D H E C
PROMOTE PROTECT PROSPER
Catherine E. Heigel, Director
Promoting and protecting the health of the public and the environment

January 7, 2016

John Deatrick, Chief
Field Services Branch
Science and Ecosystem Support Division
US EPA, Region 4
980 College Station Road
Athens, Georgia 30605-2720

Re: SCDHEC Ambient Air Monitoring Program Technical Systems Audit Project 15-0347

Dear Mr. Deatrick:

On July 13-17, 2015, the US EPA Region 4 Science and Ecological Support Division conducted a Technical Systems Audit (TSA) of the SC Department of Health and Environmental Control's ambient air monitoring program. Attached please find our corrective action plan to address the recommendations within the final report, dated November 17, 2015.

We appreciate the time and effort your staff have invested in this assessment. Their observations, recommendations and assistance are invaluable in the continued maintenance and improvement of the ambient monitoring program. We also appreciate the extra time to respond to the final report.

If you have any questions or need additional information please do not hesitate to contact me at (803) 896-8994 or by email at shealyrg@dhec.sc.gov or Rhonda Thompson in the Bureau of Air Quality at (803) 898-4391 or by email at thompsrb@dhec.sc.gov.

Sincerely,

[redacted]

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SCDHEC RESPONSE TO EPA FINDINGS AND RECOMMENDATIONS

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.

SCDHEC Response:

All network sites with potential vegetation impact have been evaluated. Property owners in all cases but one have been contacted and permissions necessary for removal or trimming have been secured or are in negotiation. Status of each site is indicated in Table SC1. We expect that all tree trimming or removal will be completed by **March 31, 2016.**

We will submit a waiver renewal for one location (Greenville ESC) and, in consultation with Region 4 staff, may submit a waiver request for additional sites. Waiver requests and concurrent public notice will be made by **January 31, 2016**.

All continuous hourly data and 5-minute SO_2 data from January 1, 2015, through the current verified data collected at the following sites have been flagged as requested and submitted to EPA's Air Quality System (AQS) as of December 23, 2015: Ashton, Bushy Park, Chesterfield, Clemson, Congaree Bluff, Cowpens, CPW, Long Creek, and York. The 2015 Lead data for the Parklane site and the two potentially impacted Florence County locations will be flagged by **January 31, 2016**. The 2015 potentially impacted $PM_{2.5}$ data for FAA, CPW and Chesterfield (FRM) and Longcreek (FEM) will be flagged by **January 31, 2016**.

Application of the flags will be discontinued as each site/monitor is addressed. Current AQS reports should show the application of the flags. We will forward AQS reports when all verified 2015 data has been entered.

SCDHEC Schedule for Deliverables:

Item	Date
Tree trimming/removal	March 31, 2016
Site waiver requests for concurrent review with public notice	January 31, 2016
Flagged data – Lead	January 31, 2016
Flagged data – $PM_{2.5}$	January 31, 2016

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).*

SCDHEC Response:
The probe cap was replaced on August 10, 2015. SCDHEC noted that there was no damage to the Teflon coating in the interior or on the edge of the cap. No 'flaking/peeling' or abrasion was noted in any area through which air was compelled to flow by the inlet system.

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.

SCDHEC Response:
The network ozone monitors are universally equipped with ozone sources to allow a daily span check without the overhead of an on-site dedicated transfer standard. The sources are not transfer standards and are not used for or intended to be used for a precision check, and the results are not reported as a precision check to AQS. Pressurized zero air is not required for zero check on the Thermo 49. The source and unpressurized zero scrubber provide an adequate daily operational check for this particular model.

The reference in the instrument manual states "zero air can be obtained either from compressed cylinders or scrubbed ambient air" (IV-2) and "in addition an atmospheric dump should be utilized to ensure that the zero air gas is being delivered at atmospheric pressure" (IV-20).

This model analyzer is configured consistent with Instrument Instruction (Operation) manual and Standard Operating Procedure (SOP). The accuracy of the nightly zero is verified every two weeks during our audits. The manual states that the "following scheme is recommended by the EPA (EPA-600/4-79-057 in the Technical System Document)." Note that the scheme not the only way the instrument can be configured. The Technical System Document (TSD) states "various schemes may be acceptable" and that the "...activated charcoal removes NO_2, O_3, hydrocarbons and various other substances" which may affect instrument response during the checks.

The adequacy of the zero scrubber performance is checked against an audit system zero source during all biweekly precision checks and performance evaluations.

