEHS Counties: Fairfield, Lexington, Newberry, Richland
8500 Farrow Rd Bldg 12 Phone: (803) 896-0620 Fax: (803) 896-0617 **Air Program Lead:** Ben Buchanan
Columbia, SC 29203 Mailing Address: POB 156 State Park SC 29147-0156 Air Program Personnel: Mike Bates

Midlands Region - Aiken (old REGION 5) – Area Director – Jennifer Hughes:

- Aiken BEHS Counties: Aiken, Barnwell, Edgefield, Saluda
206 Beaufort Street, NE Phone: (803) 642-1637 Fax: (803) 643-4027 **Air Program Lead:** Tim Pearson
Aiken, SC 29801 Air Program Personnel: Jason Shirley

Pee Dee Region - Florence and Sumter (old REGION 4) – Area Director – Buck Graham:

- Florence BEHS Counties: Chesterfield, Darlington, Dillon, Florence, Marion, Marlboro
145 E. Cheves Street Phone: (843) 661-4825 Fax: (843) 661-4858 **Air Program Lead:** Bryan Baxley
Florence, SC 29506 Air Program Personnel: Earle Watson

- Sumter BEHS Counties: Clarendon, Kershaw, Lee, Sumter
105 Magnolia Street Phone: (803) 778-6548 Fax: (803) 934-2938 **Air Program Lead:** Regie Watts
Sumter, SC 29151 Air Program Personnel: Thomas Mimms

Pee Dee Region - Conway, Myrtle Beach and Williamsburg (old REGION 6) – Area Director – Ted Ambrose:

- Myrtle Beach BEHS Counties: Georgetown, Horry, Williamsburg
927 Shine Avenue Phone: (843) 238-4378 Fax: (843) 238-4518 **Air Program Lead:** Jay Cox
Myrtle Beach, SC 29577 Air Program Personnel: Katherine Mann

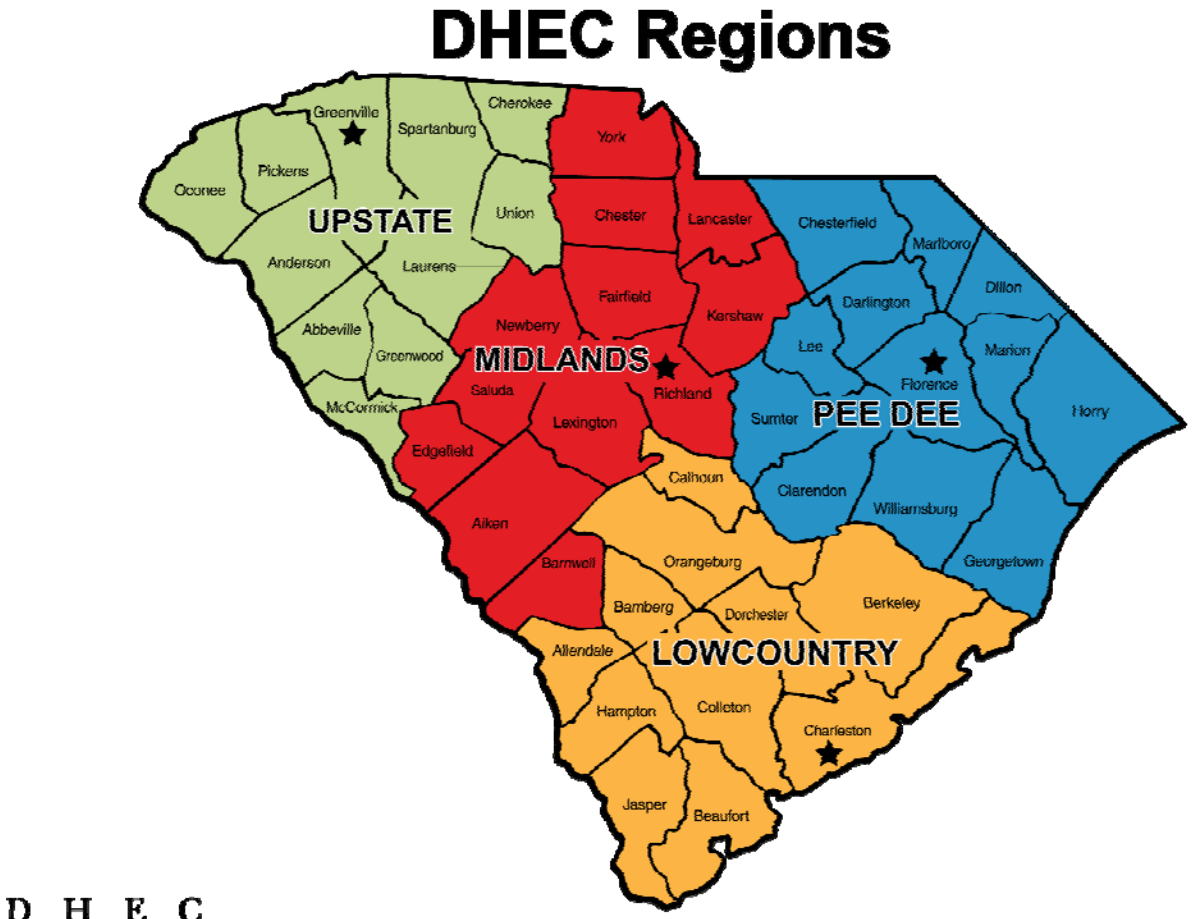
Low Country Region - Charleston (old REGION 7) – Area Director – Christine Sanford-Coker:

-Charleston BEHS Counties: Berkeley, Charleston, Dorchester
1362 McMillan Avenue, Ste 300 Phone: (843) 953-0150 Fax: (843) 953-0151 **Air Program Lead:** Wendy Boswell
Charleston, SC 29405 Air Program Personnel: Hollon Stillwell
Randolph Cook

Low Country Region - Beaufort and Orangeburg (old REGION 8) – Area Director - Russell Berry:

- Beaufort BEHS Counties: Beaufort, Colleton, Hampton, Jasper
104 Parker Drive Phone: (843) 846-1030 Fax: (843) 846-0604 **Air Program Lead:** Shane Johnson
Burton, SC 29906

-Orangeburg BEHS Counties: Allendale, Calhoun, Bamberg, Orangeburg
1550 Carolina Avenue Phone: (803) 533-5490 Fax: (803) 268-5784 **Air Program Lead:** Alan Risa
Orangeburg SC 29115



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CR-000228 4/2013

b) Facilities

Identify the principle facilities where the agency conducts work that is related to air monitoring. Do not include monitoring stations, but do include facilities where work is performed by contractors or other organizations. Select which purpose(s) each facility serves. Add additional lines as necessary								
Facility Address	General Office Space	Data Verification and Processing	Criteria Gas Instrument Maintenance and Storage	Standards Certification / Calibration	PM Filter Weighing	Records Storage	Air Toxics Maintenance and Storage	Air Toxics Laboratory
8231 Parklane Road Columbia, SC29223	X	X	X	X	X	X	X	X

Are monitoring sites ever used for storage of equipment, spare parts or supplies?

- Not typically

Identify any facilities that should be upgraded. Identify by function and any suggested improvements or recommendations.

-

Are facilities adequate concerning safety? If not, please explain and give suggested improvements or recommendations.

- Yes

Are there any significant changes which are likely to be implemented to agency facilities within the next three years? No		
Facility	Function	Proposed Change - Date

Comment on the agency's need for additional physical space (laboratory, office, storage, etc.)

-

c) Quality Assurance and Quality Control

i) Status of Quality Assurance Program

QA activities are performed and supported by sources uniquely different from those used in routine QC activities. Independent / dedicated equipment, different personnel and calibration methodologies are purposely used in performing QA audits, performance checks, etc.

Question	Yes	No	Comments
Does the agency perform QA activities with internal personnel? If no, skip this table.	X		
Does the agency maintain a separate laboratory to support quality assurance activities?		X	
Has the agency documented and implemented specific audit procedures separate from monitoring procedures?	X		
Are there two levels of management separation between QA and QC operations? Please explain:		X	
Does the agency have separate auditing equipment and standards (specifically intended for sole use) for audits?		X	Audit and Calibration Section Manager schedules routine QA activity to ensure systems are challenged using different equipment and operators on successive audits.

Do you conduct mandatory biweekly precision point checks?

- Yes

Are they automated or conducted manually?

- Manually

Select which of the following <u>additional</u> QA you conduct at your gaseous sites				
Precision Checks	Typically Performed?	How?		Frequency
		Manually	Automated	
Precision Point	**Yes**	**X**		**Bi-Weekly**
Zero Precision Span	**Yes**		**X**	**Daily**
Zero Precision				
Probe Line Integrity Checks	**No**			
Other: _____				

ii) <u>Audits</u>

Question	Yes	No	Comments
Does the agency have separate facilities to support audits and calibrations?		X	
If the agency has in place contracts or agreements with another agency/contractor to perform audits/calibrations, please name the organization and briefly describe the type of agreement.	NPAP, PEP		
Does the agency maintain independence of audit standards and personnel?		X	
Do any site operators audit their own sites?		X	No site operators
Does the agency have a certified source of zero air for performance audits?	X		
How do you generate your zero air?	Zero air packs with silica/Purafil/charcoal canisters.		
Does the agency have procedures for auditing and/or validation performance of meteorological monitoring?		X	
Has the agency established and documented criteria to define agency-acceptable audit results?	X		

Question	Yes	No	Comments
Are your sites regularly reviewed for Appendix E siting criteria?	X		Frequency: Sites periodically reviewed by BAQ staff.
Do you conduct internal audits of your air monitoring agency?		X	
(1) How frequently?			
(2) What type of audit is conducted (e.g., performance or systems audit)?			
(3) Who receives the results of these audits?			
(4) Do you report these results to EPA?			

Please provide a list of internal audit standards currently being used (these do not include standards used for calibrations and/or biweekly checks). Add additional lines as necessary.			
Name	Model Number	Date of Last Certification	Approximate Age (years)
Ozone Photometer	**API-700**	**03/19/15**	**19 years**
NIST Traceable Thermometer	**Fisher Scientific Traceable Thermometer**	**09/11/14**	**9 years**
Flow Cal Standard for PM2.5 & SASS	**Goohs-Neck GNV-10**	**04/29/15**	**14 years**
Orifice Cals for TSP/PM10/PUF	**Rootsmeter Model 5M L25 TC**	**N/A**	**32 years**
Flow Cal Standard for MFC calibrators	**BIOS Defender 510-H and 510-L**	**11/21/14**	**3 years**

****Please have certifications of standards available for viewing during the audit**

Question		Yes	No	Comments
Does your agency participate in NPAP, $PM_{2.5}$ PEP, Pb PEP and other performance audits performed by an external party and/or using external standards?		X		
If the agency does not participate, please explain why:				
Are NPAP audits performed by QA staff, site operators, calibration staff, and/or another group?				EPA Contractor
Is your agency audited by the State (if you are a local agency)?				N/A
(1) How frequently?				
(2) What type of audit is conducted (e.g., performance or systems audit)?				
(3) Who receives the results of these audits?				
(4) Do you report these results to EPA?				

Who is primarily responsible for coordinating participation in:

(1) The National Performance Audit Program (NPAP)?

- Kevin Watts

(2) $PM_{2.5}$ Performance Evaluation Program (PEP)?

- Kevin Watts

(3) Lead Performance Evaluation Program (PEP)?

- Robert Schilling(Lab), Kevin Watts (Field)

Please complete the table below:	
Parameter Audited	Date of Last NPAP and/or PEP Audit
CO	12/12/13 (AIRS ID# 45-079-0007)
O_3	05/28/15 (AIRS ID# 45-083-0009)
SO_2	09/24/14 (AIRS ID# 45-063-0008)
NO_2	08/27/14 (AIRS ID# 45-019-0003)
$PM_{2.5}$	01/25/12 (AIRS ID# 45-045-0016)
Pb	

d) Planning Documents

QMP Questions	Yes	No	Comments
Has the QMP been approved by EPA within the last five years?	X		Date of Original Approval: 2003? Date of Last Revision: March, 2014 Date of Last Approval: 5/9/2014
QAPP Questions	**Yes**	**No**	**Comments**
Has the QAPP been reviewed by EPA annually?		X	Date of Original Approval: Date of Last Revision: January ,2007 Date of Last Approval: 11/13/2007
Does the State review your QAPP prior to EPA review? (local agencies only)	X		BAQ and OQA review
Does your agency have any revisions to your QAPP pending?		X	Revisions in process
How does the agency verify the QAPP is fully implemented?			
How is the QAPP available to the staff (e.g.., electronically, hard copies at site, etc.)	Electronically		
SOP Questions	**Yes**	**No**	**Comments**
How does the agency verify that the SOPs are implemented as provided (e.g., staff are regularly observed for correct implementation of SOPs)?			
How are revisions to the SOP distributed?	By appropriate section managers		
How are SOPs available to the staff (e.g.., electronically, hard copies at site, etc.)	Electronically and paper copies of Section 12 of the Field Operations SOP		
Are any new monitoring SOPs needed? If yes, please list in comments section.	X		See Below

List all of the agencies current SOPs:

			SOP Status List	
		Revision Date	Title	EPA Approved
Appendix	Part			
B		Oct-84	Electronic Calibration for Maintenance Section	
G		Jun-08	Automated Data Units	9/11/2008
H		Sep-85	Data Reduction and Quality Control	
I		Sep-85	Data Handling	
K		Jun-99	Chain-of-Custody and Documentation	5/18/2007
P		Dec-91	Total Suspended Particulates	
Q		Feb-87	Samples & Analysis of Lead in Ambient Air	
	Q-1		High Volume Filter Extraction Procedure	9/12/2008
	Q-2		High Volume Filter Analysis for Lead Using Flame Atomic Absorption Spectroscopy	
	Q-3		High Volume Filter Anlaysis for Lead Using Inductively Coupled Plasma Spectroscopy	9/17/2008
	Q-4		High Volume Filter Lead Data Handling Procedure	
	Q.5		Graphite AA	
AC		Sep-04	Sampling and Analysis of Ambient Fluorides	9/23/2008
AD		Oct-84	Operation and Maintenance of Precipitation Chemistry Measurements System	
	AD.1		Field Procedures	
	AD.2		Laboratory Procedures	
	AD.3	Feb-13	Data Handling Procedures	
AE		Apr-96	Microscopic Analysis of a Particulate Filter	
	AE-1	Mar-11	Airborne Particulate on TSP Filters	5/8/2012
	AE-2	Mar-11	Airborne Complaint Samples	5/8/2012
AF		Aug-96	High Volume, Size Selective Inlet, Mass Flow Controlled, PM10 Sampling	
AI		Feb-96	Method for the Determination of Semi-Volatile Organics in Ambient Air	
	AI-1	Aug-07	Field Procedures	9/28/2007
	AI-2		Laboratory Procedures	
AJ		Aug-90	Thermo Environmental Model 48 GFC Ambient CO Analyzer	9/15/1993
AK		Jul-93	Thermo Enviornmental Model 42S Continuous Chemiluminescence NO/NO2/NOY Analyzer	9/22/1993
AL		Jul-93	Thermo Environmental Model 48S Continuous Carbon Monoxide Monitor	9/15/1993
AM		Jul-93	Thermo Environmental Model 43S Pulsed Fluorescent Ambient SO2 Analyzer	9/22/1993
AN		Jul-93	Thermo Environmental Model 49 U.V. Photometric Ambient Ozone Monitor	11/28/2012
AP		Aug-95	Determination of Volatile Organic Compounds in Ambient Air	9/21/1995
	AP-1		Sample Collection Procedures	

AR		Oct-96	Method for the Determination of Carbonyl Compounds in Ambient Air	
	AR-1		Field Procedures	
	AR-2		Laboratory Procedures	6/2/2008
	AR-3		ATEC 800 Carbonyl Samper	
	AR-4		Data Management and QA for R&P Partisol Plus Model 2025 Sequential Air Sampler	
AT			PM2.5 Single Sampler R&P 2000	
AU		Aug-00	R&P Model 2025 PM2.5 Sampler	6/7/2010
AV		May, 2003	PM2.5 Lab Procedures	5/29/2003
	AV.1	Sep-09	PM2.5 Laboratory Procedrues	6/7/2010
	AV.2		Maintenance and Documentation of Weigh Room Conditions	
AX			Gravimetric Analysis of Hi-Vol Particulate Filters	5/8/2012
AY		Apr-01	MetOne SASS PM2.5 Speciation Sampler	4/23/2001
AZ		Jan-14	R&P TEOM 1400A	
BA		Jan-06	Writing of Standard Operating Procedures	N/A
BB			Thermo Environmental Model 43A Pulsed Fluorescent Ambient SO2 Analyzer	
BD			Tekran Model 2537A Mercury Vapour Analyzer	
BE			Thermo Environmental Model 146 Dynamic Gas Calibration System	
BF		May-03	Data Management and QA for R&P Partisol Plus Model 2025 Sequential Air Sampler	6/30/2003
BI		Oct-09	Site Information Form	10/31/2008
BK		Jun-08	Troubleshooting, Maintenance, & Repair of the TSP, PM10, & PUF Samplers	N/A
BL		Jun-08	Troubleshooting, Maintenance & Repair of the Thermo-Environmental Model 49 Series Ozone Monitors	N/A
BM			RESERVED	
BN			Thermo Environmental Model 42 Continuous Chemiluminescence NO/NO2/NOx Analyzer	
BO		Jun-11	Troubleshooting, Maintenance & Repair of the R&P Model 2025 PM2.5 Sampler	N/A
BP		Nov-04	Air Monitoring Site Infrastructure Maintenance	N/A
BQ		Jun-08	Troubleshooting, Maintenance & Repair of the Thermo-Environmental Model 42 NOX Monitor	N/A
BR			Aethalometer	
BS		Jun-09	ChartLog	N/A
BT		Jun-09	Inventory	N/A
BU			PCAS	
BV		Mar-09	NullData	N/A
BW		Mar-09	YellowCard	N/A
BX			Ion Chromatographic Analysis of Anions and Cations of Acid Precipitation Samples	

BY		Aug-08	Troubleshooting, Maintenance & Repair fo the Thermo Environmental Model 43 SO2 Monitor	N/A
BZ		Jul-08	Troubleshooting, Maintenance & Repair of the Thermo Environmental Model 48 CO Monitor	N/A
CA		Jul-08	Troubleshooting, Maintenance & Repair of the ESC 8816 Data Logger	N/A
CB			Method for the Determination of Volatile Organic Compounds in Ambient Air	
	CB.1	Sep-09	Active	7/21/2010
	CB.2	Sep-09	Passive	7/21/2010
CC		Jul-09	Continuous Particulate Speciation Reduction/Verification	N/A
CD		Mar-09	Site Evaluation	3/31/2009
CE		Jul-08	Hourly Rain Data Validation	N/A
CF			BGI frmOmni Particulate Sampler	
CG			Teledyne CO Analyzer Model 300EU	
CH			MetOne EBAM Particulate Monitor	
CI			Environics 6103 Multi Gas Calibrator	
CJ			Teledyne API Model 400E Photometric Ambient Ozone Monitor	
CK			URG 3000	
CL			Inlet Retention Time Check	
CM			Thermo Environmental Model 49i UV Photometric Ozone Monitor	
CN			Thermo Environmental Model1405F/1405DF TEOM Continuous Particulate Monitor	
CO			Thermo Environmental Model 2025i Particulate Sampler	
CP			Thermo Environmental Model 43i-TLE SO2 Monitor	
CQ			Thermo Environmental Model 42i NO/NOx Analyzer	
CR			Teledyne API Model T300U CO Analyzer	

Missing letters in Appendix series are Obsolete Assigned numbers as of 6/26/2015

e) General Document Policies

Question	Yes	No	Comments
Does the agency have a documented records management plan?	X		AAM QAPP section 19 and Retention Schedule
Does the agency have a list of files considered official records and their media type? (i.e., paper, electronic)		X	
Does the agency have a schedule for retention and disposition of records?	X		
Are records maintained for at least three years?	X		
Who is responsible for the storage and retrieval of records?	Office management and (for data related records) Data Management staff		
What security measures are utilized to protect records?	Stored in secure areas		
Where/when does the agency rely on electronic files as primary record?	AQS is primary ambient air monitoring data storage		
What is the system for storage, retrieval and backup of these files?	Working data stored on WAN and backed up no less than daily		

f) Training

Question	Yes	No	Comments
Does the agency have a training program and training plan?	X		
Where is it documented?	QAPP Section 8 and electronically tracked (ELearn)		
Does it make use of seminars, courses, and/or EPA sponsored courses?	X		When available and affordable
Are personnel cross-trained for other ambient air monitoring duties?	X		When possible and consistent with job duties
Are training funds specifically designated in the annual budget?		X	
Does the Training Plan Include: 1. Training requirements by position		X	Generic plans include DHEC required, EQC Required, laboratory required, and Air Staff and Region plans
2. Frequency of Training	X		
3. Training for contract personnel		X	NA
4. A list of core QA related courses		X	

Indicate below the three most recent training events and identify the personnel participating in them:		
Event	Dates	Participants(s)
1. Several Onsite and Hands-on 2025 Training sessions for New and existing Regional Personnel	4/10, 4/16 and 5/6,	Regional staff from Aiken, Greenville, Florence and Charleston offices
2.		
3.		

g) Corrective Action

Question	Yes	No	Comments
Does the agency have a comprehensive corrective action program in place?			
Have the procedures been documented?			
1. As a part of the QA project plan?			
2. As a separate standard operating procedure?			
Does the agency have established and documented corrective action limits for QA and QC activities?	X		QAPP validation Table and SOPs
Are procedures implemented for corrective actions based on results of the following which fall outside of established limits:			
1. Performance Evaluations		X	
2. Precision Goals		X	
3. Bias Goals		X	
4. NPAP Audits		X	
5. PEP Audits		X	
6. Validation of one point QC Check Goals		X	
7. Completeness Goals		X	
8. Data Audits		X	
9. Calibrations and Zero Span Checks		X	
10. Technical Systems Audit		X	
Have the procedures been documented?		X	

How is responsibility for implementing corrective actions assigned? Briefly discuss

- Based on scope and impact of identified deficiency, DAQA Director will assign development and implementation of corrective action through the Section Managers

How does the agency follow up on implemented corrective actions?