Other analyzer models (ex: Thermo 49i) do require a pressurized source of zero air to operate properly and have a consistent rapid response to the challenge and check the system. This has been determined in the instrument acceptance testing.

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.

SCDHEC Response:
SCDHEC does not use the 40 CFR Part 50, Appendix B Federal Reference Method for Lead analysis. The Manual Equivalent method used by DHEC (EQL-380-044) specifically allows alternate methods of folding the filter for protection of the sample as long as the filter constant is calculated correctly. The current SOP filter handling method protects sampled surface as well as or better than the recommendation.

Field personnel will be instructed and provided wipes to clean hands between filter handling operations to further minimize the potential for cross contamination. Field personnel will also be provided gloves to be used in filter handling operations. More detailed instructions will be included in a revision to the field operations SOP by **January, 31, 2016**.

A cleaning schedule is established and has been followed which requires this to be done in April and October to ensure post pine pollen cleaning of the samplers. The cleaning schedule will be modified to a 4 month frequency (April/August/December) and cleaning materials provided to the field operator for non-scheduled touchups. The field operations SOP will be revised to include total suspended particulate (TSP) sampler cleaning by **January 31, 2016**. In addition, self-tapping screws used in the sampler construction will be replaced with fasteners to facilitate more frequent cleaning and minimize injury by **January 6, 2016**.

Finally, central lab staff will schedule on site visits to observe routine field sample collection operations by regional staff. Initial observations and on-site training will be completed by **March 31, 2016.**

SCDHEC Schedule for Deliverables:

Item	Date
Replace self-tapping screws	January 6, 2016
Field Operations SOP revisions	January 31,2016
Observe and conduct onsite training of sample collection	March 31, 2016

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.

SCDHEC Response:
A six month replacement schedule is in place and is followed. The equipment malfunction reporting system (Yellowcard) has a manifold/line cleaning/replacement schedule incorporated. Approaching due dates for scheduled service are available on an opening page/one button report. Completion of the task is documented in the Yellowcard system.

Manifolds at Long Creek (August 12, 2015) and Greenville (August 10, 2015) were replaced. Cape Romain's inlet was cleaned and fittings changed with clean fittings (August 10, 2015).

Spare manifolds are available and are used when replacement/cleaning is needed to allow thorough cleaning. No periodic inspection will prevent foreign material in the inlet system. For example, the Cape Romain inlet line and manifold had to be replaced within 30 days of the August 10 service due to a mud dauber nest.

All staff are expected to observe and report intake, and correct if possible, any manifold and line issues observed at each site visit and that responsibility has been discussed with all DAQA field staff and will be refreshed during annual SOP review.

SCDHEC Schedule for Deliverables:

Item	Date
Observe and conduct onsite training of sample collection	March 31, 2016

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.

SCDHEC Response:
Significant funding recently received allowed replacement of problematic instruments and the start of phased replacement of monitors. Equipment will be replaced as quickly as funding is available and new instruments can be incorporated into the network. Additional funding has been requested from the State Legislature to replace and modernize the air monitoring network. A final decision will be made by July 1, 2016. In addition, the Department plans to request additional grant funding through EPA Region 4 for monitor replacements by the January 15, 2016, deadline.

SCDHEC Schedule for Deliverables:

Item	Date
Request EPA grant funding for monitor replacements	January 15, 2016

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.

SCDHEC Response:
All equipment is tested prior to operational field deployment. On occasions where field deployment is used as part of the evaluation (typically collocated with an operating site monitor) the data is not submitted to AQS. Equipment is tested while under warranty. Improvements for more efficient use of space for testing, troubleshooting and evaluation are being explored.

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, Section8.2.

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.

SCDHEC Response:
The 2013-2015 low volume filter data have been reviewed (for impact on data completion/average) and evaluated. Filters that were weighed when conditions were not in

control have been identified and records are being created to address the affected data points in AQS. All affected data will be corrected in AQS by **March 31 2016.**

In all cases the temperature was below the range stated in the rule. There were no deviations to the humidity criterion. Equivalent review of weigh batch standard deviation information was not possible for the first two quarters of 2012. The recording of the standard deviation of the environmental conditions was initiated in mid-May, 2012, in response to the 2012 TSA Report received in April, 2012.

Lab staff have been instructed to follow the SOP and not weigh filters when any of the conditions outlined in 40 CFR Part 50, Appendix L, Sec. 8.2 have not been met and to follow the corrective actions outlined in the Laboratory's $PM_{2.5}$ SOP. This will be reinforced through the annual review of SOPs by staff.

SCDHEC Schedule for Deliverables:

Item	Date
$PM_{2.5}$ data corrections in AQS	March 31, 2016

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 postsampling 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.

SCDHEC Response:
Comparison of the initial and final weighing conditions occurs at the time of final weighing and is checked during verification by management.

The one deviation that occurred (January 12, 2015) was due to inability of the humidity control to keep up with extreme cold and low humidity over a weekend. Weighing had been postponed from the Friday to Monday to reestablish conditions for a necessary batch of initial weights. Conditions were restored prior to the weighing session but the standard deviation of the humidity when the initial batch was weighed (a guidance suggested indicator) was outside the specification suggested by guidance. Lab management made the decision to proceed with weighing and distribution, concluding that potentially compromised values were better than missed samples – the only alternative. The evaluation of relative humidity data and variability during conditioning is consistent with guidance (QA 2.12 ,7.6). The relative humidity standard deviation had returned to specifications by 18:00 on the 12th. All lab blanks associated with the batch and reweighed during the subsequent final weight sessions met acceptance criteria.

Mechanisms have been put in place to prevent recurrence of this type of environmental control upset. Associated concentration data in AQS will be flagged with a "4" QA qualifier to indicate the atypical laboratory circumstance by **January 31 2016.**

Lab staff have been instructed to follow the SOP and not weigh filters when any of the conditions outlined in 40 CFR Part 50, Appendix L, Sec.8.2 have not been met and to follow the corrective actions outlined in the Laboratory's $PM_{2.5}$ SOP. This will be reinforced through the annual review of SOPs by staff.

SCDHEC Schedule for Deliverables:

Item	Date
$PM_{2.5}$ data flag applied in AQS	January 31, 2016

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.

SCDHEC Response:
This observation does meet the criteria for a "Finding" since there are no requirements for a date and time stamp in the *Federal Register* or Method 2.12 and no impact on data quality. As stated in the discussion, the analyst was observed to follow the weighing protocols outlined in Method 2.12 as well as the laboratory's gravimetric $PM_{2.5}$ SOP. The laboratory will incorporate the date and time stamp into the $PM_{2.5}$ weighing spreadsheet to make data review by independent auditors easier. The revision to the application is currently being tested and is expected to be implemented for the 2016 filter initial weights.

The gravimetric $PM_{2.5}$ SOP will be reviewed to determine if any significant revision is needed to reference the additional data collection.

SCDHEC Schedule for Deliverables:

Item	Date
Add date and time stamp into $PM_{2.5}$ weighing spreadsheet and test	January 9,2016
Review gravimetric $PM_{2.5}$ SOP	January 31, 2016

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.

SCDHEC Response:
The cause of instability has been determined to be the presence of a second person standing and moving around in the small volume of the weight room during weighing operations. Only one person is typically allowed in the work space during weighing activity. The microbalance is sufficiently stable and its stability has been observed over multiday periods of 1 minute and 5 minute observations. The balance is not impacted or affected by flow of the air conditioner in typical conditions. The taring process is consistent with guidance in Method 2.12, Sec. 7.9.6 which indicates "… should rezero the balance between each weighing."

The placement of the High Volume filter weighing and conditioning in the conditioned space area is more likely to be subject to discernible air flow around the balance than the low volume balance area. Collocation of weighing activity in one conditioned space is necessitated by space and operational limitations, provides tighter control for the high volume methods and has been demonstrated through lab and batch blank results of low volume filters to have no impact on the analysis.

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.

SCDHEC Response:
The SOP for $PM_{2.5}$ Laboratory Procedures (AV.1) will be revised to include appropriate equipment for protection of sample integrity, to include anti-static gloves and lab coats, by **January 31, 2016.**

SCDHEC Schedule for Deliverables:

Item	Date
Revisions to $PM_{2.5}$ Laboratory Procedures SOP	January 31, 2016

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 all precision checks for all 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.

SCDHEC Response:
Errors in validation caused by lapse in process have been identified and the data corrected in AQS. Limits are being corrected/clarified in revisions to related SOPs and the Ambient Monitoring Quality Assurance Program Plan (QAPP), all to be completed by **September 30, 2016.**

Ozone **warning/action** limits were changed from ±10% to ±7% in 2010. This limit is used to indicate the necessity to re-calibrate the instrument. Until January 2015, we were not invalidating data until the "span" point indicated >25% difference (%D) **and/or** the average of all of the points was >25%D. Beginning in 2015, we changed to invalidating data when the span and/or the average of all points were >15%D.