- Section 22 AAMQAPP

Please fill out the table below for <u>precision</u>			
Pollutant	Action Level	Corrective Action (if exceeded)	Redbook Guidance Action Level Reference
O_3			QA Handbook Volume II, Appendix D Revision No. 1 Page 3 of 30
CO			QA Handbook Volume II, Appendix D Revision No. 1 Page 5 of 30
NO_2			QA Handbook Volume II, Appendix D Revision No. 1 Page 7 of 30
SO_2			QA Handbook Volume II, Appendix D Revision No. 1 Page 9 of 30

Please fill out the table below for <u>accuracy</u>			
Pollutant	Action Level	Corrective Action (if exceeded)	Redbook Guidance Action Level
O_3			QA Handbook Volume II, Appendix D Revision No. 1 Page 3 of 30
CO			QA Handbook Volume II, Appendix D Revision No. 1 Page 5 of 30
NO_2			QA Handbook Volume II, Appendix D Revision No. 1 Page 7 of 30
SO_2			QA Handbook Volume II, Appendix D Revision No. 1 Page 9 of 30

At what point do you invalidate data?

-

h) Quality Improvement

Question	Yes	No	Comments
Have all deficiencies indicated on the previous TSA been corrected? If not, explain.		X	Much SOP development is incomplete.
What actions were taken to improve the quality system since the last TSA?	-See attached Table		
Since the last TSA, do your control charts indicate that the overall data quality for each pollutant steady or improving?	X		
For areas where data quality appears to be declining, has a cause been determined?	X		Age of instruments, limited staff time to provide oversight and focused review.
Are there pending plans for quality improvement such as purchase of new or improved equipment, standards, or instruments?	X		Equipment replacement contingent on availability of funds and resources.

2) Network Management/Field Operations

a) Network Design

Complete the table below for each of the sites in your air monitoring network (active in the last three years) with the number of instruments measuring each pollutant (including NCore low level instruments – e.g. 1 low level CO + 1 regular CO = 2 CO instruments).

AQS ID	Common Site Name	Pb	CO	SO_2	NO_2	O_3	Manual				Collocated		Continuous		Meteorology
							$PM_{2.5}$	PM_{10}	$PM_{2.5}$ speciation	$PM_{2.5}$ Carbon	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	
45-029-0002	Ashton					1							1		
45-007-0005	Big Creek					1									
45-079-0019	Bates House										1			1	
45-015-0002	Bushy Park					1									
45-079-0021	Congaree Bluff			1		1									
45-025-0001	Chesterfield					1	1		1	1		1	1		1
45-063-0010	Cayce City Hall													1	
45-077-0002	Clemson					1									
45-021-0002	Cowpens					1									
45-019-0046	Cape Romain			1	1	1							1		1
45-001-0001	Due West					1									
45-019-0048	FAA										1				
45-045-1003	Famoda Farms					1									

Complete the table below for each of the sites in your air monitoring network (active in the last three years) with the number of instruments measuring each pollutant (including NCore low level instruments – e.g. 1 low level CO + 1 regular CO = 2 CO instruments).

AQS ID	Common Site Name	Pb	CO	SO_2	NO_2	O_3	Manual				Collocated		Continuous		Meteorology
							$PM_{2.5}$	PM_{10}	$PM_{2.5}$ speciation	$PM_{2.5}$ Carbon	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	
45-045-0015	Greenville ESC	1	1	1	1		1		1	1			1	1	1
45-045-0016	Hillcrest					1					1				1
45-043-0011	Howard High #3													1	
45-063-0008	Irmo Rec Center			1			1						1		
45-003-0003	Jackson					1									
45-019-0003	Jenkins St.	1		1	1									1	
45-041-800X	Johnson Controls (3 sites)	7													
45-073-0001	Longcreek			1		1	1						1		
45-083-0009	N. Spartanburg Fire Station					1									
45-031-0003	Pee Dee					1									
45-079-0007	Parklane	1	1	1	1	1	1	1	1	1			1		1
45-019-0049	CPW						1						1		
45-079-1001	Sandhill				1	1	1								1
45-083-0011	T.K. Gregg						1						1		
45-037-0001	Trenton					1	1						1		

Complete the table below for each of the sites in your air monitoring network (active in the last three years) with the number of instruments measuring each pollutant (including NCore low level instruments – e.g. 1 low level CO + 1 regular CO = 2 CO instruments).

AQS ID	Common Site Name	Pb	CO	SO_2	NO_2	O_3	Manual				Collocated		Continuous		Meteorology
							$PM_{2.5}$	PM_{10}	$PM_{2.5}$ speciation	$PM_{2.5}$ Carbon	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	
45-077-0003	Wolf Creek					1									
45-041-0003	Williams M.S.						1						1		
45-091-0006	York			1		1									
Sites not currently operating															

Select which of the following are typically found at your Gaseous and PM sites		
Equipment/ Supplies	Gaseous	PM
Data Logger	X	
Calibrator		
Gas Blender		
Zero Air System		
Perm Tube Oven		
Paper Strip Chart		
Permanent Site Computer		
DSL Connection		
Cellular Modem Connection		
Modem	X	
Phone	X	
Meteorological Station		
Interior Temperature Probe	X	
Interior Min/Max Thermometer		
Air Conditioner / Heater	X	
Uninterrupted Power Supply or Backup Power	X	
Instrument Manuals		
Instrument Logbooks	X	X
Site Logbooks	X	X
SOPs		
Other:_____		
Other:_____		

Select which of the following are typical of your Probe System	
Tee'd Probe System	
Retractable Probe System	
Glass Manifold within Probe System	X
Heat Tape for Moisture Control	X

If none of the above is applicable, please describe your probe system.

-

How often do you clean / replace your probe lines?

- Every 6 months

What material are your probe lines made of?

- Teflon

What material are your inlet funnels made of (e.g. glass, Teflon, plastic)?

- Stainless steel

How often do you change the particulate filter on the back of the instrument?

- After every audit/bi-weekly

How often do you clean your glass manifold (if applicable)?

- 6 months

How do you connect your instrument to your data logger (analog, RS232, or Ethernet)?

- RS232

Question	Yes	No	Comments
What is the date of the most current Monitoring Network Plan?	2015 plan dated 6/30/2014 Approved 10/08/2014		
Is it available for public inspection?	X		http://www.scdhec.gov/HomeAnd Environment/Air/AmbientAir/

Has EPA granted waivers for any of your monitoring sites?

- Yes

Are you aware of any sites that are not currently meeting the requirements of 40 CFR Part 58 Appendix D & E?

- Yes

Question	Yes	No	Comment
Are hard copy site information files retained by the agency for all air monitoring stations within the network?	X		
Does each station have the required information including:			
1. AQS Site ID Number?	X		
2. Photographs/slides to the four cardinal compass points?	X		
3. Startup and shutdown dates?	X		
4. Documentation of instrumentation?	X		In Inventory
Who has custody of the current network documents?	Name: Scott Reynolds Title: Director, DAQA		
Does the current level of monitoring effort, station placement, instrumentation, etc., meet requirements imposed by current grant conditions?	X		
How often is the network siting reviewed?	Network reviewed annually		
Do any sites vary from the required frequency in 40 CFR 58.12?	X		Several site parameters are sampling at a higher frequency than required
Does the number of collocated monitoring stations meet the requirements of 40 CFR 58 Appendix A?	X		
Is each method for PM monitoring collocated with the same method type? (40 CFR 58 Appendix A Section 3.2.5.2 paragraph (a))	X		

b) Changes to the Network since the Last Audit

Please provide information on any site changes since the last audit:				
Pollutant	Site ID	Site Name	Site Added/Deleted/ Relocated	Reason (Assessment, lost lease, etc.) Provide documentation of reason for each site change

c) Proposed Changes to Network

Please provide information on proposed site changes, including documentation of the need for change and any required approvals:				
Pollutant	Site ID	Site Address	Site to be Added/Deleted/ Relocated	Reason (Assessment, lost lease, etc.) Provide documentation of reason for each site change
Proposed changes are included in the 2016 Network Monitoring plan or separate communication with Region 4 to amend the current Monitoring Plan.				

d) Field Support

Question	**Yes**	**No**	**Comments**
On average, how often are most of your stations visited by a field operator?	once per week		
Is this visit frequency consistent for all reporting organizations within your agency?			N/A – Our agency is the only reporting organization for S.C.

i) Instrument Inventory

Please list instruments in your inventory:			
Pollutant	Manufacturer	Models	Reference or Equivalent Method Number
SO_2	TEI, API	43A,B,C,S,i; 100A	EQSA-0486-060 EQSA-0495-100
NO_2	TEI , API, Ecotech	42, 42C; 200A, EC9841	RFNA-1289-074 RFNA-1194-099 RFNA-1292-090
CO	TEI, API	48; 300EU, T300U	RFCA-0981-054 RFCA-1093-093
O_3	TEI, API	49, 49C, 49i,; 400E	EQOA-0880-047 EQOA-0611-199
PM_{10}	Anderson		RFPS-1287-063
$PM_{2.5}$	R&P, TEI	2000, 2025, 2025i	RFPS-0498-118
Pb	Tisch	HiVol+	[EQL-0895-107]
Multi gas calibrator	TEI, Environics	146; 6103	NA
$PM_{2.5}$ speciation	Met one	SASS, Super SASS	NA
$PM_{10-2.5}$ speciation	NA	NA	NA
$PM_{10-2.5}$ FRM mass	R&P, TEI	2025 sampler pair	
Continuous $PM_{2.5}$ mass	TEI	1400, 1400A, AB, F, DF	EQPM-0609-181
Trace levels (CO)	API	300EU	NA
Trace levels (SO_2)	TEI	43,C,43i-TLE, 43S	NA
Trace levels (NO)			
Trace levels (NO_y)	TEI	42C- NOy	NA
Surface Meteorology			NA
Data Logger	ESC	8816, 8832	NA
Others			

ii) Calibration

Please indicate the frequency of multi point calibrations:		
Pollutant	Frequency	Name of Calibration Method
Ozone	Every 3 months, audit failure, maintenance performed or instrument moved.	Appendix AN
SO2	Every 3 months, audit failure, maintenance performed or instrument moved.	Appendix AM Appendix BB Appendix BY
CO	Every 3 months, audit failure, maintenance performed or instrument moved.	Appendix AJ Appendix AL
NO2	Every 3 months, audit failure, maintenance performed or instrument moved.	Appendix BN

Please list the authoritative standards used for each type of flow measurement, indicate the certification frequency of standards to maintain field material/device credibility:		
Flow Device	Primary Standard	Frequency of Certification
HiVol Orifice	Rootsmeter	Annually
Streamline	Sent back to Chinook Laboratory for recert/recal	Annually
Trical	Sent back to BGI for recert/recal	Annually
Bios	Sent back to Bios for recert/recal	Annually

Please list the authoritative standards and frequency of each type of dilution, permeation and ozone calibrator and indicate the certification frequency:		
Calibrator	Primary Standard	Frequency of Certification
Permeation Calibrator Flow Controller		
Permeation Calibrator Temperature		
Dilution Calibrator air and gas Flow Controllers	BIOS Defender 510-H & 510-L	Every 3 months
Field/Working Standard Photometer	EPA's Standard Reference Photometer (SESD, Athens GA)	Annually
Ozone Generator		

Please identify station standards for gaseous pollutants at representative air monitoring stations			
Parameter	Station(s)	Identification of Standard(s)	Recertification Date(s)
CO	N/A		
NO_2	N/A		
SO_2	N/A		
O_3	N/A		

If an instrument goes down, at what length of time would you <u>recalibrate</u> the instrument before bringing it back online (24 hours, 48 hours, etc.)?

- It depends on what causes the instrument to go "down". A pump failure is repaired then audited. If the audit passes, the instrument is brought back online. Typically, any other failure would require a recalibration before bringing it back online.

Question	Yes	No	Comments
Are field calibration procedures included in the document SOPs?	X		Location (site, lab, etc.):
Are calibrations performed in keeping with the guidance in section Vol II of the QA Handbook for Air Pollution Measurements Systems?	X		If no, why not?
Are calibration procedures consistent with the operational requirements of Appendices to 40 CFR 50 or to analyzer operation/instruction manuals?	X		If no, why not?
Have changes been made to calibration methods based on manufacturer's suggestions for a particular instrument?	X		
Do standard materials used for calibrations meet the requirements of appendices to 40 CFR 50 (EPA reference methods) and Appendix A to 40 CFR 58 (traceability of materials to NIST-SRMs or CRMs)?	X		
Where do field operations personnel obtain gaseous standards?	Current contract is with AirGas		
Are those standards certified by: 1. The agency laboratory?	X		Before acceptance, we check the accuracy of all gaseous standards when receiving them after purchase.
2. EPA/NERL standards laboratory?		X	
3. A lab separate from this agency's but part of the same reporting organization?		X	
4. The vendor?	X		
5. Other (describe)			
How are the gas standards verified after receipt?	We check the accuracy of all new gaseous standards by running a zero/span point and comparing them to a "known" gaseous standard.		
Are you involved in the EPA protocol gas certification program?	X		We have not had any certified because the EPA is not equipped to check trace level gases as of yet.
What equipment is used to perform calibrations (e.g., dilution devices) and how is the performance of this equipment verified?	MFC calibrators are checked/calibrated every 3 months.		
Does the documentation include expiration date of certification?	X		
1. Reference to primary standard used?	X		
2. What traceability is used?			Gaseous and MFC standards are NIST traceable.
Is calibration equipment maintained at each station?		X	
How is functional integrity of this equipment documented?	Documented using spreadsheets of calibration that are filed.		
Who has responsibility for maintaining field calibration standards?	S.C. DHEC Audit and Calibration Section staff		

iii) Repair

a) Who is responsible for performing preventative maintenance?
- Technical Support Staff

b) Is special training provided to them for performing preventative maintenance? Briefly comment on background or courses.
- On the job Training

c) Is this training routinely reinforced? If no, why not?
- yes

d) What is your preventative maintenance schedule for each type of field instrumentation?
- Per operations /service manual

e) If preventative maintenance is MINOR, it is performed at (check one or more):

_x__ Field Station
___ Headquarters Facilities
___ Equipment is sent to Manufacturer

f) If preventative maintenance is MAJOR, it is performed at (check one or more):

___ Field Station
__x_ Headquarters Facilities
___ Equipment is sent to Manufacturer

g) Does the agency have service contracts or agreements in place with instrument manufacturers? Indicate below which instrumentation is covered.
- No

h) Comment briefly on the adequacy of availability of the supply of spare parts, tools and manuals available to the field operator to perform any necessary maintenance activities. Do you feel that this is adequate to prevent any significant data loss?
- Each TS personnel has the tools necessary to perform maintenance. For small repairs, TS personnel have spare parts for equipment in their vans or tool box. For large scale repairs, spare parts are available at the Columbia facility. TS personnel have copies of all manuals available.
- Typically

i) Is the agency currently experiencing any recurring problem with equipment or manufacturer(s)? If so, please identify the equipment manufacturer, and comment on steps taken to remedy the problem.
Thermo Environmental TEOM 1405DF has never provided data of sufficient quality for all channels to be reported. Manufacturer said they are working on problem.

j) Have you ever lost any data due to repairs in the last 2 years?

- More than 24 hours? Yes
- More than 48 hours? Yes
- More than a week? Yes

k) Explain any situations where instrument down time was due to lack of preventative maintenance or unavailability of parts.

-

iv) Logbooks and Records

Question	Yes	No	Comments
What type of station logbooks are maintained at each monitoring station? (maintenance logs, calibration logs, personal logs, etc.)	There are instrument logs to document maintenance, audits, calibrations, etc. that are specific to a monitor. There are site logs to document maintenance, happenings, observances, etc. at the site		
What information is included in the station logbooks?	Boxes to indicate if book is a site or instrument logbook. Spaces for make/model of instrument, inventory decal number, parameter, site name, date/time, and description of work performed.		
Who reviews and verifies the logbooks for adequacy of station performance?	Data Management staff		
How often are logbooks reviewed?	Pages reviewed as necessary or when completed and returned to Data Management Section		
How is control of logbook maintained?	Uniquely numbered pages, copies stored with data		
Where is the completed logbook archived?	Data Section files		
What other records are retained?	Daily audit sheets		
1. Zero span record?			
2. Gas usage log?		X	
3. Maintenance log?	X		In site and instrument logbooks and in Yellowcard system
4. Log of precision checks?			
5. Control charts		X	We have not kept control charts up to date because they do not provide useful information. We understand the intent to provide an indicator of trends or approach to control limits and their usefulness when the same standards and systems are used consistently for QA audits, but our system using different standards systems and operators for each audit introduces to many variables to allow them to be useful.
6. A record of audits?	X		

Please describe the use and storage of these documents.			
Are calibration records, or at least calibration constants, available to field operators?	X		Everything is documented in the instrument logbooks.
Are logbooks backed up regularly to ensure against theft/vandalism?	X		Copies of completed pages are maintained by Data Management section

3) Data and Data Management

a) Data Handling

Question	Yes	No	Comments
Is there a procedure, description, or a chart which shows a complete data sequence from point of acquisition to point of submission of data to EPA?		X	
Please describe or provide a data flow diagram from collection to submittal of data. Please include detail regarding data review and validation.	Hourly data values are polled from the site data loggers via modems. These values are reviewed several times throughout the day. Quality assurance is performed on these values, and null codes are assigned when necessary. A month's worth of data are sent to AQS, usually within two weeks after the month has passed (when an audit is available for verification through the end of the month). A raw data report is then run for that month's data, and the values on the report are compared to those on the monthly report generated from AirVision,		
Are procedures for data handling (e.g. data reduction, review, etc.) documented?	X		SOP in revision process
In what media (e.g., diskette, data cartridge, or telemetry) and formats do data arrive at the data processing location? Please list below:			
Category of Data (by Pollutant)	Data Media and Formats		
Gaseous and Continuous PM	DAS Polling		
Particulate $PM_{2.5}$	Chain of Custody , Download by PDA or Phone		
Particulate (High Volume)	Filter Cover/Chain of Custody, SD card-(Hivol+)		
How often are data received at the processing location from the field sites and laboratory?	Daily		
Is there documentation accompanying the data regarding any media changes, transcription, or flags which have been placed into the data before data are released to agency internal data processing?			NA- only raw data recovered
- Describe the type of documentation			

How is data actually entered into the computer system (e.g. computerized transcription (copy from disk or data transfer device), manual entry, digitization of strip charts, or other)?	Continuous data acquired direct from poll of site data systems through data management system		
For manual data, is a double-key entry system used (e.g., a second pair of eyes double checking for transcription errors)?		X	Data checked - not double entry

b) Software Documentation

Question	Yes	No	Comments
Does your agency submit data directly to AQS?	X		
Does your agency participate in AirNow?	X		
How does your agency process P/A data?	AQS		
Does the agency have information on the reporting of precision and accuracy data available?	X		Through AQS
What software is used to prepare air monitoring data for release into the AQS and AirNow database? Please list the documentation for the software currently in use for data processing, including the names of the software packages, vendor or author, revision numbers, and the revision dates of the software.	Agilaire AirVision 2.13.25 (build 2014.10.31.2)		
What is the recovery capability in the event of a significant computer problem (i.e. how much time and data would be lost)?	Multiple redundancies, both at site and within data management system. Unlikely any data would be lost.. Time to recovery would depend on the mode and scope of the failure.		
Has your agency tested the data processing software to ensure its performance of the intended function is consistent with the QA Handbook, Volume II, and Section 14.0?		X	
Does your agency document software tests?		X	If yes, provide the documentation

c) Data Validation and Correction

Question	Yes	No	Comments
Has your agency established and documented the validation criteria?	X		Validation template in QAPP
Does documentation exist on the identification and applicability of flags (i.e., identification of suspect values) within the data as recorded with the data in the computer files?	X		Where possible or in supporting data
Does your agency document the data validation criteria including limits for values such as flow rates, calibration results, or range tests for ambient measurements?	X		
1. If yes, please describe what action the data validator will take if he/she find data with limits exceeded (e.g., flags, modifies, deletes, etc.)	When limits are exceeded (Main flow being too low, for example), data are assigned a null code (AH in this case).		
2. If yes, give examples to illustrate actions taken when limits are exceeded.	One example would be a PM10C monitor whose Main flow should be 2.0 but instead reads 1.75. Data points with these flows are assigned a null code of AH (Sample flow rate out of limits).		
How does the agency track missing data?	AQS		
Please describe how changes made to data that were submitted to AQS and AirNow are documented.	Not currently documenting such changes		
Who has signature authority for approving corrections?	Name: Craig Burchell Program Function: Data Management Section		
What criteria are used to determine a data point should be deleted? Discuss briefly	Data demonstrated to be void due to system or component not operating (operated) consistent with SOP		
What criteria are used to determine if data need to be reprocessed? Discuss briefly	If an instrument audit fails by more than the allowable amount, and the preceding data have already been sent to AQS, new data records that include null codes are created and sent to AQS to replace the current records.		
Are corrected data resubmitted to the issuing group for cross-checking prior to release?			NA

d) Data Processing

Question	Yes	No	Comments
Does the agency generate data summary reports?	X		
Please list at least three reports routinely generated, including the information requested below.			
Report Title	Distribution		Period Covered
Daily Summary Report	In-house		One day
Monthly Report	In-house		One month

Question	Yes	No	Comment
How often are data submitted to AQS and AirNow?	Several times a week – as soon as data has been verified		
Briefly comment on difficulties the agency may have encountered in coding and submitting data following the guidance of AQS guidelines			
Does the agency routinely request a hard copy printout on submitted data from AQS?		X	As needed for review
Are records kept for at least 3 years by the agency in an orderly, accessible form?	X		
If yes, does this include: 1. Raw Data?	X		
2. Calculation?	X		
3. QC Data?	X		
4. Reports?	X		
If no, please comment			
Has your agency submitted data along with the appropriate calibration equations used to the processing center?			NA
Are PM_{10} concentrations corrected to EPA standard temperature and pressure conditions (i.e. 298˚K, 760 mm Hg) before input to AQS?	X		
Are $PM_{2.5}$ and Lead concentrations reported to AQS under actual (volumetric) conditions?	X		
Are audits on data reduction procedure performed on a routine basis?		X	As needed, probably once every 2 years.
Are data precision and accuracy checked each time they are calculated, recorded, or transcribed to ensure incorrect values are not submitted to EPA?	X		

e) Internal Reporting

What internal reports are prepared and submitted as a result of the audits required under 40 CFR 58, Appendix A?	
Report Title	Frequency

What internal reports are prepared and submitted as a result of precision checks also required under 40 CFR 58, Appendix A?	
Report Title	Frequency

Question	**Yes**	**No**	**Comments**
Do either the audit or precision check reports indicated include a discussion of corrective actions initiated based on audit or precision check results?			

Who has the responsibility for the calculation and preparation of data summaries? To whom are such summaries delivered?			
Name	Title	Type of Report	Recipient

f) External Reporting

For the past 3 calendar years, please list all quarters that data were submitted beyond the 90 day requirement:

-

Identify the individual within the agency with the responsibility for reviewing and submitting the data to AQS.