Moving forward, we still plan to use **±7%** as our **warning/action** limit to re-calibrate, but will invalidate data when the "**precision**" point and/or the average of all audit points are **>±15%.** We will only calibrate the monitors when an audit fails or maintenance is performed, not quarterly as we have done in the past. Ozone instrument SOPs will be revised to reflect the change. All related SOPs will be revised by **March 31, 2016.**

Spreadsheets used by staff to calculate and document field QA activity have been reviewed and re-configured to include conditional formatting to indicate "Pass/Fail" and "Valid/Void" audits based on the precision point and/or the average of all audit points. The spreadsheets have been protected to prevent any changes to formulas and are now "Read Only" for staff. All cells that require information will be yellow and will only turn white when a response is entered into the cell.

The spreadsheets have been prepared to facilitate future mining of the data to facilitate more comprehensive review of the QA data.

All 2012 through 2015 Ozone data and supporting documentation (through the latest available 2015 verification) have been reviewed, validated and entered into AQS using the 7%D Action and 15%D (Average or precision point) criteria.

All associated QA data in AQS is being reviewed for errors or omissions that may impact the performance characterizations provided by summary statistics. QA review will be completed by **January 31, 2016,** to allow recertification which will be accompanied by the requested AQS database AMP reports.

SOP's for the TE-49 (App. AN) and the API-400E (App. CJ) have been updated and after management review, will be submitted for EPA approval. SOPS for 49c (BM rev) and 49i (CM new) will be submitted by **March 31 2016.**

The Monitoring QAPP and specific instrument SOPs are being revised so that QA criteria is incorporated in the SOP to provide clear indication to users (in addition to the spreadsheet conditional formatting) of the control and actions limits for the parameter.

The requested AQS AMP reports will accompany SCDHEC's recertification letters for the 2012 through 2014 calendar years.

SCDHEC Schedule for Deliverables:

Item	Date
Monitoring QAPP revisions	September 30, 2016
Ozone SOP revisions (App BM and CM)	March 31, 2016
Ozone data AQ review	January 31, 2016

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.

SCDHEC Response:
As indicated in response to 3.3.1, all 2012 through 2015 continuous gaseous data and supporting documentation (through the latest available 2015 verification) have been reviewed, validated and entered into AQS.

Reverification of $PM_{2.5}$ data is almost complete. Once data points are verified the Data Management staff will use the most efficient method to modify the AQS records and verify the corrected data is resubmitted. This will be completed by **April 30, 2016** to allow for recertification of the data.

Requested reports will be provided with the recertification of the data.

SCDHEC Schedule for Deliverables:

Item	Date
Resubmission of 2012 – 2015 $PM_{2.5}$ data	April 30, 2016

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.

SCDHEC Response:
Three staff positions are in the hiring process to allow more attention to be paid to operational and QA needs in the Audit and Calibration, Data Management and Analytical Sections. Two part-time positions have been authorized to assist with QA document and data review. Budget requests to support modernization of equipment were noted previously (3.1.6).

AQS Site and Monitor records have been reviewed and the records correctly indicate the metadata associated with the monitors. Requested reports will be provided with the recertification of the data, by **May 1, 2016.**

SCDHEC Schedule for Deliverables:

Item	Date
Submission of AMP 430 report to SESD	May 1, 2016

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.

DHEC Response:
In the most recent agency budget process, SCDHEC requested resources to provide two FTE's for quality assurance (QA) positions to reestablish an independent QA function. In the interim, the Bureau of Environmental Health Services (BEHS), within which the air monitoring program operates, has tasked an experienced QA manager (formerly the QA manager for DHEC environmental programs) to assist with data review tasks and document review. We are in the process of hiring a part time hourly position to provide additional ongoing review of data and facilitate revision and review of QA documentation.

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 startup. 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.

SCDHEC Response:
The schedule for external review (by designated staff outside DAQA) of critical documents identified in the Audit are listed in Table SC2. The remaining SOPs will be prioritized and scheduled as our commitments are met.

Two part-time positions have been authorized to assist with QA document and data review.

DAQA SOP (BA) was modified to incorporate external review (by designated staff outside DAQA) in September, 2015 to expedite review and submission of SOPs and QAPPS.