- Data Management Section staff - Craig Burchell, Rick Patterson

Question	Yes	No	Comments
Does your agency report the Air Quality Index?	X		Through AirNow
Has your agency submitted its annual data summary report (as required in 40 CFR 58.26)?		X	With certification package 40 CFR 58.15(b)
If yes, did your agency's annual report include the following:			
1. Annual precision and accuracy information described in Section 4 of Appendix A?	X		With certification package 40 CFR 58.15(c)
2. Location, date, pollution source and duration of all episodes reaching the significant harm levels?		X	No events
Is Data Certification signed by a senior officer of your agency?		X	Designee is Director , Division of Air Quality Analysis

4) Laboratory Operations

a) Routine Operations

What analytical methods are employed in support of your air monitoring network? Add other pollutants not listed to the table.		
Pollutant	Analysis	Name or Description of Method
PM_{10}	Gravimetric	Appendix AX
$PM_{2.5}$	Gravimetric	Appendix AV.1
Pb	Graphite Furnace Atomic Absorption	Appendix Q.5
$PM_{10-2.5}$	Gravimetric	Appendix AV.1
TSP	Gravimetric	Appendix AX
Carbonyls	HPLC/UV Vis	Appendix AR.2
VOCs	GC/MS	Appendix AP
PAHs	GC/MS	Appendix AI.2

Please describe areas where there have been difficulties meeting the regulatory requirements for any of the above analytical methods.

-

Please identify the current versions of written methods, supplements, and guidelines that are used in your agency. Add other pollutants not listed to the table. **See list of SOPs**	
Analysis	Documentation of Method
PM_{10}	Appendix AX, Rev. 0.1, 2012
$PM_{2.5}$	Appendix AV.1, Rev. 1.1, 2013
Pb	Appendix Q.5, Rev. 0, 2013
$PM_{10-2.5}$	Appendix AV.1, Rev. 1.1, 2013
TSP	Appendix AX, Rev. 0.1, 2012
Carbonyls	Appendix AR.2, Rev. 2, 2008
VOCs	Appendix AP, Rev. 1.1, 2005
PAHs	Appendix AI.2, Rev. 1, 2007

Question	Yes	No	Comments
Were procedures for the methods listed above included in the agency's QA Project Plan or SOPs and reviewed by EPA?	X		Provided for review when complete
Are the SOPs easily/readily accessible for use and reference?	X		
Does your lab have sufficient instrumentation to conduct analyses?	X		

Please describe needs for laboratory instrumentation

b) Laboratory Quality Control

Please identify laboratory standards used in support of the air monitoring program, including standards which may be kept in an analytical laboratory and standards which may be kept in a field support area or quality assurance laboratory that is dedicated to the air monitoring program (attach additional sheets if appropriate):

Parameter	Type	ID / Serial Number	Last Recertification Date
Weights	Class U NVLAP Traceable	83854 1000032531 1000032532 1000032533	11/10/2014
Temperature			
Relative Humidity			
Barometric Pressure			
Balance	Microbalance Solutions Balance	27901413 41108075	05/08/2015 05/08/2015
Other			

****Please have certifications of standards available for viewing during the audit**

Question	Yes	No	Comments
Are all chemicals and solutions clearly marked with an indication of shelf life?	X		
Are chemicals removed and properly disposed of when shelf life expires?	X		
Are only ACS grade chemicals used by the laboratory?	X		AQS grade or better

Comment on the traceability of chemicals used in the preparation of calibration standards.

- All chemicals used to prepare calibration standards are NIST traceable with certificate provided by the manufacturer.

Question	Yes	No	Comment
Does the laboratory purchase standard solutions such as those for use with lead or other metals analysis?	X		
Are all calibration procedures documented?	X		Title: Revision Number: Document Location:
Are at least one duplicate, on blank, and one standard or spike included with a given analytical batch?	X		
Briefly describe the laboratory's use of data derived from blank analyses:	Blank data for gravimetric analyses is used to determine the cleanliness of the balance room and stability of conditioning environment. Metals blank data is used to correct final concentration data for background contamination. VOC blank data is used to determine the cleanliness of the analytical system. PAH blank data is used to determine the cleanliness of the laboratory media handling and extraction glassware as well as the cleanliness of the analytical system. Carbonyl blank data is used to determine the suitability of the sampling media prior to use and an average blank concentration for each paramenter is subtracted from sample results.		
Are criteria established to determine whether blank data is acceptable?	X		

How frequently and at what concentration ranges does the lab perform duplicate analysis? What constitutes an acceptable agreement?

- Gravimetric analyses include at least 10% reweighs and Pb analysis includes 10% replicate analyses and at least 1 filter recut per extraction batch.
- $PM_{2.5}$ duplicate weighings must agree within ± 15 micrograms, PM_{10} initial weight replicate analyses must agree within ± 10 milligrams while final weight duplicate weighings must agree within ± 20 milligrams, and Pb duplicate analyses must agree within ± 20%.

Please describe how the lab uses data obtained from spiked samples, including the acceptance criteria (e.g., acceptable percent recovery).

- Spike recoveries are used primarily to determine any sample matrix interferences that may result in erroneous data. That data would then be flagged if the interferences can not be reduced. Spike recovery should be within ± 20% of actual.

Question	Yes	No	Comments
Does the laboratory routinely include samples of reference material within an analytical batch?		X	
If yes, indicate frequency, level, & material Used			
Are mid-range standards included in analytical batches?		X	Standards are included in analytical batches but the concentration is dependent on the parameter and the normal or expected concentrations of the analytes in routine samples.
Please describe the frequency, level, and compound used in the comments section.			
Are criteria for real time quality control established that are based on results obtained for the mid-range standards discussed above?		X	
If yes, briefly discuss them in the comments section or indicate the documentation in which they can be found:			
Are appropriate acceptance criteria for each type of analysis documented?	X		

c) Laboratory Preventative Maintenance

Question	Yes	No	Comments
For laboratory equipment, who has the responsibility for performing preventative maintenance?	Primary analysts are responsible for simple routine maintenance but all primary analytical equipment is covered by a service contract that always includes at least one preventative maintenance visit by the contractor.		
Is most maintenance performed in the lab?	X		
Is a maintenance log maintained for each major laboratory instrument?	X		
Are service contracts in place for major analytical instruments?	X		

d) Laboratory Record Keeping

Question	Yes	No	Comments
Are all samples that are received by the laboratory logged in?	X		
If appropriate, is sample shipping temperature recorded upon arrival?	X		
Discuss sample routing and special needs for analysis (or attach a copy of the latest SOP which covers this). Attach a flow chart if possible.	Laboratory samples are received from site operators through a statewide courier or hand delivered to the laboratory. Laboratory personnel then assign each sample a unique log number. PAH, VOC and carbonyl samples are received by Organic team personnel who are responsible for logging in the samples. Filters are received and logged in by the primary $PM_{2.5}$ analysts or high volume filter analyst.		
Are log books kept for all analytical laboratory instruments?	X		
Are there log books or other records that indicate the checks made on materials and instruments such as weights, humidity indicators, balances, and thermometers?	X		
Are log books maintained to track the preparation of filters for the field?		X	All filter preparations are documented either in the weighing worksheet or on chain of custody cards that accompany high volume filters.
1. Are they current?	X		
2. Do they indicate proper use of conditioning?	X		
3. Weighings?	X		
4. Stamping and numbering?			Filters pre-numbered
Are log books kept which track filters returning from the field for analysis?		X	
How are date records from the laboratory archived?	One time writeable CD or DVD depending on amount of data and available technology		
1. Where?	In the Laboratory		
2. Who has the responsibility? Title?	Robert Schilling, Laboratory Manager		
3. How long are records kept?	Indefinitely		
Does a chain-of-custody procedure exist for laboratory samples?		X	Title & Date: Parameter specific Revision Number: Location:

e) Laboratory Data Acquisition and Handling

Question	Yes	No	Comments
Identify those laboratory instruments which make use of computer interfaces directly to record data. Which ones use strip charts? Integrators?	Sartorius Microbalance, Sartorius Solutions balance, HPLC, GC/MS, GFAA		
Are QC data readily available to the analyst during a given analytical run?	X		
What is the laboratory's capability with regard to data recovery? In case of problems, can they recapture data or are they dependent on computer operations? Discuss briefly.	All computerized data is maintained on a network server that is backed up nightly and files can be recovered for the previous days data by request to the network administrator		
Has a user's manual been prepared for the automated data acquisition instrumentation?		X	

Please provide below a data flow diagram which establishes, by a short summary flow chart: transcriptions, validations, and reporting format changes the data goes through before being released by the laboratory.

Data management and flow is parameter or Analysis specific.

f) Specific Pollutants: Particulate Matter

High Vol PM_{10}			
Question	**Yes**	**No**	**Comments**
Does the agency use filters supplied by EPA?	X		
Do filters meet the specifications in 40 CFR 50?	X		
Are filters visually inspected for defects before exposure?	X		
Where does the laboratory keep records of the serial numbers of filters?	Filter Serial numbers are recorded on the initial weighing page of the electronic spreadsheet during weighing operations. Filters used as blanks for metals analyses are recorded with the metal batch sheet.		
Are the temperature and humidity monitors calibrated?	X		
Are balances checked with Class S or Class M weights each day when they are used?	X		
To what sensitivity are filter weights recorded?	0.0001g		
What method of documentation is used to record filter weighing sessions? (e.g., logbook, computer software, etc.)	Computer spreadsheet (MS EXCEL). Additionally filter weights are recorded on the chain of custody card that accompanies the filters from initial weighing to final archive.		
During conditioning, are the following true:			
(1) Filters equilibrate for a minimum of 24 hours	X		
(2) The temperature range is from 15˚C-30˚C	X		
(3) Temperature control is ±3˚C SD over 24 hrs	X		
(4) Humidity range is 20% - 45% RH	X		
(5) Humidity control is ± 5% SD over 24 hrs	X		
(6) Pre/post sampling RH difference in 24-hr means is ≤± 5% RH		X	
(7) Balance is located in the conditioning environment	X		
Are filters packaged for protection while transporting to and from the monitoring stations?	X		
Are filters shipped at ambient temperature to the monitoring stations?	X		
Are filters shipped at ambient temperature from the field to the laboratory?	X		
Are exposed filters reconditioned for at least 24 hrs in the same conditioning environment as for unexposed filters?	X		
Briefly describe how exposed filters are prepared for conditioning	Exposed filters are removed from the sampling card that the filters were shipped in, inspected for tears and other abnormalities that may have occurred during sampling, and placed in wire racks in the filter conditioning room for at least 24 hours		

Briefly describe how exposed filters are stored after being weighed	Filters are returned to the sampling/chain of custody card that has accompanied the filter since initial weighing, then stored indefinitely in a file cabinet arranged by year then by site within that year.		
Are blank filters reweighed?		X	
Are chemical analyses performed on filters?	X		
If yes, what analysis is performed?	Metals (Arsenic, Beryllium, Cadmium, Cobalt, Chromium, Manganese, Nickel, Lead, Antimony, Selenium		
$PM_{10-2.5}$ / Low Vol PM_{10} / $PM_{2.5}$			
Question	**Yes**	**No**	**Comments**
Does the agency use filters supplied by EPA?	X		
Do filters meet the specifications in 40 CFR 50?	X		
Are filters visually inspected via strong light from a view box for defects before exposure?	X		
Where does the laboratory keep records of the serial numbers of filters?	Serial numbers are recorded on the "Initial Weighing" page of the electronic spreadsheet used for handling data.		
Are temperature and humidity monitors calibrated?	X		
Are balances checked with Class 1 weights each day when they are used?	X		
To what sensitivity are filter weights recorded?	.0001mg		
What method of documentation is used to record filter weighing sessions? (e.g., logbook, computer software, etc.)	Computer Software – EXCEL Spreadsheet		
During conditioning, are the following true:			
(1) Filters equilibrate for a minimum of 24 hours	X		
(2) The temperature range is 20˚C-23˚C for the 24-hr mean	X		
(3) Temperature control is ±2˚C SD over 24 hrs	X		
(4) Humidity range is 30%-40% RH for 24-hr mean OR ≤5% sampling RH but >20% RH	X		
(5) Humidity control is ± 5% SD over 24 hrs	X		
(6) Pre/post sampling RH difference in 24-hr means is ≤± 5% RH	X		
(7) Balance is located in the conditioning environment	X		
Are filters packaged for protection while transporting to and from the monitoring stations?	X		
Are filters shipped at ambient temperature to the monitoring stations?	X		
Are filters shipped at ≤ 4˚C from the field to the laboratory?	X		Ideally all filters are returned at ≤4ºC, but occasionally the filters return at slightly higher temperatures
Are filters post-weighed in ≤30 days?	X		

Are filters post-weighed in ≤10 days if they arrive >4˚C?	X		
Are exposed filters reconditioned for at least 24 hrs in the same conditioning environment as for unexposed filters?	X		
Briefly describe how exposed filters are prepared for conditioning	Exposed filters are removed from the cassette used during sampling and transferred to a pre-labeled petri-dish with the top partially covering the filter. The filters are placed on a tray with all other filters received on the same date and left in the conditioning room for at least 24 hours		
Briefly describe how exposed filters are stored after being weighed	Filters are stored in the same Petri-dish that has accompanied the filter from initial weighing to final weighing. The petri-dish is capped and filters are stored in a freezer for one year by sampling site.		
Are blank filters reweighed?	X		
Are chemical analyses performed on filters?		X	
If yes, what analysis is performed?			

Lead			
Question	**Yes**	**No**	**Comments**
Does the agency use filters supplied by EPA?	X		
Is analysis for lead being conducted using atomic absorption spectrometry with air acetylene flame?		X	Flame Atomic absorption spectrometry can no longer meet the required minimum method detection limit
If not, has the agency received an equivalency designation for their procedure?		X	Using an already approved FEM for graphite furnace atomic absorption spectrometry.(EQL-0380-044)
Is either the hot acid or ultrasonic extraction procedure being followed precisely?	X		Which? Ultrasonic
Is Class A borosilicate glassware used throughout the analysis?	X		
Is all glassware cleaned with detergent, soaked and rinsed three times with distilled or deionized water?	X		
If extracted samples are stored, are linear polyethylene bottles used?	X		
Are all batches of glass fiber filters tested for background lead content?	X		
At a rate of 20 to 30 random filters per batch of 500 or greater?	X		Indicate Rate – 5 blank filters per box of 65.
Are ACS reagent grand HNO_3 and HCl used in the analysis?	X		Ultra pure acids are used in the analysis for Pb and other metals
Is a calibration curve available having concentrations that cover the linear absorption range of the atomic absorption instrumentation?	X		
Is the stability of the calibration curve checked by alternately re-measuring every 10^{th} sample a concentration # 1Φg Pb/ml; # 10 Φg Pb/ml?	X		

US EPA REGION 4
SESD
Air Toxics Laboratory
Technical Systems Audit Form

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Technical System Audits (TSAs) and Instrument Performance Audits (IPAs) for the National Air Toxics Trends Stations (NATTS)

Analysis Laboratory
Technical Systems Audit Form

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Part 1. General Information

Laboratory Information

NAME AND ADDRESS OF AGENCY

South Carolina Department of Health and Environmental Control

2600 Bull Street, Columbia, South Carolina, 29201

NAME AND ADDRESS OF **PRIMARY** (State or Local Agency) ANALYSIS LABORATORY
(List analysis methods associated with each laboratory: VOC, SVOCs, Carbonyl, Cr6+, PM10 Metals):

South Carolina Department of Health and Environmental Control – Division of Air Quality Analysis

8231 Parklane Road, Columbia, SC 29223

VOC, SVOC, Carbonyl

NAME AND ADDRESS OF **CONTRACT** ANALYSIS LABORATORY
(List analysis methods associated with each laboratory: VOC, SVOCs, Carbonyl, Cr6+, PM10 Metals):

South Carolina Department of Health and Environmental Control – Bureau of Laboratories, PM10 Metals

8231 Parklane Road, Columbia, SC 29223

ON-SITE AUDIT TEAM MEMBERS/ AFFILIATIONS:

_____

_____

ON- SITE AUDIT DATE: _____

PERSONNEL INTERVIEWED:

NAME	POSITION	PHONE/E-MAIL

Part 2: Basic QA/QC

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. QAPP and SOPs				
1. Is there an approved quality assurance project plan (QAPP) for the laboratory?	√			
2. Has it been reviewed by all appropriate personnel?	√			
3. Has the EPA reviewed the QAPP?	√			
4. Has EPA signed the QAPP?	√			Most recent revision sent to EPA on 6/16/09
5. Is a copy of the approved QAPP available for review by the laboratory staff? If not, briefly describe how and where QA and QC requirements and procedures are documented.	√			
6. Is a signed copy of the QAPP onsite?	√			
7. Is it available to the laboratory staff?	√			
8. Are there amendments or deviations from the QAPP?		√		
9. Have they been documented or approved?			√	
10. Are they available for review?			√	
11. Has the QAPP been reviewed or will be reviewed on a periodic basis?	√			
12. Is this or will it be documented? (Ask to see).	√			
13. Is there a corrective action process in place when DQOs (e.g., out-of-control calibration data) are not met?	√			
14. Are written and approved standard operating procedures (SOPs) in place for the analytical methods?	√			
15. Are the SOPs signed?	√			
16. Are the SOPs available for review?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
17. Are the SOPs controlled documents?	√			
18. Are signed copies of the SOPs available to the laboratory staff?	√			
19. Are there deviations from the SOPs?		√		
20. If yes to Question 19, have these deviations been documented or approved?				
21. If the deviations affect this project, are they available for review?				
22. Has training been conducted for these SOPs?	√			
23. Is this training documented?	√			
24. Are the SOPs current and up to date to requirements and procedures?		√		Several SOP's are currently being reviewed and updated. Canister VOC and PUF SVOC
25. Have the SOPs been reviewed on a periodic basis?	√			
26. Is this review documented? (Ask to see).	√			

Additional Comments:

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
B. Organization and Responsibilities				
1. Is there a Quality Management Plan (QMP), or analogous document, in place?	√			
2. Is it up-to-date?	√			
3. Is it available for review?	√			
4. Is there an organizational chart available?	√			
5. Is the QMP, or analogous document, available to staff?	√			
6. Are administrative policies complete, clear, and well-documented?				
7. Is there a Project Manager? Who? If not, who is responsible for the overall conduct of the project?	√			Name: Robert Schilling
8. Is there someone responsible for maintaining contact with the field monitoring site? If so, who?	√			Name: Robert Schilling
9. Is there someone who receives samples from the field monitoring site? Who?		√		All laboratory personnel are allowed to receive samples from the field.
10. Are all analysts equally qualified to perform sample analyses?	√			Number of analysts: 3
11. Is there someone authorized to halt the project in the event of inadequate quality, or health or safety hazards? If not, why?	√			Name: Robert Schilling
12. Is there someone who reviews all laboratory notebooks/forms and analytical data? Who?	√			Name: Robert Schilling

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
1. Is there a Quality Assurance Manager? If not, who is responsible for quality on the project and are they independent of project management?				Name: _____
2. Has training on the elements of quality assurance/quality control been done? If so, who by?				Name: _____
3. Is this training documented?				
4. Is anyone responsible for quality audits of the analytical work? If so, who?				Name: _____
5. Has an audit(s) been performed? If so, when?				Date: _____
6. Are audits documented? If available, ask to view audits from this project.				
7. Are audit reports distributed to staff for review?				
8. Are there corrective action/follow-up procedures? If so, briefly describe?				
9. Are they completed in a timely manner?				
10. Have there been previous external audits performed on the method(s) used for this project?	√			
11. Can we briefly review their results?	√			
12. Are all QC data reviewed by Quality Assurance?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
13. Are their findings documented? If available, ask to see.				
Additional Questions or Comments:				
D. Training				
1. Is a formal training program for laboratory staff in place?	√			
2. Is it fully implemented?	√			
3. Is there an SOP for training and certification of staff? If not, how is it documented?		√		
4. Is there an initial training program for new staff covering health, safety, quality assurance, and analytical or other job-related responsibilities?	√			
5. Is training documented? Who documents? How?	√			Name: Brian Gootee – Health and Safety Training, Trainer for QA, and analytical procedures, Lab manager for general laboratory operations How: DHEC e-Learning System, Personal Training Records
6. Are job descriptions available for staff?	√			
7. Is it documented that staff members meet the minimum qualifications for their job description? How?	√			How: Personnel files, Personal Training Documentation
8. Is there a process of training, testing, and validation for job responsibilities?		√		
9. Are analysts and other staff adequately trained to use appropriate equipment, software and computer systems?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
10. Do analysts have to undergo proficiency training before they are allowed to analyze samples?	√			
11. If so, is this documented?		√		
12. Are training records for all pertinent staff complete, up-to-date, and available for review?	√			
Additional Questions or Comments:				
E. Safety				
1. Are Material Safety Data Sheets (MSDS) available and easily accessible for chemicals used on this project? Ask to see where they are stored.	√			
2. Is there a safety training program? If so, what is done, on what schedule, and how is it documented?	√			Initial training performed by Building Safety Officer. Annual updates are self-paced courses and all training is documented in the DHEC eLearning System
3. Are safety training records maintained? If so, are they up-to-date, complete, and easily accessible? Ask to see.	√			
4. Is the safety training up-to-date for laboratory staff working on this project?	√			
5. Are laboratory staff wearing the appropriate personal protective equipment (PPE), such as laboratory coats, safety glasses with side shields, and gloves? If not, why?				
6. Is there evidence that staff have been eating, smoking, or drinking in the laboratory areas?				
7. Is appropriate safety equipment available to staff (i.e., fire extinguishers, safety showers, etc.)?				
8. Are they in place and clearly marked?				
9. Have they been checked at recommended or required frequencies?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
10. Are acids and bases stored in separate cabinets?				
11. Are any chemicals being stored next to other chemicals that could create toxic fumes or cause an explosion?				
Additional Questions or Comments:				
F. Document Control and Records				
1. Is there a document control program?	√			
2. Are the following necessary documents for this project in the controlled document program:				
a. QAPP?	√			
b. SOPs?	√			
3. Have the following necessary quality documents for this project been reviewed, approved and signed by Quality Assurance:				
a. QAPP?	√			
b. SOPs?	√			
4. Is distribution of the project documents controlled to prevent unauthorized copies from being made/distributed? If so, how?		√		Describe: _____ _____
5. Are outdated controlled documents collected and disposed of?	√			
6. Is this documented?		√		
7. Are procedures in place if out-of-date documents are found? If so, briefly describe.	√			If process is still being performed, an immediate review is performed with appropriate revisions made. If process no longer is use, documents archived according to schedule