Ambient Monitoring QAPP will incorporate NCore activity and will be available for external review (by designated staff outside DAQA) by **June 30, 2016.**

$PM_{2.5}$ QAPP is being revised to include elements in response to the 2015 Technical Systems Audit Report. We expect to provide it for external review (by designated staff outside DAQA) by **January 15, 2016.**

FY 2016 NATTS QAPP revision is in external review (by designated staff outside DAQA). It will be submitted by January 15, 2016.

JCI Lead project QAPP necessitated by switch to analysis using National contract lab will be provided for external review by **January 31, 2016.**

SCDHEC Schedule for Deliverables:

Item	Date
Ambient Monitoring QAPP	June 30, 2016
$PM_{2.5}$ QAPP	January 15, 2016
JCI Project QAPP	January 31, 2016

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 JCl 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.

SCDHEC Response:
The Air Data Analysis and Support Section in the Bureau of Air Quality (ADASS) will continue to perform site evaluations independent of DAQA. Conducting an annual full site evaluation per their current site evaluation SOP would require more resources than are currently available. SCDHEC will conduct a full site evaluation every three years and conduct a more abbreviated check of the Appendix E probe siting requirements on a one to two-year basis, as resources permit. ADASS is in the process of completing a revision of the site evaluation SOP. We anticipate submission of the site evaluation SOP by **March 31, 2016**.

The responsibility for the site evaluation will be incorporated into the Monitoring QAPP (to be provided for external review by designated staff outside DAQA by June 30, 2016).

SCDHEC Schedule for Deliverables:

Item	Date
Site Evaluation SOP (BAQ – ADASS)	March 31, 2016

Item	Date
Ambient Monitoring QAPP	June 30, 2016

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.

SCDHEC Response:
As funding mechanisms are identified we will evaluate purchasing dedicated calibrators to be used for auditing purposes.

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.

SCDHEC Response:
SCDHEC does not understand The EPA concern. SCDHEC does not enter the results of biweekly precision checks as both a 1-point precision check and an annual performance audit.

We continue to challenge the gaseous parameter analyzers more extensively than the required biweekly 1 point (precision) check which includes an additional span verification and additional levels in the multipoint Annual Performance Audit (APE) (where three concentrations are required). Every analyzer calibration is followed within two weeks by a multi-point audit – a zero check and five upscale points, one of which is the precision point. Typically, each ozone monitor receives five to six multi-point audits in an ozone season. The rule does not prohibit the incorporation of additional measurement quality checks.

The entry of span points as an APE check has been the practice for well over 20 years. It is not clear how fewer data points can provide a better record of monitor performance. The reporting is consistent with the requirement is 40 CFR App A, 5.1.1 that each Primary Quality Assurance Organization (PQAO) "...shall report to AQS all valid measurement quality checks it has carried out..." In 40 CFR App A, 4.1.4 it is indicated that the precision and bias indicators and the associated probability limits for a PQAO are solely dependent on the 1-point precision checks. The APEs, whether one or many, "...verify the results of the 1-point QC Checks and [to] validate those results across the range of concentration levels."

The entry of the span data into the QA database does not impact summary statistics for either monitor or PQAO. A complete review of QA data in AQS is being conducted to insure any errors in data entry are corrected prior to re-certification of the data, expected to be completed by **May 1, 2016**.

SCDHEC Schedule for Deliverables:

Item	Date
Re-certification of ambient monitoring data	May 1, 2016

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 setup 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.

SCDHEC Response:
Three staff positions are in the hiring process to allow more attention to be paid to operational and QA needs in the Audit and Calibration, Data Management and Analytical Sections. Two part-time positions have been authorized to assist with QA document and data review. Budget requests to support modernization of equipment were noted previously (3.1.6).

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.

SCDHEC Response:
We will initiate an alternate inert attachment method or discontinue regular monitoring of the sample temperature exposure. The device was only attached to the collocated sampler. No indication of any impact was detectable in the analysis of any collocated sample.

Several years of 100 % collocated, second lab analyzed data has demonstrated there is no loss of material (indicated by spiked surrogates) during media transport. Temperature data logging (initiated at EPA suggestion to document the transport temperatures) has indicated and demonstrated that the heads are not subject to elevated temperature during transport to the region offices or back to the laboratory. Temperatures are maintained below 25°C. All media shipment duration is no longer than overnight from regional offices to the laboratory and from the

laboratory to the regional offices. All shipments are made using the state operated courier service.

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.

DHEC Response:
Sampling in pressurized canisters is used by several NATTS organizations and has practical and analytical advantages, especially for rural background sites where the concentrations of target compounds are expected and demonstrated to be low. Pressurized canisters offer the advantage of allowing larger aliquots and multiple analyses. Pressurized canister samples cannot be contaminated during transport. A leak can only result in less sample, not a lost sample.

The value and acceptability of pressurized canisters is acknowledged in the DRAFT NATTS TAD (4.2.1 and 4.2.5.2.3).

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.

SCDHEC Response:
We will provide powder-free latex gloves for use when handling high volume PM_{10} filters. The associated SOPs will be updated by February29, 2016 to reflect the revision.

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

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

SCDHEC Response:
Fire extinguishers are not maintained at any sites but are carried by all DAQA field staff in their vehicles.

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.

SCDHEC Response:
All DAQA field personnel have been reminded of the proper documentation of logbooks and filter cards.

Proper documentation of errors will be stressed to field personnel in on site and laboratory training and by taking advantage of opportunities to reinforce the instructions in the Field Operations SOP. The training for field staff will occur by March 31, 2016 and reinforced through the annual review of SOPs by staff.

Item	Date
Observe and conduct onsite training of sample collection	March 31, 2016

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.

SCDHEC Response:
Current samplers deployed at the NATTS site in Chesterfield do not allow the operator to record the beginning and ending flows. Current sampler control software allows the user to set the flow rate for the sampler only. The sampler then controls the flow throughout the sampling event based on the set flow rate. The sampler software calculates a total air volume sampled based on the actual flow rate during the sampling event. The operator can review the average, maximum and minimum flow rates during the sampling event only after the end of the event during sample media retrieval. The operator records the average on the chain-of-custody forms.

AIR TOXICS LABORATORY OPERATIONS

Finding 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.

SCDHEC Response:

At the time of the TSA none of our SOPs referred to retired instruments. We were in the process of developing methods for the new dilution system and GC/MS/Concentrator system but we were still using the older instrumentation that was referred to in the SOP.

SOP and QAPP reviews and revisions are in progress as indicated in Table SC2 and final documents will be provided to SESD for approval.

FY 2016 NATTS QAPP revision is in external review. It will be submitted by January 15, 2016.

Finding 3.2.1:

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.

SCDHEC Response:

The current EPA approved SOP does not specify the pressure required for leak checking. Canisters are currently leak checked at only 5 to 10 psig which is the normal range for the samples after collection. The SOP will be revised by **March 31, 2016** to include a pressure of 30 psig for leak checking canisters prior to use as outlined in EPA guidance Method TO-15.

SCDHEC Schedule for Deliverables:

Item	Date
SOP Revision	March 31, 2016

Finding 3.2.2:

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.

SCDHEC Response:
SCDHEC will correct the canister analytical SOP, Section 8.3.1, to reflect the guidance provided in TO-15 by **March 31, 2016**. The precision of replicate analyses should be ≤ 25% relative percent difference.

SCDHEC Schedule for Deliverables:

Item	Date
SOP Revision	March 31, 2016

Finding 3.2.3:
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.

SCDHEC Response:
The instruments used for volatile organic compounds, semi-volatile compounds and carbonyl compounds report an r^2 value to assess the linear regression curve. All SOPs will continue to use r^2 to determine the validity of the linear regression curve, but will also explain the relationship between the r^2 value reported by the instruments and r value required by the guidance. The use of the term correlation coefficient will be changed to r^2 instead. The correlation coefficient will then be calculated ($\sqrt{r^2}$) for comparison with EPA guidance methods and technical assistance documents.

Finding 3.2.4:
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.

SCDHEC Response:
SCDHEC has responded to every suggestion made as the result of EPA systems audits. We will attempt to conduct a MDL study below the calibrated range of the instrument by **February 29, 2016**, to address the current recommendation. MDL methodology will be revised to reflect the requirements of the current TAD when it is final.

Item	Date
MDL Study	February 29, 2016

Finding 3.2.5:
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.

SCDHEC Response:
Field surrogate spikes will be added to cartridges prior to shipment to the field in the future. The SOP for the semi-volatile analysis (AI-2) will be revised to reflect the change by **June 30, 2016.** Once all of the necessary revisions to the SOP are complete the revised SOP will be submitted to EPA for approval.