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
8. Are all laboratory notebooks/forms being filled out promptly, legibly, and clearly?				
9. Are all entries being made in indelible ink (preferably a dark color)?				
10. Are corrections to hardcopy data being made with a single line through the entry so as not to obliterate the original entry, initials of the corrector, and date of the correction?				
11. Has a review of the laboratory notebooks/forms and analytical data been performed?	√			
12. Have any problems/deviations occurred? How are they handled?				
13. How are laboratory notebooks/forms and analytical data stored? What is their retention time?				Lab notebooks are stored in the Lab Manager's Office or with the Instrument. Analytical data hardcopies are filed by the primary analyst. Analytical electronic data is transferred to CD and stored. Storage time: Lab notebooks – indefinitely Analytical Hardcopies – 10 years Analytical Electronic Data - Indefinitely

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
G. Facilities, Equipment, Software				
1. Is access to the facility limited and controlled?	√			
2. Is the facility generally well maintained, clean and in order?				
3. Are facility accommodations (bench space, fume hoods, ventilation, etc.) appropriate for the performance of the test procedures?				
4. Are SOP manuals available?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
5. Are flows through the fume hoods monitored and documented?	√			
6. Are gas cylinders properly secured?				
7. Are refrigerators and freezers for sample storage monitored regularly? What is/are the temperature(s)?		√		Temperature: _____ _____
8. Are chemicals stored properly and clearly designated?				
9. Are all reagents and standards used traceable?	√			
10. Are Certificates of Analysis (COA) available? (If possible) ask to review.	√			
11. Are pipettes and balances calibrated? If so, at what frequency?				Balances calibrated bi-annually Pipettes are not calibrated
12. Are there corrective action procedures if they don't pass? Briefly describe	√			Balances recalibrated by balance maintenance contractor
13. Is Class A glassware used?	√			
14. Is it certified?				
15. Has all computer software been installed in accordance with manufacturer's recommendations? If not, why?	√			
16. Is there an automated data collection system for the analytical instrument(s)? If so, briefly describe.		√		
If Yes above, continue to next 5 questions. If no, continue to Question 22.				
17. Is there a training program for use of the automated data collection system? Is so, briefly describe.				
18. Is there an individual responsible for the automated data collection system? If so, who?				Name: _____
19. Is there a system to back up information from the automated data collection system? At what interval?				Frequency: _____
20. Is data routinely reviewed from the automated data collection system?				
21. Is maintenance testing done on the automated data collection system?				
Continue to Question 25 below.				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
22. If no automated data system is used, what is used to collect analytical data?				System: GC/MS Systems – Agilent Data System and Software HPLC System – Hitachi Data System and Software Balance Data – Internal Network
23. Is maintenance testing done on the software?	√			
24. If so, is it documented?	√			
25. Are data backed up/removed from the analytical instrument(s) on a regular basis? If so, at what interval?		√		Frequency: _____
26. Is there one person responsible for data back-up/removal? If so, who? If not, how many and who?		√		Name: _____
27. Is the back-up/removed data stored in a secure location? Who has access?		√		Name: _____
28. Are procedures in place if software needs to be updated?		√		
29. Is it documented and by who?				Name: _____
Additional Questions or Comments:				

Part 3: VOC/Canister Analysis

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. Canister Cleaning Equipment				
1. Is your canister cleaning system a commercially available unit?	√			If yes, then identify manufacturer. Entech Instruments
2. Is your vacuum system capable of evacuating canisters to 0.5 mm Hg? (0.5 mm Hg = 66 Pa = 6.6 x 10^{-4} atm)	√			If yes, then identify pump. ALCATEL 5011CP Molecular Drag Pump
3. Does your canister cleaning system include a source of humidified air?	√			
4. Is the air humidified by passing through a container containing high quality water?	√			
5. Is the air humidified by passing through a Perma-Pure humidifier?		√		
6. Is a shop/laboratory oil-free air compressor used to supply the source of air for the cleaning operation?		√		Ultra High Purity Nitrogen Cylinder from PraxAir
7. Does the shop/laboratory air undergo further cleanup treatment?			√	
8. Is an ultra-high purity cylinder used as the source clean air?	√			
9. If no to questions 6 & 8, indicate other source of zero purge gas.			√	
10. Is a cryogenic trap used to keep pump contaminants from back-streaming into the canisters?		√		
11. Is a molecular sieve trap used to keep pump contaminants from back-streaming into the canisters?		√		
12. Is another type of adsorbent trap used to keep pump contaminants from back-streaming into the canisters?		√		If yes, then please identify._____
13. Are sorbent traps replaced regularly?			√	Frequency: _____
14. Is the pump used to evacuate canisters oil-free (e.g., a turbomolecular pump)?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
B. Canister Cleanliness				
1. There are two methods used to assess canister cleanliness. Do you use the EPA TO-12 method?		√		
2. There are two methods used to assess canister cleanliness. Do you use the EPA TO-15 method?	√			
3. Do you check the cleanliness of one canister per each batch of cleaned canisters?		√		If no, then what is the frequency of checking cleanliness of cans? Every canister is checked
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE Y	N	NA	COMMENTS
C. Canister Sampler Cleanliness				
1. Has the canister sampler been subjected to a laboratory zero certification test?	√			
2. For the certification test, was humidified zero air used?		√		Humidified UHP Nitrogen
3. For the certification test, was a 24 h samples collected?		√		
4. Is the frequency of this test at least once per year?		√		If no, indicate frequency: Before deployment and after any sampler maintenace
Additional Questions or Comments:				
D. Canister Analysis Procedures				
1. Are the canister samples received in the laboratory at sub-atmospheric pressure?		√		
2. Is the pressure verified before filling/analysis?	√			
3. Do you fill the canister with a zero grade air? Indicate pressure to which canisters are pressurized.		√		What kind of air is used? _____ Final pressure: _____
4. Is a certified/calibrated gauge used in this filling operation?			√	
5. Is the zero grade air analyzed for contamination?		√		UHP Nitrogen is checked
6. Are you using an automated preconcentrator and autosampler?	√			Manufacturer: Entech Model # 7100

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
7. Are you using a gas chromatograph with a mass spectrometer for analyses?	√			Manufacturer: Agilent Model 6890/5973
8. If no to question 7, indicate type of detection system employed.			√	
9. Is the mass spectrometer operated in the scan mode of operation?	√			What sample volume is normally analyzed? 400 mL
10. Is the mass spectrometer operated in the selected ion monitoring mode of operation?		√		What sample volume is normally analyzed? _____
11. Is 4-bromofluorobenzene (BFB) tuning compound used daily to tune the mass spectrometer?		√		BFB used daily to verify instrument tune.
12. If no to question 11, are you using perfluoro tertiarybutyl amine (PFTBA)?	√			
13. Is a DB-1 60 meter by 0.32 mm (1-micrometer film thickness) column or equivalent used for separation?	√			
14. Are gas calibration standards purchased commercially?	√			
15. Are liquid calibration standards purchased commercially?			√	
16. Are calibration mixtures certified? Ask to inspect CoAs.	√			
17. Are calibration mixtures diluted in a dynamic fashion using electronic flow controllers/meters?	√			
18. Are the flow controllers/meters recalibrated or recertified annually?		√		
19. Are the calibration mixtures diluted in a static fashion, i.e., with syringes, pressure, etc?		√		
20. Is humidified zero grade air used in these dilution processes?	√			
21. Do you use a second source calibration standard to reference to your primary calibration mixture?	√			
22. Do you use gaseous internal standards during each analytical run?	√			
23. Are multi-point calibration curves (at least 5 points) generated at least on a quarterly basis?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
24. When doing the multi-point calibration, is the RSD of the response factors ≤30% for each analyte?	√			
25. When doing the multi-point calibration, is the relative retention time (RRT) for the target peaks ±0.06 RRT units from the mean RRT?	√			
26a. At a minimum, is a single point calibration point generated each day cans are analyzed?	√			
26b. Does the analyst verify that the RF bias is ≤30% from the multi-point calibration curve average RF?	√			
27a. At a minimum, is a second source single point calibration point generated each day cans are analyzed?		√		Single calibration point generated daily using dilution of calibration standard.
27b. Does the analyst verify that the recoveries are 70% to 130%?				
28a. Is a system blank analyzed each day cans are analyzed?	√			
28b. Does the analyst verify that the concentrations are ≤0.2ppb?	√			
29a. Are all duplicate and collocated canister samples analyzed twice?	√			
29b. Does the analyst verify that the RPD is ≤30% for compounds greater than 5*MDL?	√			
30. For all samples, does the analyst verify that the internal standard response is ±40% of the calibration mean and the IS retention time is ±0.33 minutes of the calibration mean?	√			
31. Does the analyst experimentally determine the MDLs in accordance with 40 Code of Federal Regulations, Part 136, Appendix B?	√			
32. Does the analyst verify that all cans are analyzed within 30 days of collection?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
E. Chain-of-Custody and Sample Handling				
1. How are samples received? Briefly review sample labels/tags.				Samples received from the field from DHEC courier. Assigned a Log number, which is stamped on the Sample Record Sheet and written on the canister tag.
2. Are Chain-of-Custody (CoC) forms complete on arrival?				
3. Does the laboratory finish filling out the form(s)?				
4. Are completed CoC forms available for review?	√			
5. Are samples assigned a tracking number upon arrival to track through extraction/analysis?	√			
6. Are all samples handled with the necessary care and finesse to avoid contamination and/or loss of material?				
7. Observe the following handling steps (if possible) for routine samples, verifying that laboratory staff follow the SOP(s) correctly:				
a. receipt of sample(s) at laboratory				
b. completion of CoC entries and other required documentation				
c. inspection of sample(s) prior to extraction/analysis				
d. installation of sample(s) on analytical instrument(s)				
e. retrieval of the sample(s) after analysis				
8. Are samples stored properly before/after extraction?				
9. Are they being stored at the proper temperature? If so, in what?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
10. Are samples stored before/after extraction in such a way as to prevent contamination?				
11. Are samples retained? How long?				Time: Canister Samples are retained for 24 hours after analysis
12. Are corrective actions in place if samples appear to be contaminated? If so, what? Who is responsible?	√			Possible sources investigated and eliminated. Data flagged Name: Robert Schilling
13. Is corrective action documented?	√			
Additional Questions or Comments:				
F. Performance Evaluation				
1. Are performance evaluation (PE) samples from an external source prepared and analyzed by this facility on the instrument(s) for this project? If so, on what basis?	√			Frequency: Quarterly or as provided by National Contract
2. Does this facility participate in any interlaboratory comparisons?	√			Yes, when available
3. Does QA provide single blind and/or double blind samples for analysis? If so, on what basis?		√		Frequency: _____
4. Are single blind samples prepared after major maintenance or repair on the instrument(s)?		√		
5. Is the analytical performance of the instrument(s) on PE samples consistently acceptable?		√		
6. Does the analyst(s) and their supervisor(s) receive feedback on the PE results, nonconformance, and/or corrective actions?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
7. Are corrective actions taken if parameters fail for PE samples on the instrument(s)? If so, briefly describe.	√			Possible causes investigated, alleviated, changes to procedures documented, reports of findings submitted to Division Director, PE samples re-analyzed if possible.
8. Are corrective actions documented?	√			
9. Are they available for review?	√			
10. Are PE results on the instrument(s) monitored and trends noted (i.e. control charts)?		√		
11. Are PE results and corrective actions reported to management?	√			
12. Are any of these PE samples used for certification of the facility? If so, what certification(s)?		√		
Additional Questions or Comments:				

Part 4: Carbonyl Analysis

AUDIT QUESTIONS	RESPONSE Y	N	NA	COMMENTS
A. Carbonyl Sampler Cleanliness				
1. Has the carbonyl sampler been subjected to a laboratory zero certification test?	√			
2. For the certification test, was humidified zero air used?		√		Just UHP grade Air
3. For the certification test, was a 24 h samples collected?	√			
4. Is the frequency of this test at least once per year?		√		If no, indicate frequency: Only performed after major repairs
Additional Questions or Comments:				
B. Analysis Procedures				
1. Is your acetonitrile (ACN) high purity or reagent grade quality?	√			Manufacturer: Fisher Scientific
2. Is all glassware washed/rinsed with deionized water, rinsed again with ACN and then baked at ~60 C?		√		Glassware rinsed and allowed to air dry. Some dried at 80°C
3. Is the high performance liquid chromatograph (HPLC) a fixed wavelength absorbance detector?		√		Manufacturer: _____ Model # _____
4. Is the high performance liquid chromatograph (HPLC) a variable wavelength absorbance detector?	√			Manufacturer: Hitachi Model # LaChromElite
5. Is the column a Zorbax C18 reversed phase column or equivalent?	√			Manufacturer: Waters Model # Nova-Pak C18
6. Is a guard column also used?	√			Manufacturer: Waters Model # WAT044380
7. Is a DNPH cartridge lot blank checked for each new lot?	√			Cartridge manufacturer: Sigma-Aldrich (Supleco)

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
8. Are the compounds from the lot blank less than:				
a. formaldehyde < 0.15 µg cartridge	√			
b. acetaldehyde < 0.10 µg cartridge	√			
9. If the answer to the question above is no, then do you use the cartridge lot anyway?				
10. Are the compounds from the field blank less than:				
a. formaldehyde < 0.3 ug cartridge Indicate frequency of field blank collection.	√			Frequency: Quarterly at each site
b. acetaldehyde < 0.4 ug cartridge Indicate frequency of field blank collection.	√			Frequency: Quarterly at each site
11. Are duplicate and collocated field samples analyzed to determine reproducibility?	√			
12. The acceptance criterion for duplicate or collocated field samples is <20%. Is the measured % difference tracked/recorded?	√			Recorded on data hardcopy.
13. Replicate analyses for measured concentrations greater than 0.5 µg/cartridge should be <10%. Is the measured % difference tracked/recorded?	√			Recorded on data hardcopy
14. At a minimum, is a five point calibration curve carried out once per 6 months?		√		Chemical Source of stds: Sigma-Aldrich (Supleco)
15. The correlation coefficient (CC) should be ≥0.999 and the relative error for each level ≤20%. Are the CC and measured % difference tracked/recorded?	√			
16. Is a second source quality control standard (SSQCS) used to reference to your primary calibration curve?	√			Chemical Source of stds: Restek Incorporated
17. The recovery of the SSQCS should be 85-115%. Are the data recovery values tracked/recorded?	√			Data recovery recorded on data hardcopies but not tracked.
18. Are all samples bracketed with QC standards?		√		
19. Is a QC standard run at least once per 10 samples?	√			
20. Do you use internal standards during each analytical run?		√		IS Compound: _____

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
21. A method spike (MS) involves injecting a known amount of carbonyl-derivative onto the DNPH cartridge and extracting it. The MS recovery acceptance criteria are 80 to 120% for all compounds.				
a. Is the recovery analysis done at least once per quarter?		√		
b. Are the results tracked/recorded?				
22. Is an acetonitrile instrument blank analyzed at the beginning of each sequence?	√			
23. Does the analyst experimentally determine the MDLs in accordance with 40 Code of Federal Regulations, Part 136, Appendix B?	√			
24. Are samples extracted within 2 weeks of collection?	√			
25. Are samples refrigerated after collection and prior to extraction?	√			
26. Are sample extracts analyzed within 30 days of extractions?	√			
27. Are reported sample results corrected based upon field blank results before entry into the database?	√			
28. Are sample results (uncorrected for field blank contribution) reported into the database?		√		
29. Are field blank results reported in the database?		√		

Additional Questions or Comments:

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
C. Chain-of-Custody and Sample Handling				
1. How are samples received? Briefly review sample labels/tags.				Samples received from the field from DHEC courier. Assigned a Log number, which is stamped on the Sample Record Sheet
2. Are Chain-of-Custody (CoC) forms complete on arrival?				
3. Does the laboratory finish filling out the form(s)?				
4. Are completed CoC forms available for review?				
5. Are samples assigned a tracking number upon arrival to track through extraction/analysis?	√			
6. Are all samples handled with the necessary care and finesse to avoid contamination and/or loss of material?				
7. Observe the following handling steps (if possible) for routine samples, verifying that laboratory staff follow the SOP(s) correctly:				
a. receipt of sample(s) at laboratory				
b. completion of CoC entries and other required documentation				
c. inspection of sample(s) prior to extraction/analysis				
d. installation of sample(s) on analytical instrument(s)				
e. retrieval of the sample(s) after analysis				
8. Are samples stored properly before/after extraction?				
9. Are they being stored at the proper temperature? If so, in what?				
10. Are samples stored before/after extraction in such a way as to prevent contamination?				
11. Are samples retained? How long?	√			Time: Six months - refigerated
12. Are corrective actions in place if samples appear to be contaminated? If so, what? Who is responsible				Name: _____
13. Is corrective action documented?				

AUDIT QUESTIONS	RESPONSE Y	N	NA	COMMENTS
Additional Questions or Comments:				
D. Performance Evaluation				
1. Are performance evaluation (PE) samples from an external source prepared and analyzed by this facility on the instrument(s) for this project? If so, on what basis?	√			Frequency: Semi-annually
2. Does this facility participate in any interlaboratory comparisons?	√			When available
3. Does QA provide single blind and/or double blind samples for analysis? If so, on what basis?		√		Frequency: _____
4. Are single blind samples prepared after major maintenance or repair on the instrument(s)?		√		
5. Is the analytical performance of the instrument(s) on PE samples consistently acceptable?	√			
6. Do the analyst(s) and their supervisor(s) receive feedback on the PE results, nonconformance, and/or corrective actions?	√			
7. Are corrective actions taken if parameters fail for PE samples on the instrument(s)? If so, briefly describe.				
8. Are corrective actions documented?				
9. Are they available for review?				
10. Are PE results on the instrument(s) monitored and trends noted (i.e., control charts)?		√		
11. Are PE results and corrective actions reported to management?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
12. Are any of these PE samples used for certification of the facility? If so, what certification(s)?		√		
Additional Questions or Comments:				

Part 5: TSP/PM_{10} Metals Analysis

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. Filter Preparation				
1. Are the filters pre-numbered by the supplier?	√			
2. If no, is a numbering device available to print ID numbers on filters before conditioning?				
3. Are all filters visually inspected for pinholes, imperfections, discolorations, etc., before use?	√			
4. At all times, are filters handled only with finger cots or vinyl/plastic/latex, nonpowdered gloves?		√		
5. Is the use of metal tweezers avoided as a way to prevent contamination? (Note that if tweezers are used, they must have Teflon coated tips.)	√			
6. Is one field blank filter sent to be analyzed with every tenth actual sample?		√		Frequency: 5 per 65
7. Hi Volume systems: Is/Does the glass fiber or quartz filter:				
a. 8 x 10" in size?	√			
b. Spectro-grade quality with pH ~7.5?	√			
c. Have a collection efficiency >99% for particles with diameter 0.3 μm and larger?	√			
d. Have a unique ID number that is a permanent part of the filter?	√			
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
B. Sample Receipt & Storage				
1. Are filters received folded in half, lengthwise, with the particulate matter inward?		√		Folded width-wise with particulate inside.
2. Are filters received in protective envelopes (manila folders)?		√		Filter received in protective folded COC card
3. Are samples stored at a temperature between 15-30 C before analysis?	√			
4. Are samples analyzed within 180 days of collection?	√			
Additional Questions or Comments:				
C. Sample Digestion				
1. Is the size of the of the filter strip cut for sample digestion 1" x 8" (1/9 of overall filter)?		√		¾" x 10"
2. Are measures taken to avoid contamination of laboratory apparatus used to obtain filter section:				
a. Acid washing filter template before use?		√		
b. Wiping template between samples with Kimwipes?	√			
3. Are one in twenty field samples prepared in duplicate? A field duplicate is prepared by cutting another 1" x 8" strip from the same filter and extracting this strip separately.	√			Frequency: 1 in 10
4. Is a matrix spike (MS) performed on one in twenty field samples (or at minimum one per batch or extraction day)? An MS is prepared by cutting another 1" x 8" strip from the same filter, spiking this section with a target level of analyte, then digesting this strip separately. (Spike is added before digestion.)				Frequency: 1 in 10