SCDHEC Schedule for Deliverables:

Item	Date
SOP Revision AI-2	June 30, 2016

Finding 3.2.6:
Samples were not cooled to $\leq 4^{\circ}$ 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 $\leq 4^{\circ}$ C with blue during shipment.

SCDHEC Response:
Implementation of cooling and control at sample collection requires purchase of insulated shipping containers, temperature loggers, additional coolant, and freezer space. Additional shipping cost will be incurred by the program due to additional weight and volume of the containers. The application of the unnecessary temperature requirement is likely to cause unnecessary voiding of samples when the arbitrary limit is exceeded. We will implement as resources will allow.

Several years of collocated, second lab analyzed data has demonstrated there is no loss of material (as indicated by spiked surrogates) during media transport. Temperature data logging has indicated and demonstrated that the heads are not subject to elevated temperature during transport to the district offices or back to the laboratory. Temperatures are maintained below 25°C and typically lower than temperatures to which they are exposed in the sampler. All media shipments are no longer than overnight from regional offices to the laboratory and from the

laboratory to the regional offices. EPA should investigate, confirm and document the need for cooling of the ambient samples for inclusion of supported guidance in the current NATTS Technical Assistance Document revision.

Finding 3.2.7
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.

SCDHEC Response:
Currently, the EPA approved SOP for the analysis of semi-volatile organic compounds describes the Soxhlet extraction using hexane only. Experiments performed in the laboratory with spiked cartridges extracted using hexane only and a 90:10 mix of hexane and diethyl ether have shown no significant impact on the recoveries of PAHs using only hexane. Performance on NATTS PAH proficiency samples have also shown no significant impact on PAH recoveries.

SCDHEC will initiate a new comparison using collocated samples to reconfirm efficacy of the approved method starting with the January, 2016 sample sets and will provide comparison data to the NATTS TAD work group for consideration.

EPA should investigate, confirm and document the need for added ethyl ether to the extraction solvent to document the necessity for the additional cost for analysis of the NATTS target compounds. The results should be considered for inclusion as supported guidance in the current NATTS Technical Assistance Document revision.

Finding 3.2.8:
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.

SCDHEC Response:
Currently, the laboratory has only six positions for Soxhlet extractions and five samplers running on the national 1 in 6 day schedule. QA/QC elements (i.e. field blanks, matrix (cartridge) blanks, and solvent blanks) are added in the sixth position on a rotating basis. The laboratory will develop a schedule to incorporate a laboratory control spike in the rotation of QA/QC elements. The SOP (AI-2) will be revised by **June 30, 2016,** to reflect the addition of the laboratory control spike and the process for preparing the spike.

SCDHEC Schedule for Deliverables:

Item	Date
SOP Revision AI-2	June 30, 2016

Finding 3.2.9:
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.

SCDHEC Response:
The laboratory currently has only six positions for Soxhlet extractions. Spiking six cartridges is the only way to perform the PAH MDL study requested. If EPA is in agreement with only using six spiked cartridges for the MDL study, then the PAH SOP (AI-2) will be revised to reflect the new method for determining the method detection limit. Trying to use seven spike cartridges would require that the spiked cartridges be extracted and concentrated on different days and may impact the MDL study.

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

SCDHEC Response:
The current laboratory SOP provides for analyzing low level and mid-level calibration verification standards throughout the analytical sequence after every ten samples as well as at the end of the analytical sequence. The low level standard used to bracket the samples at the end of the run is a better indicator of system performance and the concentrations detected in the rural samples. The higher mid-level standard will be used if atypical concentrations are observed during a sample run.

Finding 3.2.11:
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.

SCDHEC Response:
The guidance method (TO-11) for carbonyls requires a correlation coefficient of ≥ 0.999 and the EPA approved laboratory SOP allows for a lower limit of the correlation coefficient of 0.995. The laboratory has been comparing the wrong values when determining the validity of the curve. The laboratory has been using r^2 instead of r. The 0.998 was an r^2 value which calculates to an r value of 0.999. The terminology and comparison to guidance methods and documents will be adjusted in the revision of the SOP (AR-2) by **June 30, 2016.**

SCDHEC Schedule for Deliverables:

Item	Date
SOP Revision AR-2	June 30, 2016

Finding 3.2.12:
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.

SCDHEC Response:
MDL studies are being performed as outlined in Section 13.5.1 of EPA Compendium Method TO-11a. Future MDL studies will be performed using the procedure outlined in the final version of NATTS Technical Assistance document involving seven cartridges spiked with a low level standard and extracted. The SOP will be revised to reflect the change in the process of method detection limit determination **within 30 days of the publication of EPA's current Technical Assistance Document revision.**

Comment 3.2.13:
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.

SCDHEC Response:
SCDHEC does not use the 40 CFR Part 50, Appendix B Federal Reference Method for Lead analysis. The Manual Equivalent method used by DAQA (EQL-380-044) specifically allows alternate methods of folding the filter for protection of the sample as long as the filter constant is calculated correctly.

Currently and historically, the laboratory has folded the filters on the short axis and cut a 0.75" x 10" strip for analysis. Cutting the filter in this manner results in a sampled area for extraction of 6.75 sq. in. compared to the 1" x 8" strip that results in a sampled area for extraction of 7.0 sq.in. The filter constant is calculated based on the area of the strip as a fraction of the total sampled area. Any difference in area is accounted for by the calculation of the filter constant used in the calculation of the final concentration.

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.

DHEC Response:

SCDHEC-DAQA will investigate the possible differences between the QC requirements in the method used by the SC DHEC Inorganic Chemistry Lab and the IO-3.5 guidance method referenced in the NATTS Technical Assistance Document. If missing QA/QC elements are discovered, adjustments to the contract laboratory analytical method will be negotiated and implemented by **March 31, 2016.**

Table SC 1 – 40 CFR Part 58, Appendix E Deviations

Site ID	Site Name	Monitor (O_3 = X)	>2h	Drip <10m	Sampler	Lead	>2h	Drip <10m	Deviation area	Property owner - status	P
001-0001	Due West	X									
003-0003	Jackson Middle School	X							<5° ENE	Abandoned golf course - one marginal tree	
007-0005	Big Creek	X									
015-0002	Bushy Park	X							>200° NE & SSW	Looking for replacement site	
019-0003	Jenkins Avenue	x									
019-0046	Cape Romain	X								All trees d>2h, but permit to maintain has been issued by US FWS	✓
019-0048	FAA				X				~100° NNE ~45° WSW	Life Center of Charleston Chas Southern	✓
019-0049	CPW	x			X				~60° ENE	City of Charleston	✓
021-0002	Cowpens	X							>90° ESE and 60° W	Consulting with NPS on alternatives	
025-0001	Chesterfield - roof	X			X				~70° NE	USFWS	
	-PM stand (N)				X				~60° ENE	USFWS	
	-PM10 Stand (S)				X				~90° WSW	USFWS	
029-0002	Ashton	X							~40° NNE & SSW	Private owner	
031-0003	Pee Dee	X									
037-0001	Trenton	X			X						
041-0003	Williams	x			X						
041-8001	JCI Railroad					X					✓
041-8002	JCI Entrance					X			~40° N &~20°	ENE Facility will remove trees	✓
041-8003	JCI River					X				All quadrants Facility will remove trees	✓
043-0011	Howard High #3										
045-0015	Greenville ESC- roof	x							~15° SSE	State of SC	V
	-stand				X				~20° SSE & 10° WSW	State of SC	V
045-0016	Hillcrest	X			X						
045-1003	Famoda Farms	X									
151-000x	Coastal Carolina	X								Site under construction	
063-0008	Irmo	x			X						
063-0010	Cayce City Hall	x									

Site ID	Site Name	Monitor (O_3 = X)	>2h	Drip <10m	Sampler	Lead	>2h	Drip <10m	Deviation area	Property owner - status	P
073-0001	Long Creek	X							135° E to SE	US FS permit granted	✓
077-0002	Clemson	X							20° WNW &10° S	No cut allowed (SC heritage corridor)	
077-0003	Wolf Creek	X									
079-0007	Parklane -roof	X									
	-stand				X	X			~45° SSW	DAQA-tree removal in progress	
079-0019	Bates House - PM10	x							<30° SW	Monitoring likely to be discontinued 2016	V
	-PM2.5				X						
079-0021	Congaree Bluff	X							~130° ESE	~40 Trees identified –consulting with US DOI-NPS and R4	✓
079-1001	Sandhill	X									
083-0009	North Spartanburg	X								Tree might be on Shady Grove Baptist Church property. Possible to swing probe to SW corner of trailer to maximize distance to the tree.	
083-0011	T.K. Gregg	x			X						
091-0006	York	X								Monitoring to be discontinued Q2 2016	
091-000X	York #3	X								Site under Construction	
Grayed criteria met										✓- permission obtained V