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
5. Is a filter lot blank analyzed prior to use of a new filter lot? A filter lot blank is a section from a filter taken from a new filter lot.		√		Frequency: _____
6. Is one method blank (MB) performed after every twenty samples (or at minimum one per batch or extraction day)? A blank filter section is prepared, all reagents are added, and the entire digestion procedure is followed.		√		Frequency: 1 per extraction batch
7. Is one reagent blank (RB), which is also known as a laboratory reagent blank (LRB) performed after every twenty samples (or at minimum one per batch or extraction day)? All reagents are used and the entire digestion procedure is followed, but no filter is actually processed.		√		Frequency: 1 per extraction batch
8. Is one laboratory control spike (LCS; also known as a laboratory fortified blank, LFB) performed after every 20 samples (or at minimum one per batch or extraction day)? An LCS/LFB is a section of blank filter spiked with the same target level of analyte as the MS (~100 µg/L) and carried through the entire extraction process.		√		Frequency: 1 per extraction batch
9. Is appropriate caution taken to clean all glassware, pipettes, centrifuge tubes, reaction vessels, etc., so that background levels of metals are low?				
10. Is Microwave Digestion used to extract metals from filters? If yes, skip to question 12.		√		
11. Is Hot Acid Digestion used to extract metals from filters? If yes, skip to question 19.		√		
Microwave Digestion				
12. Has an initial multipoint calibration of microwave power output performed to insure linearity?				
13. Is this calibration checked on a regular basis using a three point calibration routine?				
14. Are 12 samples digested at 486 W for 23 min?				
15. If fewer than 12 samples are digested at once, is the microwave power adjusted accordingly?				
16. Is the difference between pre- and post-reaction vessel weight verified to be less than 0.1 g before final processing of sample (thus insuring no sample loss)?				
17. Can the automatic dispensing pipette or Class A glass pipette accurately deliver 10.0 mL of liquid?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
18. Is a ~10 mL aliquot of digestate from the volumetric flask pulled into a nylon or Teflon syringe, pushed through an Acrodisc (or similar) filter to remove suspended solids, then transferred to a prelabeled, sterile centrifuge tube?				
Hot Acid Digestion				
19. Is the sample completely covered by acid in the beaker during the 30 min reflux on the hot plate?				
20. Following reflux and cooling, is reagent water added to the beaker and allowed to stand for 30 min so that acid can diffuse from the filter into the rinse?				
21. Are the contents of the beaker (digestate) transferred quantitatively to a 20.00 mL volumetric flask (Class A), including undissolved solids?				
22. Is a ~10 mL aliquot of digestate from the volumetric flask pulled into a nylon or Teflon syringe, pushed through an Acrodisc (or similar) filter to remove suspended solids, then transferred to a prelabeled, sterile centrifuge tube?				
Additional Questions or Comments:				
D. Metals Analysis				
1. Is the ICP/MS instrument allowed to warm up for at least 30 min before performing any tuning or calibration procedures?				
2. Are mass calibration and resolution checks performed using appropriate magnesium isotopes for the low masses and the appropriate lead isotopes for the higher masses?				
3. Is the MS tuned using the resolution criterion of 0.75 amu at 5% peak height?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
4. Is mass calibration adjusted if a shift of more than 0.1 amu has occurred?				
5. Is instrument stability tested using the criterion that the relative standard deviation of the absolute signals from a minimum of five analyses of the tuning solution be less than or equal to 5%?				
6. Are all samples (tuning solutions, cal standards, samples) aspirated for a minimum of 30 seconds before collecting data or making measurements?				
7. Is a minimum of three replicate integrations performed for each measurement of any sample?				
8. Is the average of these three replicate integrations used for instrument calibration and data reporting?				
9. Is a rinse blank consisting of 2% (v/v) HNO3 in DI water used to purge the system between solution changes for blanks, standards and samples?				
10. Is sufficient time allowed for the rinse blank to remove traces of the previous sample (a minimum of one minute) so as to reduce memory interferences?				
11. To compensate for physical interference effects, are a minimum of three of the following metals used in the internal standard (IS): scandium (Sc), yttrium (Y), indium (In), terbium (Tb), bismuth (Bi)? List which metals are used.				
12. Is the IS directly added to each calibration standard, blank and sample solution before analysis?				
13. Is the IS mixed with each solution undergoing analysis prior to nebulization using a second channel of the peristaltic pump and a mixing coil?				
14. Is it insured that the IS present is present in all samples, standards and blanks at identical levels, regardless of the method of spiking selected?				
15. Is the concentration of each IS metal ion chosen to give a response approximately equivalent to the response of the concentration of metals expected in the analysis? List actual concentrations used for several of the IS metals.				
16. Are calibration solutions used past their expiration dates?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
17. Do the concentrations of the metals in the multi-element calibration solution bracket the expected metal concentration ranges in the samples? List typical concentrations for typical metals.				
18. Is the MS capable of scanning from 5-250 amu?				
19. Has all laboratory glassware been cleaned prior to use?				
20. Are all stock, calibration and IS solutions stored in Teflon bottles?				
21. Is the Quality Control Sample (QCS) prepared from a second source, outside the laboratory?				
22. Is the QCS used past its expiration date?				
23. Before analyses of samples, is an initial demonstration of performance, including determination, for each analyte of interest, of method detection limits (MDL) and linear calibration range?				
24. Is the MDL determined using procedures outlined in 40 CFR 136 App B. by analysis of seven (or more) replicate aliquots of reagent water fortified at 2-5 times estimated detection limit, processed through the entire analytical procedure (but not digestion procedure).				
25. Is MDL determined every six months and whenever a significant change in background or response is expected (e.g., detector change or significant maintenance)?				
26. Is the linear concentration range determined every six months and whenever a significant change in background or response is expected (e.g., detector change or significant maintenance)?				
27. Is a multi-point calibration curve (minimum two points) generated for each analyte of interest?				
28. Is a calibration blank (1% HNO_3 (v/v) in DI water) used as the zero for the calibration curve?				
29. Is calibration initially verified (initial calibration verification, ICV) by analysis of the QCS, prepared at a concentration approximately at the midpoint of the calibration curve, insuring that its calculated concentration is 90-110% its actual concentration?				
30. Is an initial calibration blank (ICB, 1% HNO_3 (v/v) in DI water) run immediately after the QCS?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
31. Is it verified that the recovery of the ICB is less than the MDL?				
32. Is a High Standard Verification (HSV, a high concentration calibration standard) run after the ICB?				
33. Is it verified that the recovery of the HSV is between 95-105%?				
34. Is the interference check standard (ICS) run after the HSV, every eight hours, and after the end of all sample analyses?				
35. Is a continuing calibration verification (CCV, from the calibration stock solution at a midpoint calibration curve concentration) run after the HSV, after every ten samples, and after the last sample?				
36. Is it verified that the concentration of every CCV is between 90-110% of its actual concentration?				
37. Is a continuing calibration blank (CCB) analyzed following every CCV?				
38. Is it verified that the CCB concentration is less than the MDL?				
39. Is one method blank (MB) analyzed with every twenty samples or at least one with each batch?				
40. Is one reagent blank (RB) or laboratory reagent blank (LRB) analyzed with every twenty samples or at least one with each batch?				
41. Is a laboratory control spike (LCS), also known as a laboratory fortified blank (LFB), analyzed with every twenty samples, or, at minimum, with every sample batch?				
42. Is the concentration of the LCS/LFB verified to be within 80-120% of its actual concentration? (exceptions are silver, Ag, and antimony, Sb)				
43. Is a matrix spike (MS) analyzed with every twenty samples, or, at minimum, with every sample batch?				
44. Is the recovery of the MS verified to be within 75-125%?				
45. Is one duplicate sample analyzed with every twenty samples or, at minimum, with every sample batch?				
46. Is the relative percent difference (RPD) between duplicates typically < 20%?				
47. Is one serial dilution (fivefold) performed on one sample in every batch?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
48. Is the recovery of the analytes in the diluted solution typically between 90-110% of the undiluted sample concentration?				
49. Are samples with concentrations outside the calibration range diluted to be within the calibration range (but diluted no more than 5 times the MDL) and then reanalyzed?				
50. Are individual samples from collocated samplers analyzed in duplicate?				
51. Is the RPD for the replicate analyses verified to be no more than ± 10%?				
52. Is the RPD for the means of the replicate analyses for the collocated sample pairs no more than ± 20%?				
53. Is the absolute response of the IS mixture monitored to insure that remedial action can be taken if deviations larger than 60-125% of the original response in the calibration blank occur?				
54. If the absolute IS response drifts outside the acceptable range above, are potential problems, including drifting instrument tune investigated before performing more analyses?				
55. Are all masses that might affect data quality monitored during analysis, including IS masses?				
56. Is correction made for isobaric elemental and isobaric polyatomic ion interferences, spectral interferences such as those from chloride ion?				
57. If the RPD for replicate analyses is within ± 10%, but the RPD for the means of collocated samplers beyond ± 20%, are the samples checked to insure that they are truly collocated, collected over the same time period, etc.?				
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
E. Chain-of-Custody and Sample Handling				
1. How are samples received? Briefly review sample labels/tags.				Samples received from the field from DHEC courier. Assigned a Log number, which is stamped on the Sample Record Sheet
2. Are Chain-of-Custody (CoC) forms complete on arrival?				
3. Does the laboratory finish filling out the form(s)?				
4. Are completed CoC forms available for review?				
5. Are samples assigned a tracking number upon arrival to track through extraction/analysis?				
6. Are all samples handled with the necessary care and finesse to avoid contamination and/or loss of material?				
7. Observe the following handling steps (if possible) for routine samples, verifying that laboratory staff follow the SOP(s) correctly:				
a. receipt of sample(s) at laboratory				
b. completion of CoC entries and other required documentation				
c. inspection of sample(s) prior to extraction/analysis				
d. installation of sample(s) on analytical instrument(s)				
e. retrieval of the sample(s) after analysis				
8. Are samples stored properly before/after extraction?				
9. Are they being stored at the proper temperature? If so, in what?				
10. Are samples stored before/after extraction in such a way as to prevent contamination?	√			
11. Are samples retained? How long?	√			Time: Indefinitely
12. Are corrective actions in place if samples appear to be contaminated? If so, what? Who is responsible				Name: _____
13. Is corrective action documented?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
F. Performance Evaluation				
1. Are performance evaluation (PE) samples from an external source prepared and analyzed by this facility on the instrument(s) for this project? If so, on what basis?	√			Frequency: Quarterly
2. Does this facility participate in any interlaboratory comparisons?		√		
3. Does QA provide single blind and/or double blind samples for analysis? If so, on what basis?		√		Frequency: _____
4. Are single blind samples prepared after major maintenance or repair on the instrument(s)?		√		
5. Is the analytical performance of the instrument(s) on PE samples consistently acceptable?	√			
6. Do the analyst(s) and their supervisor(s) receive feedback on the PE results, nonconformance, and/or corrective actions?	√			
7. Are corrective actions taken if parameters fail for PE samples on the instrument(s)? If so, briefly describe.				
8. Are corrective actions documented?				
9. Are they available for review?				
10. Are PE results on the instrument(s) monitored and trends noted (i.e., control charts)?		√		
11. Are PE results and corrective actions reported to management?	√			
12. Are any of these PE samples used for certification of the facility? If so, what certification(s)?		√		

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				

Part 6: Chromium (VI) Analysis

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. Sampling Method Filter Preparation and Deployment				
1. Is the lab following the Cr (VI) analysis method as specified in Section 4.4 of the TAD for NATTS?			√	
2. Do you use Whatman No. 41, 47-mm diameter ashless cellulose filters?			√	
3. Are all filter preparation steps performed in a dedicated, N2-purged, glove box (or equivalent)?			√	
4. Are filters soaked in a 10% HNO3 bath for > 2 hours and < 18 hours, and then rinsed with DI water while on a Teflon-coated or plastic rack?			√	
5. Are filters handled only with Teflon- coated or plastic tweezers, and/or vinyl and disposable nitrile gloves?			√	
6. Is the pH of the DI-water-rinsed, wet filter checked to ensure the pH is the same as DI water? How is pH checked? If pH paper, is it "fresh"?			√	
7. Are the DI-water-rinsed filters placed on a Teflon or plastic net (in the glove box) and N2-purged until fully dry?			√	
8. Are dry filters soaked in 0.12 M sodium bicarbonate (NaHCO3) impregnating solution overnight?			√	
9. Are impregnated filters dried on Teflon or plastic net in glove box and N2-purged until dry?			√	
10. Is each prepared filter placed in a separate Petri dish? Are both Petri dish sections tight-fitting or otherwise held together tightly?			√	
11. Is each Petri dish labeled with: preparation date; preparer's initials; unique lot number?			√	
12. Is each individual filter/Petri dish stored in a freezer at -15 C for 3 weeks or less, until field use?			√	
13. Is the field sampling assembly (consisting of glass inlet funnel attached to a Teflon filter holder) cleaned with DI water in the lab and dried prior to packaging?			√	
14. Are components and prepared filter all assembled and loaded in the glove box? (TAD 4.4.1.1)			√	

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
15. Are the inlet and outlet of the filter holder plugged with a section of 1/4 - in. O.D. Teflon rod?			√	
16. Are the prepared filter assembly, funnel, and field data sheet placed in plastic shipping container?			√	
17. Is the plastic shipping container put in a cooler containing frozen "Blue Ice" and shipped to site via overnight service or hand-carried?			√	When and how:
Additional Questions or Comments:				
B. Sample Receipt and Storage				
1. Is the filter assembly received from the collection site via hand delivery and/or overnight express?			√	What are the shipping steps?
2. Is the cooler still "cold" upon receipt? How is this assessed?			√	
3. Upon receipt at the laboratory, is the sample assigned a unique ID number and logged into LIMS, and is the shipping container put in a -15 C freezer until time for preparation and analysis?			√	
4. Is the field data sheet examined for notations that may lead to invalidation of the sample and, if any are found, is this documented in the data records? Examples: a) sample recovery > 1 day beyond sample date; b) contaminated filter; c) filter with tears or pinholes; d) sample flowrate < 9 LPM or > 16 LPM; e) sampling start and stop flow rates vary by > +/- 10%; f) sampler operated < 23 hours or > 25 hours.			√	
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
C. Preparation for Cr (VI) Sample Analysis				
1. Is the ion chromatograph equilibrated, calibrated, and ready for analysis as soon as filter extraction is complete?			√	
2. Is all glassware used in the extraction process soaked in 10% HNO3 solution for 24 + hours, then rinsed with DI water? (TAD 1/1/07 Sec. 4.4.2.4)			√	
3. Is exposed filter removed from collection assembly while inside N2-purged glove box?			√	
4. Are disposable nitrile gloves and plastic or Teflon tweezers used during filter removal?			√	
5. Is filter folded and placed in a 14-mL polystyrene test tube, 10 mL of 20 mM NaHCO3 added, and the tube capped tightly with Teflon-lined screw cap?			√	
6. Are sealed tubes containing filters removed from glove box, placed in a test tube rack, and sonicated for one hour?			√	
7. Are filter blanks, method blanks, and filter spikes prepared in the same way as sample filters?			√	
8. Are extracts refrigerated until all analyses are complete, nominally within 12 hrs after extraction?			√	
9. Are extracts ever stored in a freezer, awaiting analysis? Does analysis of liquid occur within 24 hours after freezer storage?			√	
Additional Questions or Comments:				
D. Ion Chromatography Analytical System Preparation and Calibration (Refer to Part F, "Summary of Hexavalent Chromium Quality Control Procedures")				
1. Are the ion chromatograph (IC) instrument operating conditions similar to those listed in the TAD, Section 4.4.2.4 [guard column, analytical column, eluent flow rate, post-column reagent flow rate, detection wavelength, sample volume]?			√	

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
2. Is the IC analytical system prepared for analysis per steps in Section 4.4.2.5 of the TAD?			√	
3. Is an initial calibration (minimum of 5 concentration levels) conducted during setup per Section 4.4.2.6 of the TAD?			√	
4. Are Cr (VI) calibration stock standards NIST traceable?			√	
5. Is the coefficient of correlation, R, of the calibration points at least 0.995?			√	
6. Is the retention time for the each calibration peak's appearance within +/- 5 seconds of the initial, expected time? What happens if it is not?			√	
7. Are the following samples analyzed before and/or during an analytical sequence for field samples? (Section 4.4.2.7 of TAD)				
a. Initial calibration verification (ICV)			√	
b. Continuing calibration verification (CCV) after every 10 samples and at the end of an analytical sequence.			√	
c. Initial and continuing calibration blanks verification after ICV and every 10 samples, respectively			√	
d. Laboratory control sample (LCS) spikes (prepared in N2-purged glove box) after every 10 samples			√	
8. Do the percent recoveries of the ICV and CCV meet requirements of the TAD (85-115%) and/or the laboratory SOP?			√	
9. Are results of the ICB and CCB analyses less than the MDL?			√	
10. Are LCS results acceptable (80-120% recovery)?			√	
11. Method Detection Limit (MDL). Describe how MDL was determined. Is the MDL 0.19 ng/mL or lower? [Refer to Section 4.4.2.10 of TAD]			√	
12. What is the your laboratory's MDL for analysis of Cr(VI)?			√	
13. Give examples of corrective actions (if any were needed) taken over the past 6 months.			√	

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
E. Sample Tracking				
1. How are samples received? Briefly review sample labels/tags.			√	
2. Are Chain-of-Custody (CoC) forms complete on arrival?			√	
3. Does the laboratory finish filling out the form(s)?			√	
4. Are completed CoC forms available for review?			√	
5. Are samples assigned a tracking number upon arrival to track through extraction, analysis, and reporting of data?			√	
6. Are all samples handled with the necessary care and finesse to avoid contamination and/or loss of material? *(Observe)*			√	
7. Observe the following handling steps (if possible) for routine samples, verifying that laboratory staff follow the SOP(s) correctly:			√	
a. receipt of sample(s) at laboratory. [Is the cooler "cold"? How is this assessed?]			√	
b. completion of CoC entries and other required documentation			√	
c. inspection of sample(s) prior to extraction/analysis			√	
8. Are samples stored properly before/after extraction?			√	
9. Are they being stored at the proper temperature? If so, in what?			√	
10. Are samples stored before/after extraction in such a way as to prevent contamination?			√	

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
11. What are sample retention requirements? How old is the oldest sample?			√	
12. Are corrective actions in place if samples appear to be contaminated? If so, what are they? Who is responsible?			√	
13. Is corrective action documented?			√	
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE Y	RESPONSE N	RESPONSE NA	COMMENTS

F. Summary of Hexavalent Chromium Quality Control Procedures

Parameter	Frequency	Acceptance Criteria	Corrective Action
Initial 5-point calibration standards	Before every sequence	Correlation coefficient 0.995	1) Repeat analysis of calibration standards. 2) Re-prepare calibration standards and reanalyze.
Initial Calibration Verification (ICV)	Before every sequence, following the initial calibration	Recovery 85-115%	1) Repeat analysis of initial calibration verification standard. 2) Repeat analysis of calibration standards. 3) Re-prepare calibration standards and reanalyze.
Initial Calibration Blank (ICB)	One per Batch, following the ICV	Below MDL	1) Reanalyze. 2) Re-prepare blank and reanalyze. 3) Correct contamination and reanalyze blank. 4) Flag data of all samples in the batch.
Continuing Calibration Verification (CCV)	Every 10 Samples	Recovery 85-115%	1) Repeat analysis of CCV. 2) Re-prepare CCV. 3) Flag data bracketed by unacceptable CCV.
Laboratory Control Sample	One per 10 samples	Recovery 80-120%	1) Reanalyze. 2) Re-prepare spike and reanalyze. 3) Flag data of all samples since the last acceptable spike.
Replicate Analysis	Duplicate and/or Replicate samples only	RPD < 20% for concentrations greater than 5 X the MDL	1) Check integration. 2) Check instrument function. 3) Flag samples.
Continuing Calibration Blank (CCB)	After every CCV and at the end of the sequence	Below MDL	1) Reanalyze. 2) Re-prepare blank and reanalyze. 3) Correct contamination and reanalyze blank. 4) Flag data of all samples in the batch.

Part 7: PAH Analysis

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. Module assembly				
1. What is the manufacturer of the sampling module?				Tisch Environmental and Graseby Metal Works
2. Do you use a 102mm filter type QMA-4 (Whatman)?	√			
3. Does your oven achieve 400ºC?		√		Filters baked at 385ºC
4. Are all filters visually inspected for pinholes, imperfections, discolorations, etc., before use?	√			
5. At all times, are filters handled only with finger cots or vinyl/plastic/latex, non-powdered gloves?		√		Filters only handled with forceps after bake out.
6. There are two sorbent media you may use. Do you use PUF?	√			
7. There are two sorbent media you may use. Do you use XAD-2?	√			
8. If you use PUF, do you use chromatography grade acetone for initial cleaning?	√			
9. If you use PUF, do you use chromatography grade diethyl ether and hexane for subsequent cleaning?		√		Hexane only
10. If you use XAD-2, do you use chromatographic grade methylene chloride for cleaning?		√		XAD pre-cleaned
11. How do you determine the proper reflux rate for Soxhlet cleanup?				
12. What is your source of ultra-pure nitrogen?				PraxAir
13. Is the sampling cartridge screen stainless steel?	√			
14. Is the sampling cartridge screen 200/200 mesh?	√			
15. If you use XAD-2, do you use a piece of PUF to support the resin?	√			
16. Are Teflon® end caps used with the filter module?			√	
17. Are aluminum shipping containers used to store the modules?			√	
18. Are the shipping containers cleaned?			√	When and how:

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
19. Are the shipping containers sealed with Teflon® tape?			√	
20. What is the batch size (or batch size range) for assembly of filter modules?				1 to 7
21. How many cartridges per batch are analyzed prior to release for field use?				Every cartridge
22. What are the acceptance criteria?				Target compounds not detected above MDL
23. Are control charts used to monitor test results?		√		
Additional Questions or Comments:				
B. Cartridge certification				
1. Is the Soxhlet extractor prewashed with extraction solvent prior to extraction of the cartridge materials?	√			
2. Does the Soxhlet extractor complete at least 3 cycles per hour?	√			
3. Is diethyl ether/hexane (10:90 v:v) used to extract PUF?		√		100% Hexane
4. Is the extract dried with sodium sulfate?		√		
5. Is the extract concentrated on a Kuderna-Danish apparatus?		√		Concentrated using Zymark
6. Is the final extract volume 5 mL?		√		1 mL
7. Are the extracts analyzed by GC/MS?	√			
8. What are the acceptance criteria?				
9. Are control charts used to monitor test results?		√		

AUDIT QUESTIONS	RESPONSE Y	N	NA	COMMENTS
Additional Questions or Comments:				
C. Cartridge deployment				
1. Are surrogate standards added to all cartridges prior to field deployment?		√		
2. What is the solvent of the surrogate standards solution?			√	
3. What is the concentration of d_{10}-fluoranthene in the standards solution?			√	
4. What is the concentration of d_{12}-benzo(a)pyrene in the standards solution?			√	
5. What volume of standards solution is added to the cartridges? (*Note: spiked amount of surrogate standards should be 1 µg each.*)			√	
6. Is the solution added to the center of the cartridge?			√	
7. What size syringe is used to add the standards solution?			√	
8. Is the syringe used only for this purpose?			√	
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
D. Sample extraction, concentration, and cleanup				
1. Are samples logged in on receipt?	√			
2. Are samples stored at ≤ 4ºC prior to extraction?		√		
3. Are samples extracted within 7 days of sampling?	√			
4. Is the Soxhlet extractor prewashed with extraction solvent prior to extraction of the cartridge materials?	√			
5. Are surrogate laboratory standards added to solvent or to matrix prior to extraction?	√			
6. What is the solvent of the surrogate laboratory standard solution?				Methylene Chloride
7. What surrogate standard is used?				Supelco 47960-U 4000µg/mL of 2-Fluorbiphenyl, 2-Fluorophenol, Nitrobenzene-d_5, Phenol-d_6, p-Terphenyl-d_{14}, in $MeCl_2$
8. What is the concentration of surrogate standard in the standards solution?				4000µg/mL of each component
9. What volume of standards solution is added to the cartridges? (*Note: spiked amount of surrogate standards should be 1 µg each.*)				40 µg
10. What size syringe is used to add the standards solution?				25 µL
11. Is the syringe used only for this purpose?	√			
12. Is ethyl ether/hexane (10/90 v/v) used to extract PUF?		√		100% Hexane
13. Is methylene chloride used to extract XAD?		√		
14. Does the Soxhlet extractor complete at least 3 cycles per hour?	√			
15. Is the extract dried with sodium sulfate?		√		
16. Is the extract concentrated on a Kuderna-Danish apparatus?		√		Zymark Turbo-Vap
17. During final evaporation, is the top of the solvent kept below the level of the bath?	√			
18. During final evaporation, does the extract go dry?		√		

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
19. Is the final extract volume adjusted to 1.0 mL with hexane?	√			
20. Are pipets used in sample transfers pre-rinsed with solvent?	√			
21. Is silica gel used in cleanup type 60 (70-230 mesh)?		√		
22. Is silica gel Soxhlet-extracted for 6 hours with ethyl ether/hexane 10/90 v/v?			√	
23. Is extracted silica gel heated for 16 hours at 150ºC?			√	
24. Does the cleanup column include a glass wool plug, 10 g of silica, and a 1 g top layer of sodium sulfate?			√	
25. Is the cleanup column pre-washed with ethyl ether/hexane 10/90 v/v for 1 hour?			√	
26. Is the cleanup column pre-eluted with pentane?			√	
27. Is the pentane chromatography grade?			√	
28. Is the sample loaded then washed on with hexane?			√	
29. Is the loaded column washed with pentane?			√	
30. Is the loaded column eluted with 25 mL ethyl ether/hexane 10/90 v/v?			√	
31. Is the elution rate 2 mL/min?			√	
32. Is the eluted sample concentrated to 1.0 mL using a Kuderna-Danish apparatus?			√	
33. What internal standard is added to the sample?				Supleco 46955-U 2000µg/mL of Acenaphthene-d_{10}, Chrysene-d_{12}, 1,4-Dichlorobenzene-d_4, Naphthalene-d_8, Perylene-d_{12}, Phenanthrene-d_{10} in $MeCl_2$
34. Is internal standard added to the sample prior to transfer to an autosampler vial?		√		
35. Are autosampler vials prescreened for PAH contamination?		√		
36. What is the concentration of the internal standard solution?				2000µg/mL of each component

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
37. What volume internal standard solution is added?				10 µL
Additional Questions or Comments:				
E. Sample analysis				
1. What are the make and model of GC-MS used for the analysis?				Agilent 6890/5973N
2. Is the GC-MS operated in electron ionization mode?	√			
3. Does the laboratory have maintenance records that include calibration checks?	√			
4. What are the check standard acceptance criteria?				±20%
5. Do the records show that check standard performance is acceptable?				Check standard performance varies. Some compounds are very consistent and acceptable others vary widely.
6. When was the last time the instrument was recalibrated?				
7. Are GC-MS operating conditions consistent with TO-13A Table 2?				Differences: Column: DB-5MS, 30M x 0.25 mm ID,Temperature Program: Initial Temp. 40ºC for 4 min. Ramp at 7ºC/ min to 300ºC and hold for 10 mins. Transfer line: 280ºC. Injection volume: 1µL. He carrier gas flow : 1mL/min.
8. Are stock standards prepared from neat materials?		√		
9. Are COA/certifications retained for commercial materials?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
10. Are records available for preparation of the most recent mixed stock solution?	√			
11. Are all stock solutions less than one year old?	√			
12. Are all stock solutions stored at 4ºC in amber bottles with Teflon-lined caps?	√			
13. Do internal standard solutions include d_{12}-perylene, d_{10}-acenaphthene, d_{12}-chrysene, d_8-naphthalene, and d_{10}-phenanthrene?	√			
14. Are records available for preparation of the most recent set of working standard (calibration) solutions?	√			
15. Are calculations checked to verify they have been performed correctly?	√			
16. Are working standard solutions prepared for at least five calibration levels, spanning 0.10 ng/µL to 2.5 ng/mL?				Concentration levels: Vary by compound. Typically 9 levels 0.25µg/mL to 100µg/mL
17. Are all working standard solutions less than six months old?	√			
18. Are all working standard solutions stored at 4ºC in amber bottles with Teflon-lined caps?	√			
19. Is the instrument performance check solution decachlorotriphenylphosphine (DFTPP) at a concentration of 50 ng/mL?				DFTPP concentration 40µg/mL with 1µL injection. Total 40ng injected
20. Is the performance check solution analyzed once per 12 hours of operation?	√			
21. Is the performance check solution analyzed following corrective actions?				
22. Are all samples analyzed within 12 hours of DFTPP injection?	√			
23. Are SOPs consistent with TO-13A, Table 3 abundance criteria?				
24. When was the last failed tune check?				
25. What corrective action was taken?				
26. Is relative response factor documented for each component from the initial calibration?	√			
27. Is % RSD documented for each component from the initial calibration?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
28. Is mean RRT documented for each component from the initial calibration?	√			
29. Are mean area response and retention time for internal standard documented from the initial calibration?	√			
30. Are the acceptance criteria in TO-13A section 13.3.4.5 used to pass initial calibration?				
31. What calibration standard is used to check the calibration?				
32. When was the last time a calibration check standard failed?				
33. What aspect of the standard failed?				
34. What corrective action was taken?				
35. Is a method blank analyzed with each batch of ≤ 20 samples?		√		
36. When was the last time a laboratory blank failed?				
37. What aspect of the blank failed?				
38. What corrective action was taken?				
39. Are the acceptance criteria in TO-13A section 13.3.6.4 used to pass blanks?				
40. Is a laboratory control spike analyzed with each batch of ≤ 20 samples?		√		
41. What amount of each analyte is added to sample in a control spike?				
42. When was the last time a laboratory control failed?				
43. What aspect of the control failed?				
44. What corrective action was taken?				
45. Are the acceptance criteria in TO-13A section 13.3.7.4 used to pass controls?				
46. Is the GC-MS retention time qualification ± 0.10 min?				
47. Is the abundance qualification ± 15% of the expected value?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
48. Are failing peaks flagged by the software?	√			
49. Are failing peaks manually examined by the GC-MS operator?	√			
50. When was the last time a sample was diluted due to one or more components lying above the calibration curve?				
51. Was the internal standard supplemented in the diluted sample?				
52. Is surrogate recovery required to be 60% - 120%?				
53. Is internal standard area change relative to the check standard required to be -50% to +100%?				
54. Are samples > MDL but < lowest calibration level flagged with a "J"?		√		
Additional Questions or Comments:				
F. Chain of custody				
1. How are samples received? Briefly review sample labels/tags.				Samples received from the field from DHEC courier. Assigned a Log number, which is stamped on the Sample Record Sheet
2. Are Chain-of-Custody (CoC) forms complete on arrival?				
3. Does the laboratory finish filling out the form(s)?				
4. Are completed CoC forms available for review?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
5. Are samples assigned a tracking number upon arrival to track through extraction, analysis, and reporting of data?	√			
6. Are all samples handled with the necessary care and finesse to avoid contamination and/or loss of material? *(Observe)*				
7. Observe the following handling steps (if possible) for routine samples, verifying that laboratory staff follow the SOP(s) correctly:				
a. receipt of sample(s) at laboratory				
b. completion of CoC entries and other required documentation				
c. inspection of sample(s) prior to extraction/analysis				
d. installation of sample(s) on analytical instrument(s)				
e. retrieval of the sample(s) after analysis				
8. Are samples stored properly before/after extraction?				
9. Are they being stored at the proper temperature? If so, in what?				
10. Are samples stored before/after extraction in such a way as to prevent contamination?				
11. What are sample retention requirements? How old is the oldest sample?				
12. Are corrective actions in place if samples appear to be contaminated? If so, what are they? Who is responsible?				
13. Is corrective action documented?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
G. Performance evaluation				
1. Are performance evaluation (PE) samples from an external source prepared and analyzed by this facility on the instrument(s) for this project? If so, on what basis?	√			
2. Does this facility participate in any inter-laboratory comparisons?		√		
3. Does QA provide single blind and/or double blind samples for analysis? If so, on what basis?		√		
4. Are single blind samples prepared after major maintenance or repair on the instrument(s)?		√		
5. Is the analytical performance of the instrument(s) on PE samples consistently acceptable?				
6. Does the analyst(s) and their supervisor(s) receive feedback on the PE results, nonconformance, and/or corrective actions?	√			
7. Are corrective actions taken if parameters fail for PE samples on the instrument(s)? If so, briefly describe.				
8. Are corrective actions documented?				
9. Are they available for review?				
10. Are PE results on the instrument(s) monitored and trends noted (i.e. control charts)?		√		

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
11. Are PE results and corrective actions reported to management?	√			
12. Are any of these PE samples used for certification of the facility? If so, what certification(s)?		√		
Additional Questions or Comments:				

TO-13A.

TABLE 2. GC-MS OPERATING CONDITIONS

Activity	Conditions
Gas Chromatography	
Column	J&W Scientific, DB-5 crosslinked 5% phenylmethyl silicone (30 m x 0.32 mm, 1.0 µm film thickness) or equivalent
Carrier Gas	Helium, velocity between 28-30 cm^3/sec at 250°C
Injection Volume	2 µL, Grob-type, splitless
Injector Temperature	290°C
Temperature Program	
Initial Column Temperature	70°C
Initial Hold Time	4 ± 0.1 min.
Program	10°C/min to 300°C and hold 10 min.
Final Temperature	300°C
Final Hold Time	10 min. or until all compounds of interest have eluted
Mass Spectrometer	
Transfer Line Temperature	290°C or According to Manufacturer's Specification
Source Temperature	According to Manufacturer's Specifications
Electron Energy	70 volts (nominal)
Ionization Mode	EI
Mass Range	35 to 500 amu, full range data acquisition (SCAN) mode
Scan Time	At least 5 scans per peak, not to exceed 1 second per scan.

TO-13A.

TABLE 3. DFTPP KEY IONS & ION ABUNDANCE CRITERIA

Mass	Ion Abundance Criteria
51	30 to 60% of mass 198
68 70	Less than 2% of mass 69 Less than 2% of mass 69
127	40 to 60% of mass 198
197 198 199	Less than 2% of mass 198 Base peak, 100% relative abundance 5 to 9% of mass 198
275	10 to 30% of mass 198
365	Greater than 1.0% of mass 198
441 442 443	Present but less than mass 443 40% of mass 198 17 to 23% of mass 442

National Air Toxics Trends Stations (NATTS)

US EPA REGION 4
SESD

Monitoring Site
Technical Systems/Instrument Performance Audit Form

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National Air Toxics Trends Stations (NATTS)

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Part 1. General Information

Field Site Information

NAME AND ADDRESS OF AGENCY

South Carolina Department of Health and Environmental Control

2600 Bull Street, Columbia, South Carolina, 29201

NAME AND ADDRESS OF **PRIMARY** (State or Local Agency) ANALYSIS LABORATORY
(List analysis methods associated with each laboratory: VOC, SVOCs, Carbonyl, Cr6+, PM10 Metals):

South Carolina Department of Health and Environmental Control – Division of Air Quality Analysis

8231 Parklane Road, Columbia, SC 29223

VOC, SVOC, Carbonyl

NAME AND ADDRESS OF **CONTRACT** ANALYSIS LABORATORY
(List analysis methods associated with each laboratory: VOC, SVOCs, Carbonyl, Cr6+, PM10 Metals):

South Carolina Department of Health and Environmental Control

Analytical and Radiological Environmental Services Division

8231 Parklane Road, Columbia, SC 29223

PM10 Metals

ON-SITE AUDIT TEAM MEMBERS/ AFFILIATIONS:

_____

_____

ON- SITE AUDIT DATE: _____

PERSONNEL INTERVIEWED:

NAME	POSITION	PHONE/E-MAIL

Field Site Information

MONITORING SITE # 1 NAME and ADDRESS / LOCATION

____ Chesterfield, Rt. 2, Box 100, McBee, SC _____

GPS LOCATION OF MONITORING SITE and AQS SITE ID NUMBER

Latitude: 34.615367, Longitude: -80.198787, 45-025-0001

MONITORING METHODS PRESENT AT MONITORING SITE
(VOCs, SVOCs, Carbonyls, PM10 Metals, Chromium VI, other)

__ VOCs, SVOCs, Carbonyls, PM10 Metals, Black Carbon, Wind Speed and Direction, Rainfall, PM2.5, Speciated PM2.5, and Ozone _____

MONITORING SITE # 2 NAME and ADDRESS / LOCATION

_____

GPS LOCATION OF MONITORING SITE and AQS SITE ID NUMBER

MONITORING METHODS PRESENT AT MONITORING SITE
(VOCs, SVOCs, Carbonyls, PM10 Metals, Chromium VI, other)

_____

MONITORING SITE # 3 NAME and ADDRESS / LOCATION

_____

GPS LOCATION OF MONITORING SITE and AQS SITE ID NUMBER

MONITORING METHODS PRESENT AT MONITORING SITE
(VOCs, SVOCs, Carbonyls, PM10 Metals, Chromium VI, other)

_____

Field Site Information

MONITORING SITE # 4 NAME and ADDRESS / LOCATION

_____

GPS LOCATION OF MONITORING SITE and AQS SITE ID NUMBER

MONITORING METHODS PRESENT AT MONITORING SITE
(VOCs, SVOCs, Carbonyls, PM10 Metals, Chromium VI, other)

_____

MONITORING SITE # 5 NAME and ADDRESS / LOCATION

_____

GPS LOCATION OF MONITORING SITE and AQS SITE ID NUMBER

MONITORING METHODS PRESENT AT MONITORING SITE
(VOCs, SVOCs, Carbonyls, PM10 Metals, Chromium VI, other)

_____

MONITORING SITE # 6 NAME and ADDRESS / LOCATION

_____

GPS LOCATION OF MONITORING SITE and AQS SITE ID NUMBER

MONITORING METHODS PRESENT AT MONITORING SITE
(VOCs, SVOCs, Carbonyls, PM10 Metals, Chromium VI, other)

_____

Part 2: Basic QA/QC

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. QAPP and SOPs				
1. Is the sampling site covered in the EPA approved Quality Assurance Project Plan (QAPP) developed for the NATTS Program?	√			
2. Does the QAPP reflect, present, and address specifications (i.e., MQOs, DQIs, MDLs, etc.) that are in accordance with those specified in the most recent NATTS Technical Assistance Document (TAD)?	√			
3. Has the QAPP been reviewed by all appropriate personnel?	√			
4. Has the Regional EPA QA Officer and Air Toxics Coordinator reviewed the QAPP?	√			
5. Is the QAPP approved by the EPA Regional QA Officer and Air Toxics Coordinator and signed accordingly?	√			
6. Is a copy of the approved QAPP available for review by the field operator(s)? If not, briefly describe how and where QA and QC requirements and procedures are documented.	√			
7. Is a signed copy of the approved QAPP onsite and available to the field operator(s)?	√			
8. Has the approved QAPP been reviewed (or will be reviewed) on a periodic basis? Ask to see.	√			
9. Is this review of the QAPP documented (or will it be documented)?	√			
10. Are written and approved standard operating procedures (SOPs) in place for the various samplers?	√			
11. Is/Are the SOP(s) signed and approved by the QA Manager?	√			
11. Is/Are the SOP(s) signed and approved by the QA Manager? **(Continued)**				
12. Is this/are these the SOP(s) that is/are used for this site?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
13. Is/Are the SOP(s) available for review by the field operator(s)?		√		Condensed version of SOP contained in a field sampling manual developed by the agency for use by all field personnel. Field sampling manually routinely reviewed and updated. Field personnel notified of updates and sent replacement pages for their manual.
14. Is/Are the SOP(s) current and up to date?	√			
15. Has/Have the SOP(s) been reviewed on a periodic basis?	√			
16. Is this review of the SOP(s) documented? Review, if possible.	√			Documentation kept with field personnel's electronic training record
17. Are signed copies of the SOP(s) onsite and available to the field operator(s)? Ask to see all five.		√		
18. Is/Are the SOP(s) available onsite for review?		√		
19. How are amendments/deviations to the QAPP or SOP(s) handled?				
20. Who documents the QAPP amendments/ deviations from Question 19?				
21. Are the QAPP amendments/deviations from Question 19 available to the field operator(s)?		√		
22. Have any QAPP amendments/deviations occurred? If so, when?		√		
23. If yes to Question 21, are the QAPP amendments/ deviations available for review? Indicate what they cover.				
Additional Comments:				

B. Organization and Responsibilities

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
1. Name of Field Operations Manager, responsible for (indicate which apply):				
a. Development of monitoring site,				Name: William Jenny
b. Coordinates field operations,				Name: Robert Schilling
c. Logistical support of field operations,				Name: Robert Schilling
d. Training monitoring site operators, and				Name: Robert Schilling
e. Review of routine sampler data and quality control data.				Name: Robert Schilling
2. Name of Monitoring Site Operator(s), responsible for (indicate which apply):				
a. Operation of samplers,				Name: Earle Wilson and Bryan Baxley
b. Calibration of samplers,				Name: Kevin Watts
c. Maintenance of samplers, and				Name: William Jenny
d. Maintenance of monitoring site.				Name: William Jenny
3. Is there someone authorized to halt the program in the event of a health or safety hazard or in data quality?	√			Name: Scott Reynolds
4. Is there someone who reviews the following completed forms:				
a. Field forms? Who?				Name:
b. Chain of Custody (CoC) forms? Who?				Name: Lab Personnel
5. Has the review of completed forms and CoC forms been done?	√			
6. Is there someone responsible for shipment of samples to the appropriate analytical laboratory(s)? Who?		√		Sample Custodian:
7. Is anyone responsible for quality audits of the site? If so, who?		√		
8. Has an audit(s) been performed? If so, when?				Last audit: VOCs – NA Carbonyls – 04/09/15 PM10 metals – 06/18/15 PAHs – 06/18/15 Chromium VI – NA

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
9. Were there any findings during the audits in Question 8?				
10. Are audits documented? How?				
11. Are the audit results available for review by staff and auditors? Ask to view audits from this program.				
Additional Questions or Comments:				
C. Training, Safety and Chain-of-Custody				
1. Have the monitoring site operators been trained in the sampling procedures? If so, when?	√			
2. Is this training documented in a training record?	√			
3. Is the training record available for review?		√		
4. Has the operator been trained in the particular hazards of the instruments/materials that they are using?	√			
5. Are personnel outfitted with any required safety equipment?	√			
6. Are personnel adequately trained regarding appropriate safety procedures?	√			
7. Are the field and Chain-of-Custody (CoC) forms being filled out properly?				
8. Do sample ID's match the CoC?				
9. Are the coolers or other appropriate sample containers being packed according to the SOPs or QAPP for sample delivery to the appropriate analysis laboratory?				
10. Is the CoC present?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
D. Sample Handling and Sampling Frequency				
1. Are all samples handled with the necessary care and finesse to avoid contamination and/or loss of material?				
2. Observe the following handling steps for routine samples, verifying that the operator(s) follow the SOP(s) correctly:				
a. receipt of sample media at the sampling site and unpacking				
b. completion of sample logbook entries and other required documentation				
c. inspection of the sample media prior to sampling				
d. installation of sample media in the sampler				
e. recovery of the sample media after sampling				
f. packing the sample media and shipping to the laboratory				
g. completion of chain of custody and field data forms supplied by the reporting organization				
h. samples shipped				
3. Request the operator to perform the field blank sample-handling procedures (if not possible, go through the SOP step-by-step and verify that the operator knows the correct procedures.):				
a. receipt of sample media at the sampling site and unpacking				
b. completion of sample logbook entries and other required documentation				
c. inspection of the sample media prior to sampling				
d. installation of sample media in the sampler				
e. recovery of the sample media from the sampler (without sampling)				
f. packing the sample media and shipping to the laboratory				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
g. completion of chain of custody and field data forms supplied by the reporting organization				
4. Is the sample media/samples stored properly before/after sampling?				
5. Is the sample media/samples being stored at the proper temperature? If so, in what?				
6. Is the sample media/samples stored before/after sampling in such a way as to prevent contamination?				
7. Is sampling occurring every sixth day?				
8. If yes to Question 7, is the 1:6 day schedule detailed or written in the site log or instrument log? If not, why?				
Additional Questions or Comments:				
E. Monitoring Site Housekeeping				
1. How long has this site been used for NATTS?				
2. Are all site logbooks and/or forms filled in promptly, clearly, and completely?				
3. Does the operator(s) keep the handling area neat and clean?				
4. Is there adequate room to perform the needed operations?				
5. Do the samplers appear to be well maintained and free of dirt and debris, bird/animal/insect nests, excessive rust and corrosion, etc.?				
6. Are the walkways to the station and equipment kept free of tall grass, weeds, and debris?				
7. Is the shelter (if any) clean and in good repair?				
8a. Are there separate Operation and Maintenance (O+M) logs for the NATTS samplers?				
8b. If yes to question 8a, check the O+M or instrument logs against the SOPs. Are these acceptable?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
F. Documentation				
1. Are the following being filled out promptly, legibly, and clearly:				
a. Logbooks?				
b. Forms?				
2. Are all entries being made in indelible ink (preferably a dark color)?				
3. Are corrections to the data being made with a single line through the entry so as not to obliterate the original entry, initials of the corrector, and date of the correction?				
4. Are previous logbooks/forms onsite?				
5. If yes to Question 4, are the logbooks/forms available for review?				
6. Has a review of the logbooks/forms been performed? By whom?				
7. Are logbooks/forms stored? How?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				

Part 3: Specific Sampling Criteria

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. VOC/Canister Sampling				
1. Are your VOC Canister collections for the NATTS Program conducted in accordance with the specifications and procedures presented in the NATTS TAD?	√			
2. Do you collect duplicate samples?		√		Frequency:
3. Do you collect collocated samples?	√			Frequency: 1 in 6
4a. Does the canister sampler have its own standalone VOC sample inlet and sample line.	√			
4a. If the answer to 4a is no; Is canister sampler attached to a laminar flow manifold?				
5. If it is attached to a laminar flow manifold, is the port that services the canister sampling system the first in line with respect to the manifold inlet, and is the sample line positioned in the center of the laminar flow stream?				
6. Does sampling system yield a sub ambient final sample pressure (i.e., approximately 2-8 in Hg)?		√		
7. Is the integration of the sample collection achieved using electronic mass flow control?	√			
8. Is the integration of the sample collection achieved using critical orifice/flow control assembly?				
9. Is the sample collection system purged for 24 hours with local ambient air before performing a 24-hour sample collection?		√		Purge Time: 1 hour
10. Does the sampling system incorporate a latching solenoid valve?	√			
11. Does the sampling system incorporate a solenoid valve with a low temperature rise coil?	√			
12. Does the sampling gas pass through a pump prior to collection in the canister?	√			
13. Are bellows or diaphragm valves attached to the inlet of the canisters?	√			
14. Are quick connect valves attached to the inlet of the canister?		√		

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
15. Are passivated stainless steel sampling canisters used to collect air samples?		√		
16. Are fused silica lined stainless steel sampling canisters used to collect air samples?	√			
17. Are initial and final canister pressures measured at the field site?	√			
18. Is a vacuum gauge used in the field to measure the initial and final pressure?		√		
19. Is an electronic mass flow control device used in the field to calculate the total volume of sampled air?		√		
20. Is a particulate filter used to remove particles?	√			
21. Is this a sintered stainless steel in-line filter?	√			
22. Is there an automated event control module present to start and stop sample collection?	√			
23. Is there an elapsed time indicator present to measure the duration of the sampling period?	√			
24. Is the sampling line connecting the canister to the main sampling manifold made of chromatographic grade stainless steel tubing?	√			
25. Is the initial vacuum in the canister recorded on the field sampling data sheet?				
26. Is the final vacuum in the canister recorded on the field sampling data sheet?				
27. Is the time of day, date and elapsed time indicator recorded on the field sampling data sheet?				
28. Is there a flow diagram of the sampler?				
29. Is the sampler a multiday sampler? If yes, how long are canisters loaded before the next run?		√		Number of Days:
30. How often is a leak check performed?				Frequency: during each canister installation
31. Is the leak check in question 30 done according to the SOPs?				
Additional Questions or Comments:				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Sampler Certification				
1. Have each/all of the canister sampling system(s) being applied to the NATTS Program work been certified in accordance with the specifications and procedures presented in the NATTS TAD on an annual basis? Review documentation.		√		
2. Was a "Challenge" sample (i.e., sample gas comprised of several target species at a concentration between 3-10ppbV/species in humidified zero air) collected first? Review documentation.		√		
3. Was the Challenge sample collection integrated over 24 hours (like a real sample collection)? Review documentation.			√	
4. Were all of the recovery criteria, as presented in the NATTS TAD, met? Review documentation.			√	
5. What happens if a sampler does not pass the certification Challenge criteria?				
6. Was a "Zero" sample (i.e., sample gas comprised of humidified zero air) collected second? Review documentation.	√			
7. Was the Zero sample collection integrated over 24 hours (like a real sample collection)? Review documentation.	√			
8. Was the cleanliness criteria, as presented in the NATTS TAD, met? Review documentation.	√			
9. What happens if a sampler does not pass the certification Zero criteria?				
Additional Comments:				
B. Carbonyl Sampling				
1. Are your Carbonyl compounds collections for NATTS Program work conducted in accordance with the specifications and procedures presented in the NATTS TAD?	√			
2. Do you collect duplicate samples?		√		Frequency:
3. Do you collect collocated samples?	√			Frequency: 1 in 6 days

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
4. Does the Carbonyl compounds sampler have its own stand-alone sample inlet and sample line, or is it attached to a laminar flow manifold?	√			Connected to a laminar flow manifold
5. If it is attached to a laminar flow manifold, is the port that services the Carbonyl compounds sampling system the second in line with respect to the manifold inlet, and is the sample line positioned in the center of the laminar flow stream?				
6. Are you using an ozone denuder to remove ozone? If no, go to question 9.	√			Commercial: ATEC Custom made:
7. Is the sample gas that passes through the denuder maintained at 50-70 °C (i.e., heater temperature set at 93 °C or higher)?	√			
8. Is the denuder re-charged or replaced annually?	√			Replaced
9. Are you using an ozone cartridge to remove ozone?		√		Commercial: Custom made:
10. Are you using a commercially prepared silica gel solid adsorbent coated with DNPH?	√			Manufacturer: Sigma-Aldrich (Supleco)
11. Are you using a custom made silica gel solid adsorbent coated with DNPH?		√		
12. Is the integration of the sample collection achieved using electronic mass flow control?	√			
13. Is the integration of the sample collection achieved using critical orifice/flow control assembly?		√		
14. Is there an automated event control module present to start and stop sample collection?	√			
15. Is there an elapsed time indicator present to measure the duration of the sampling period?	√			
16. Is the sampling line connecting the carbonyl compounds sampler to the main sampling manifold made of chromatographic grade stainless steel or Teflon tubing?	√			Teflon tubing
17. Is the initial flow rate recorded on the field sampling data sheet?				List Device:
18. Is the final flow rate recorded on the field sampling data sheet?				List Device:
19. Is the time of day, date and elapsed time indicator recorded on the field sampling data sheet?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
20. Are field blanks collected? Frequency?	√			Frequency: Quarterly
21. How are the cartridges stored at the monitoring station before the run?				
22. How are the cartridges stored at the monitoring station after the run?				
23. Generally, how long is a cartridge stored at the monitoring station before a sample is collected?				
24. For weekend sampling, is the sampler made ready the day of sampling? If no, then on what day is it set up?		√		Samplers are set up the day after the previous sampling event except on weekends
25. Are the exposed samples taken to 4 degrees C as soon as they are collected?				
26. How are the exposed samples transported to the laboratory?				Shipped in coolers @ 4 °C or less with PM2.5 filters
Additional Questions or Comments:				
Sampler Certification				
1. Have each/all of the Carbonyl compounds sampling system(s) being applied to the NATTS Program work been certified in accordance with the specifications and procedures presented in the NATTS TAD on an annual basis? Review documentation.		√		
2. Has the Ozone scrubber been recharged or replaced on an annual basis? Review documentation.	√			
3. Was a "Zero" sample (i.e., sample gas comprised of humidified zero air) collected second? Review documentation.		√		
4. Was the Zero sample collection integrated over 24 hours (like a real sample collection)? Review documentation.			√	
5. Was the cleanliness criteria, as presented in the NATTS TAD, met? Review documentation.			√	
6. What happens if a sampler does not pass the certification Zero criteria?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Questions or Comments:				
C. PM_{10} Metals Sampling				
1. Are your PM_{10} metals collections for NATTS Program work conducted in accordance with the specifications and procedures presented in the NATTS TAD?	√			
2. Do you collect duplicate samples?		√		Frequency:
3. Do you collect collocated samples?	√			Frequency: 1 in 6 days
4. Hi Volume systems: Is the metals sampling system set to a flow rate between 1.1-1.7 m^3 min^{-1} (39-60 ft^3 min^{-1})? (28.317 L = 1 ft^3)	√			
5. Hi Volume systems: Is the total sample collected in a 24-hour period always greater than 1,584 m^3 (56,000 ft^3)?	√			
6. **Hi Volume systems**: Is/Does the quartz filter:				
a. 8 x 10" in size?	√			
b. Spectro-grade quality with pH ~7.5?	√			
c. Have a collection efficiency > 99% for particles with diameter 0.3 µm and larger?	√			
d. Have a unique ID number that is a permanent part of the filter?	√			
7. Low volume systems: Is the metals sampling system set to a flow rate ~16.7 L min^{-1}? Record flow rate set point in comments.				
8. **Low volume systems**: Is/Does the filter :				
a. 47 mm in size?				
b. Have a unique ID number that is a permanent part of the filter?				
9. Is the sampler set up to collect PM_{10}:				
a. High Volume?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
b. Low Volume?				
10. Is the sampler operated:				
a. every sixth day?	√			
b. for 24 hours, from 12:00 AM to 11:59 PM?	√			
11. Before beginning sampling, is the filter installed, the sampler allowed to warm up for 5 minutes, then a flow check performed to verify that the sampler is operating in the acceptable flow rate range?	√			
12. Following the completion of sampling, is the sampler allowed to warm up for 5 minutes, then a flow check performed to determine the final flow rate and to determine the amount of gas sampled?	√			
13. Do you generate field blanks? Frequency?	√			Frequency: once every 2 months
14. When site technicians handle samples in the field:				
a. Are the samples handled with appropriate gloves?				
b. Are the filters folded?				
15. How are the filters transported to the laboratory?				
16. Are the filters stored at the site after collection? If yes, what is the storage time?				
Additional Comments:				
D. Chromium VI Sampling				
1. Are your hexavalent chromium collections for NATTS Program work conducted in accordance with the specifications and procedures presented in the NATTS TAD?			√	
2. Do you collect duplicate samples?			√	

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
3. Do you collect collocated samples?			√	
4. Is the Chromium VI sampling system set to a flow rate ~15.0 L min^{-1}? Record flow rate set point in comments.			√	
5. Is the filter made of ash less cellulose fiber?				
a. 47 mm in size?				
b. Have a unique ID number that is a permanent part of the filter?				
c. Was the filter pre-treated properly with 10% nitric acid, washed with distilled water, and then soaked in a 0.12M sodium bicarbonate solution?				
d. Did the filter appear to be dry prior to placing on the sampler?				
6. Is the sampler set up to collect TSP:				
7. Is the sampler operated:				
a. every sixth day?				
b. for 24 hours, from 12:00 AM to 11:59 PM?				
8. Before beginning sampling, is the filter installed, the sampler allowed to warm up for 5 minutes, then a flow check performed to verify that the sampler is operating in the acceptable flow rate range?				
9. Following the completion of sampling, is the sampler allowed to warm up for 5 minutes, then a flow check performed to determine the final flow rate and to determine the amount of gas sampled?				
10. Do you generate field blanks? Frequency?				Frequency:
11. When site technicians handle samples in the field:				
a. Are the samples handled with appropriate gloves?				
b. Are the filters folded?				
c. Are the filters placed in a separate shipping container?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
12. How are the filters transported to the laboratory? (**cooler with frozen "blue ice" containers**)				
13. Are the filters stored at the site after collection? If yes, what is the storage time? (**should be sent to the laboratory immediately)**				
Additional Comments:				
E. PAH Sampling				
1. Are PAH collections for NATTS Program work conducted in accordance with the specifications and procedures presented in the NATTS TAD?	√			
2. Do you collect duplicate samples?		√		Frequency:
3. Do you collect collocated samples?	√			Frequency: 1 in 6 days
4. Hi Volume systems: Is the PAH sampling system set to a flow rate to obtain a volume greater than 180 m^3 over a 24-hr duration (0.125 m^3 min^{-1} or 4.4 ft^3 min^{-1})? (28.317 L = 1 ft^3)	√			
5. Hi Volume systems: Is the total sample collected in a 24-hour period always greater than 180 m^3 (6,357 ft^3)?	√			
6. Hi Volume systems: Is/Does the glass fiber or quartz filter:				
a. 102 mm diameter quartz filter in size?	√			
b. Does the site use XAD-2 resin in the glass cartridge? If not, what collection media is used (polyurethane foam, etc.)?	√			
d. Have a unique ID number that is a permanent part of the filter?		√		
7. Is the sampler set up to collect TSP:	√			
8. Is the sampler operated:				
a. every sixth day?	√			

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
b. for 24 hours, from 12:00 AM to 11:59 PM?	√			
9. Before beginning sampling, is the filter installed, the sampler allowed to warm up for 5 minutes, then a flow check performed to verify that the sampler is operating in the acceptable flow rate range?	√			
10. Following the completion of sampling, is the sampler allowed to warm up for 5 minutes, then a flow check performed to determine the final flow rate and to determine the amount of gas sampled?	√			
11. Do you generate field blanks? Frequency?	√			Frequency: Quareterly
12. When site technicians handle samples in the field:				
a. Are the samples handled with appropriate gloves?				
b. Are the filters folded?				
13. How are the filters transported to the laboratory?				
14. Are the filters stored at the site after collection? If yes, what is the storage time?		√		
Additional Comments				

Part 4. Sampler Siting

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
A. Sampler Siting				
1. Does the location for the samplers conform to the siting requirements of 40CFR58, Appendix E?				
2. Are there any visible hazards or noticeable problems at the site?				
3. Are there any changes at the site that might compromise original siting criteria (e.g., fast-growing trees or shrubs, new construction)?				
4. Are there any visible sources that might influence or impact the monitoring instrument?				
5. Horizontal and vertical placement. Indicate Y/N to criteria for each sampler, and if no, specify why:				
a. **VOCs** – The inlet probe must be between 3-15 m above ground level. The probe must be at least 1 m vertically or horizontally away from any supporting structure, wall, parapets, etc., and away from dusty or dirty areas. If the probe is located near the side of a building, it should be located on the windward side relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.				
b. **Carbonyls** - The inlet probe must be between 3-15 m above ground level. The probe must be at least 1 m vertically or horizontally away from any supporting structure, wall, parapets, etc., and away from dusty or dirty areas. If the probe is located near the side of a building, it should be located on the windward side relative to the prevailing wind direction during the season of highest concentration potential for the pollutant being measured.				
c. **Metals** – Sampler inlets for microscale PM_{10} monitor must be between 2-7 m above ground level. Sample inlets for middle or large scale PM_{10} is between 2-15 m above ground level.				
d. **Chromium VI** – Sampler inlets for microscale PM_{10} monitor must be between 2-7 m above ground level. Sample inlets for middle or large scale PM_{10} is between 2-15 m above ground level.			√	

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
e. **PAHs** – Sampler inlets for microscale PM_{10} monitor must be between 2-7 m above ground level. Sample inlets for middle or large scale PM_{10} is between 2-15 m above ground level.				
6. Spacing from obstructions. Indicate Y/N to criteria for each sampler, and if no, specify why:				
a. **VOCs** – The probe must have unrestricted airflow and located away from obstacles so that the distance from the monitoring path is at least twice the height the obstacle protrudes above the monitoring path. The monitoring path must be clear of all trees, brush, buildings, plumes, dust, or other optical obstructions, including potential obstructions that may move due to wind, human activity, growth of vegetation, etc.				
b. **Carbonyls** - The probe must have unrestricted airflow and located away from obstacles so that the distance from the monitoring path is at least twice the height the obstacle protrudes above the monitoring path. The monitoring path must be clear of all trees, brush, buildings, plumes, dust, or other optical obstructions, including potential obstructions that may move due to wind, human activity, growth of vegetation, etc.				
c. **Metals** – If the sampler is located on a roof or other structure, there must be a minimum of 2 m separation from walls, parapets, etc. No furnace or incineration flues should be nearby. In the case of emissions from a chimney resulting from natural gas combustion, the sampler should be placed at least 5 m from the chimney. If fuel oil, coal, or solid waste is burned and the stack is sufficiently short, such that the plume could impact the sampler, other buildings/locations in the area, free from these sources, should be considered. The sampler path must be located away from obstacles so that the distance from the sampler is at least twice the height the obstacle protrudes above the sampler, except for street canyon sites. Anything closer should not be classified as neighborhood, urban, or regional scale, but as middle scale. Airflow must be unrestricted in an arc of 270 degrees around the sampler except for street canyon sites. The predominant direction for the season with the greatest pollutant concentration potential must be included in the 270-degree arc.				

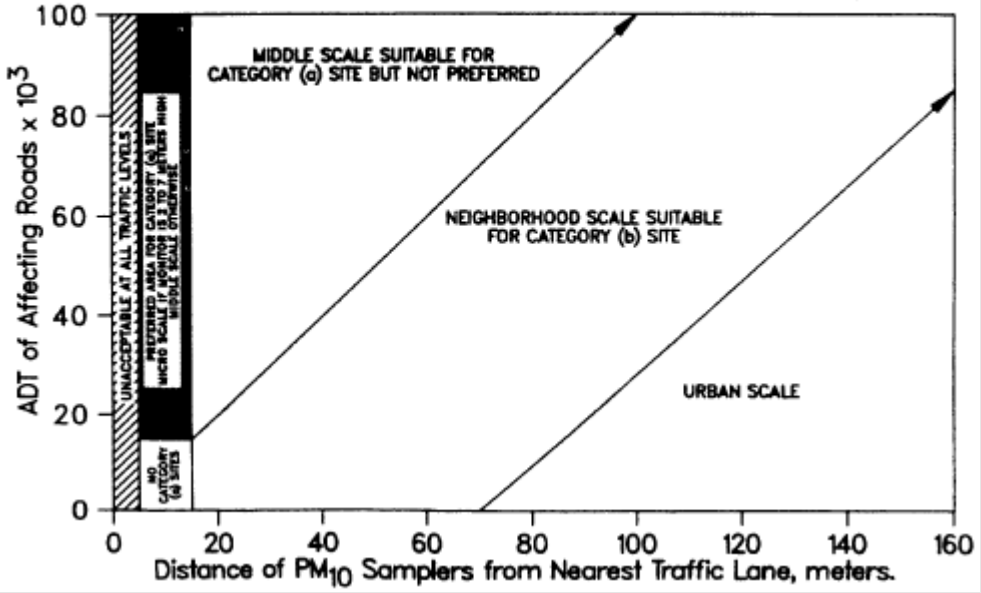
AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
d. **Chromium VI** – If the sampler is located on a roof or other structure, there must be a minimum of 2 m separation from walls, parapets, etc. No furnace or incineration flues should be nearby. In the case of emissions from a chimney resulting from natural gas combustion, the sampler should be placed at least 5 m from the chimney. If fuel oil, coal, or solid waste is burned and the stack is sufficiently short, such that the plume could impact the sampler, other buildings/locations in the area, free from these sources, should be considered. The sampler path must be located away from obstacles so that the distance from the sampler is at least twice the height the obstacle protrudes above the sampler, except for street canyon sites. Anything closer should not be classified as neighborhood, urban, or regional scale, but as middle scale. Airflow must be unrestricted in an arc of 270 degrees around the sampler except for street canyon sites. The predominant direction for the season with the greatest pollutant concentration potential must be included in the 270-degree arc.			√	
e. **PAHs** – If the sampler is located on a roof or other structure, there must be a minimum of 2 m separation from walls, parapets, etc. No furnace or incineration flues should be nearby. In the case of emissions from a chimney resulting from natural gas combustion, the sampler should be placed at least 5 m from the chimney. If fuel oil, coal, or solid waste is burned and the stack is sufficiently short, such that the plume could impact the sampler, other buildings/locations in the area, free from these sources, should be considered. The sampler path must be located away from obstacles so that the distance from the sampler is at least twice the height the obstacle protrudes above the sampler, except for street canyon sites. Anything closer should not be classified as neighborhood, urban, or regional scale, but as middle scale. Airflow must be unrestricted in an arc of 270 degrees around the sampler except for street canyon sites. The predominant direction for the season with the greatest pollutant concentration potential must be included in the 270-degree arc.				
7. Spacing from trees. Indicate Y/N to criteria for each sampler, and if no, specify why:				
a. VOCs - The probe must be at least 10 m from the drip line of the tree or trees.				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
b. Carbonyls - The probe must be at least 10 m from the drip line of the tree or trees.				
c. Metals - The sampler must be at least 10 m from the drip line of the tree or trees.				
d. Chromium VI - The sampler must be at least 10 m from the drip line of the tree or trees.				
e. PAHs - The sampler must be at least 10 m from the drip line of the tree or trees.				
8. Spacing from roadways. Indicate Y/N to criteria for each sampler, and if no, specify why:				
a. VOCs - Does the distance from the sampler to the roadway fit the criteria shown in table below?				
b. Carbonyls - Does the distance from the sampler to the roadway fit the criteria shown in table below?				
c. Metals – If the area is primarily affected by mobile sources and the maximum concentration area(s) judged to be a traffic corridor or street canyon, the monitor should be located near roadways with the highest traffic volume. See Figure 2 below or 40 CFR 58 App. E.				
d. Chromium VI – If the area is primarily affected by mobile sources and the maximum concentration area(s) judged to be a traffic corridor or street canyon; the sampler should be located near roadways with high traffic volume. See Figure 2 below or 40 CFR 58 App. E.				
e. PAHs – If the area is primarily affected by mobile sources and the maximum concentration area(s) judged to be a traffic corridor or street canyon, the monitor should be located near roadways with the highest traffic volume. See Figure 2 below or 40 CFR 58 App. E.				
9. What are the GPS coordinates (latitude and longitude) for the field site:				N W
10. What is the elevation of the site (feet)?				

AUDIT QUESTIONS	RESPONSE			COMMENTS
	Y	N	NA	
Additional Comments:				

For VOCs and Carbonyls	
Roadway Average daily traffic, vehicles/day	**Minimum separation distance, m**
<10,000	**10**
15,000	**20**
20,000	**30**
40,000	**50**
70,000	**100**
>110,000	**250**
For Metals	

Figure 2. Acceptable Areas for PM_{10} Micro, Middle, Neighborhood, and Urban Samplers Except for Microscale Street Canyon Sites.



SITE DRAWING

Part 5. Instrument Performance Audit

AUDIT QUESTIONS	RESPONSE/COMMENTS
A. General	
1. Record pressure measurement device (barometer) manufacturer, model number, calibration date.	Manufacturer: Model #: Calibration Date:
2. Record temperature measurement device (thermometer) manufacturer, model number, calibration date.	Manufacturer: Model #: Calibration Date:
3. What is used as standard temperature and pressure for conversions?	Pressure: Temperature:
B. 1. VOC Sampler – Primary	
1. Record sampler manufacturer, model number, flow rate set point (at standard conditions).	Manufacturer: Rate Set Point (at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: Calibration Date:
3. Record flow rate of the flow measurement device while monitoring flow of air through VOC sampler.	Flow Rate Measured:
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature.	Site Temperature (ºC) Auditor Temperature (ºC)
B. 2. VOC Sampler – Collocated (if applicable)	
1. Record sampler manufacturer, model number, flow rate set point (at standard conditions).	Manufacturer: Model #: Flow Rate Set Point (at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: Model #: Calibration Date:

AUDIT QUESTIONS	RESPONSE/COMMENTS
3. Record flow rate of the flow measurement device while monitoring flow of air through VOC sampler.	Flow Rate Measured:
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature.	Site Temperature (ºC) Auditor Temperature (ºC)
C. 1. Carbonyl Sampler – Primary	
1. Record sampler manufacturer, model number, flow rate set point (at standard conditions).	Manufacturer: Model # Flow Rate Set Point (at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: Model #: Calibration Date:
3. Record flow rate as measured by flow measurement device while monitoring flow of air through carbonyl sampler.	Flow Rate Measured: **Site Result** **EPA Audit Result** **L/min (STP)** **L/min (STP)** **L/min (Actual)** **L/min (Actual)**
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature	Site Temperature (ºC) Auditor Temperature (ºC)
C. 2. Carbonyl Sampler – Collocated (if applicable)	
1. Record sampler manufacturer, model number, flow rate set point (at standard conditions).	Manufacturer: Model # Flow Rate Set Point (at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: Model #: Calibration Date:

AUDIT QUESTIONS	RESPONSE/COMMENTS
3. Record flow rate as measured by flow measurement device while monitoring flow of air through carbonyl sampler.	Flow Rate Measured: **Site Result** **EPA Audit Result** **L/min (STP)** **L/min (STP)** **L/min (Actual)** **L/min (Actual)**
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature	Site Temperature (ºC) Auditor Temperature (ºC)
D. 1. Metals Sampler – Primary	
1. Record sampler manufacturer, model number, impactor cut size, flow rate set point (at standard conditions).	Manufacturer: Model Number: Impactor Cut Size: Flow Set Point (m^3/min at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: Calibration Date: Pressure: Calibration Date:
3. Record flow rate calculated by or pressure drop across flow measurement device while monitoring flow of air through metals sampler. If pressure drop is measured, use flow device calibration curve to calculate flow rate.	Sampler flow rate set at: (m^3/min STP) EPA Pressure Drop Measured: (in H_2O) Site Pressure Drop Measure: (in H_2O) **Site Result** **EPA Audit Result** **m^3/min (STP)** **m^3/min (STP)** **m^3/min (Actual)** **m^3/min (Actual)**
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature	Site Temperature (ºC) Auditor Temperature (ºC)

AUDIT QUESTIONS	RESPONSE/COMMENTS
D. 2. Metals Sampler – Collocated (if applicable)	
1. Record sampler manufacturer, model number, impactor cut size, flow rate set point (at standard conditions).	Manufacturer: Model Number: Impactor Cut Size: Flow Set Point (m^3/min at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: Calibration Date: Pressure: Calibration Date:
3. Record flow rate calculated by or pressure drop across flow measurement device while monitoring flow of air through metals sampler. If pressure drop is measured, use flow device calibration curve to calculate flow rate.	Sampler flow rate set at: (m^3/min STP) EPA Pressure Drop Measured: (in H_2O) Site Pressure Drop Measure: (in H_2O) **Site Result** **EPA Audit Result** **m^3/min (STP)** **m^3/min (STP)** **m^3/min (Actual)** **m^3/min (Actual)**
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature.	Site Temperature (ºC) Auditor Temperature (ºC)
E. 1. Chromium VI Sampler – Primary	
1. Record sampler manufacturer, model number, flow rate set point (at standard conditions).	Manufacturer: Impactor Cut Size: Flow Set Point (L at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: Model #: Calibration Date:

AUDIT QUESTIONS	RESPONSE/COMMENTS
3. Record flow rate calculated by or pressure drop across flow measurement device while monitoring flow of air through metals sampler. If pressure drop is measured, use flow device calibration curve to calculate flow rate.	**Sampler flow rate:** **L/min (Channel 1)** **L/min (Channel 2)** **Site Result** **EPA Audit Result** **Channel 1 L/min (Actual)** **L/min (Actual)** **Channel 2 L/min (Actual)** **L/min (Actual)**
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature	Site Temperature (ºC) Auditor Temperature (ºC)
E. 2. Chromium VI Sampler – Collocated (if applicable)	
1. Record sampler manufacturer, model number, flow rate set point (at standard conditions).	Manufacturer: Impactor Cut Size: Flow Set Point (L at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: Model #: Calibration Date:
3. Record flow rate calculated by or pressure drop across flow measurement device while monitoring flow of air through metals sampler. If pressure drop is measured, use flow device calibration curve to calculate flow rate.	**Sampler flow rate:** **L/min (Channel 1)** **L/min (Channel 2)** **Site Result** **EPA Audit Result** **Channel 1 L/min (Actual)** **L/min (Actual)** **Channel 2 L/min (Actual)** **L/min (Actual)**
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature.	Site Temperature (ºC) Auditor Temperature (ºC)

AUDIT QUESTIONS	RESPONSE/COMMENTS
F. 1. PAH Sampler – Primary	
1. Record sampler manufacturer, model number, flow rate set point (at standard conditions).	Manufacturer: Model #: S/N: Impactor Flow Set Point (m^3/min at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: S/N: Calibration Date: Pressure: Model No: m (at STP) = b (at STP) =
3. Record flow rate calculated by or pressure drop across flow measurement device while monitoring flow of air through metals sampler. If pressure drop is measured, use flow device calibration curve to calculate flow rate.	Sampler flow rate set at: m^3/min or in H_2O EPA Pressure Drop Measured: in H_2O Site Pressure Drop Measure: in H_2O **Site Result** **EPA Audit Result** **m^3/min (STP)** **m^3/min (STP)** **m^3/min (Actual)** **m^3/min (Actual)**
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature	Site Temperature (ºC) Auditor Temperature (ºC)
F. 2. PAH Sampler – Collocated (if applicable)	
1. Record sampler manufacturer, model number, flow rate set point (at standard conditions).	Manufacturer: Model #: S/N: Impactor Flow Set Point (m^3/min at STP):
2. Record flow rate measurement device manufacturer, model number, calibration date.	Manufacturer: S/N: Calibration Date: Pressure: Model No: m (at STP) = b (at STP) =

AUDIT QUESTIONS	RESPONSE/COMMENTS
3. Record flow rate calculated by or pressure drop across flow measurement device while monitoring flow of air through metals sampler. If pressure drop is measured, use flow device calibration curve to calculate flow rate.	Sampler flow rate set at: m^3/min or in H_2O EPA Pressure Drop Measured: in H_2O Site Pressure Drop Measure: in H_2O **Site Result** **EPA Audit Result** **m^3/min (STP)** **m^3/min (STP)** **m^3/min (Actual)** **m^3/min (Actual)**
4. Record barometric pressure.	Site Reading: (mm Hg) Auditor Reading: (mm Hg)
5. Record ambient temperature.	Site Temperature (ºC) Auditor Temperature (ºC)
Additional Comments:	

Figure 1: Probe Cap at Greenville ESC Site showing abrasion.

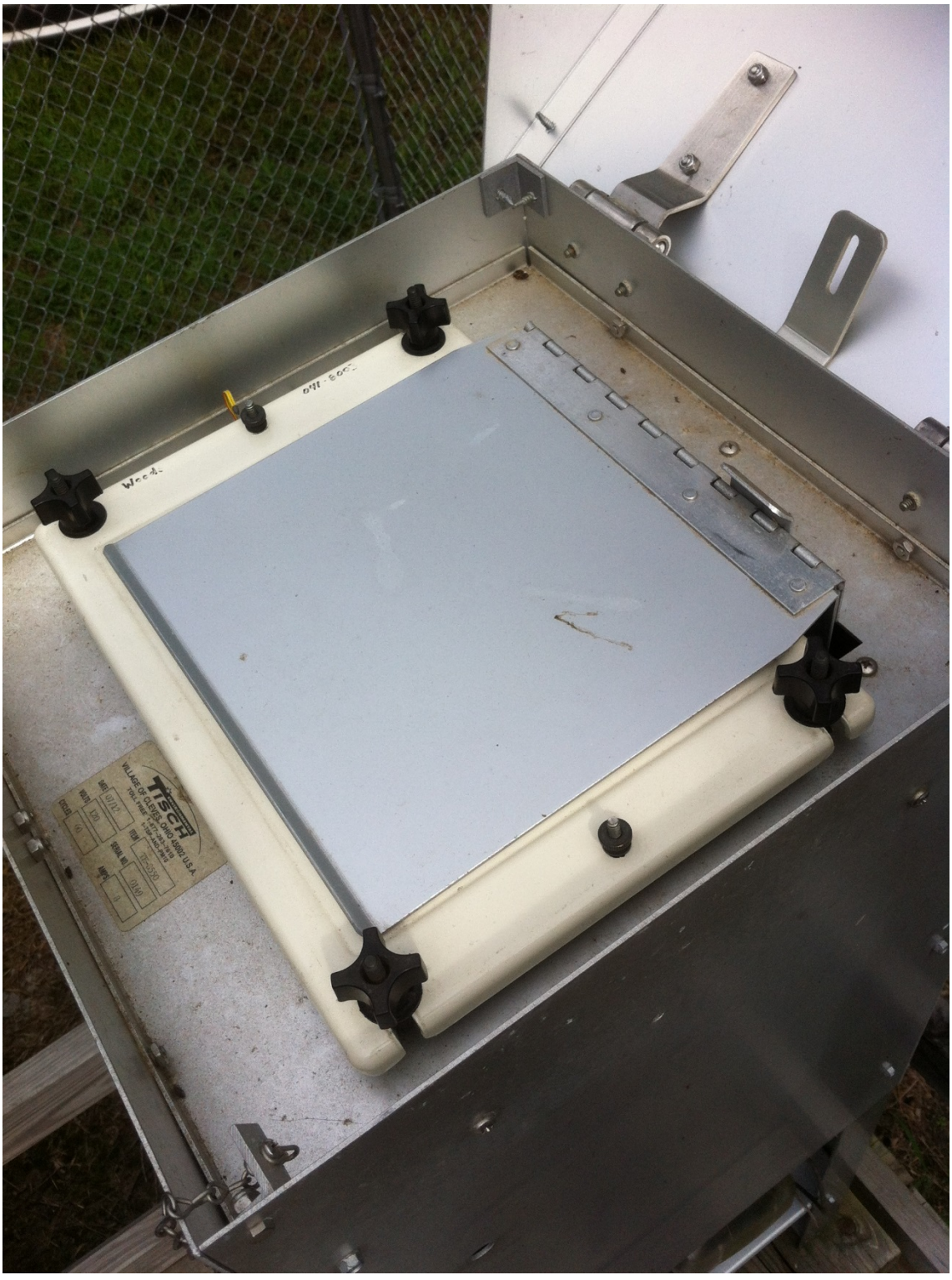


Figure 2: Example of SCDHEC lead sampler cabinet interior showing residue.

Figure 3: Manifold at Long Creek site with residue visible. There is a spider inside the manifold (circled).

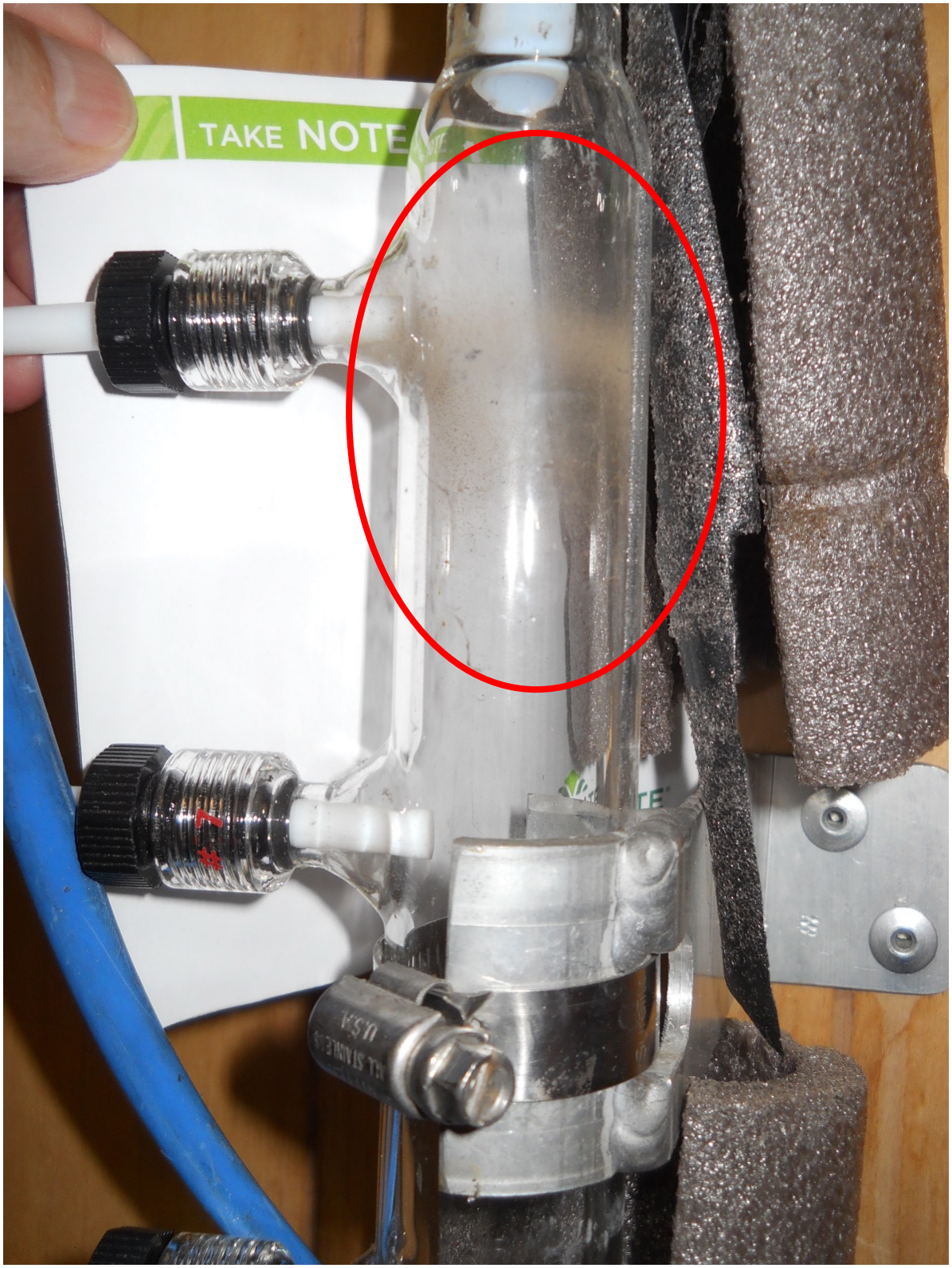


Figure 4: Manifold at Greenville ESC site with residue inside manifold circled.

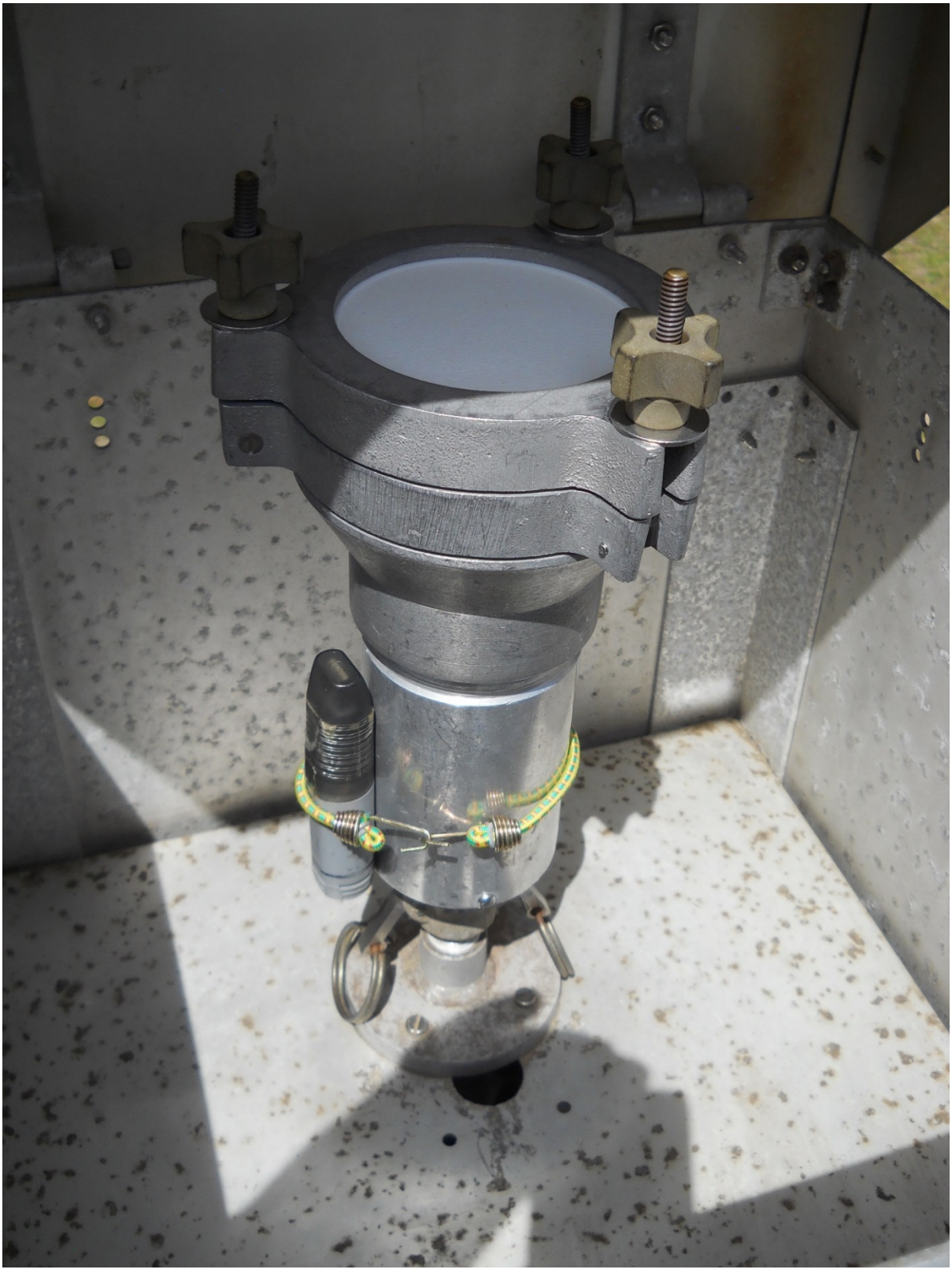


Figure 5: PUF cartridge with temperature logger attached using bungee cable.

(e) The Model 49 can be operated either with or without a particulate filter. If a filter is used, it should be a Teflon filter-holder with a 5-10 micron Teflon filter and should be connected close to the sample inlet bulkhead fitting using a 2-4" length piece of Teflon tubing.

2. MODEL 49-100/103

(a) Follow directions of II.B.1(a)-(d) above, referring to Figure II-1B.

(b) Connect zero-air to the zero air port. The zero air supply should be capable of supplying 2-5 liters per minute at 10 psi.

(c) If a particulate filter is not being used, connect a 5-8 inch piece of Teflon between the bulkhead ports labeled "OUT" and "IN" (this piece of tubing is supplied with the instrument).

(d) If a particulate filter is being used it should be a Teflon filter holder with a 5-10 Micron Teflon filter. It should be connected between bulkhead ports labeled "OUT" and "IN" with a 2-4" piece of Teflon at each end. Note the "OUT" bulkhead port should be connected to the

plumbing zero air into the common port of the ozone-free solenoid valve (see Figure IV-1).

NOTE

The calibrator must be dedicated for calibration and not be used for monitoring ozone at any time. As described below, there are certain checks to assure proper operation of the calibration photometer.

CAUTION

A PHOTOMETER BEING USED AS A CALIBRATOR SHOULD NOT BE USED AS A MONITOR (SEE EPA TECHNICAL ASSISTANCE DOCUMENT).

2. ZERO AIR SUPPLY

Zero air can be obtained either from compressed cylinders or from scrubbed ambient air. If cylinder air is used, it should be actual and not synthetic.

If ambient air is used, the following components must be removed: ozone, NO, NO_2, SO_2, and hydrocarbons. The following scheme is recommended by the EPA in its technical assistance document:

(a) Dry air using a Perma-Pure® type dryer, followed by a column of indicating silica gel;

(b) Irradiate the air with ozone generating

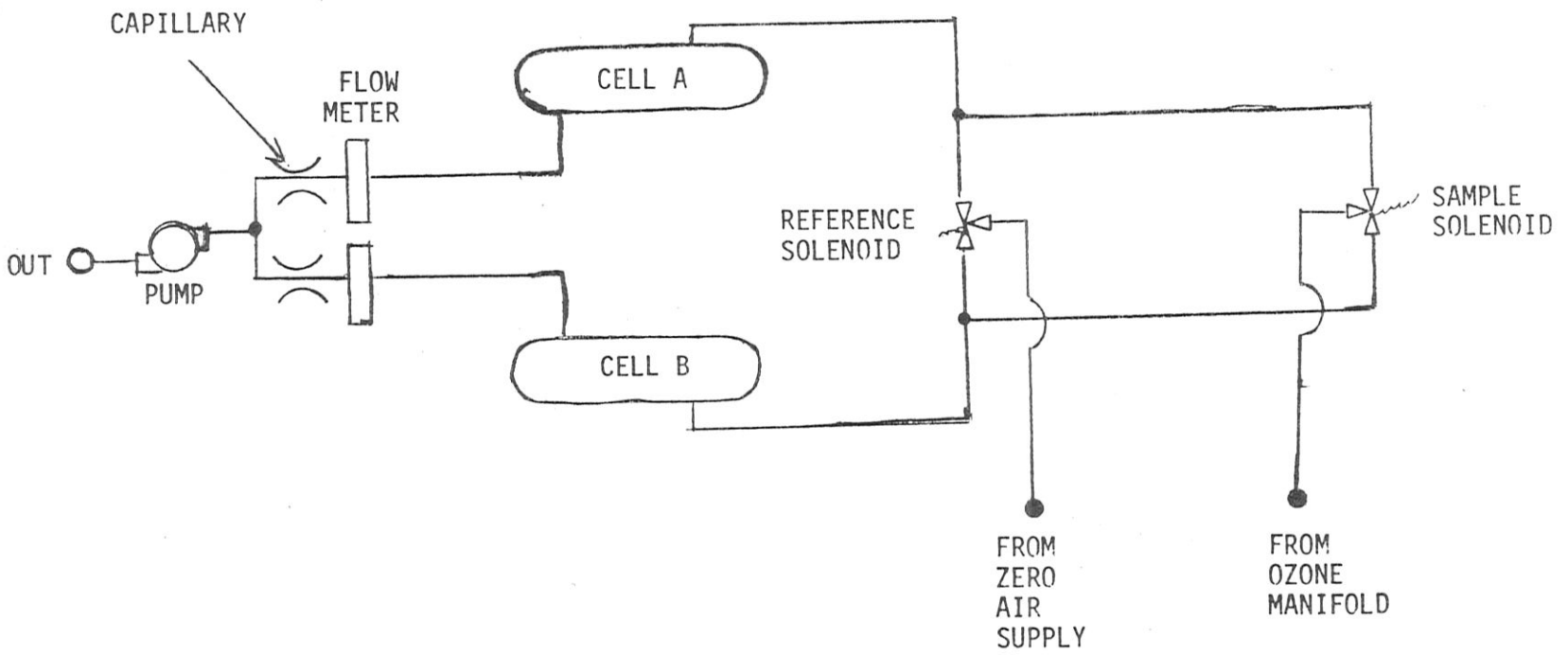


FIGURE IV-1: FLOW DIAGRAM OF MODEL 49 WHEN CONNECTED AS A CALIBRATOR

U-V lamp to convert NO to NO_2;

(c) Pass through a large column of activated charcoal to remove NO_2, O_3, SO_2, hydrocarbons, etc.;

(d) Pass through molecular sieve;

(e) Pass through final particulate filter to remove particulates which originate in scrubbing columns.

An important requirement for the calibration photometer operation is that the zero air used to reference the photometer come from the same source as the zero air used in the ozonator. This is to effectively cancel impurities present in the zero air source.

3. OZONE GENERATOR

An ozone generator capable of supplying a 0-.5 ppm or 0-1.0 ppm, depending upon the range being calibrated, stable ozone level with a flow of 5ℓ/min in order to satisfy both the photometer and the instrument being calibrated.

4. ACCURATE THERMOMETER AND BAROMETER

A thermometer and barometer is necessary to check calibration of the density transducer in the Models 49 and 49-100/103 as well as the pressure transducer and temperature transducer of the Model 49 PS if used.

should be greater than the flow demand of the Model 49. In addition, an atmospheric dump bypass should be utilized to ensure that the zero air gas flow is being delivered at atmospheric pressure.) Record the analyzer response in percent of scale as A_o. Compute the zero drift from the following equation:

$$\text{Zero Drift \%} = A_o - Z$$

where Z is the recorder response obtained at the last calibration for zero air, % scale.

(2) Periodically challenging the Model 49 with an ozone level of approximately 80% of the URL from a previously calibrated stable ozone generator (the output flow from this generator should be greater than the flow demand of the Model 49. In addition an atmospheric dump bypass should be utilized to ensure the span gas flow is being delivered at atmospheric pressure). Record the analyzer response in % of scale as A_{80}. Compute the span error from the following equation: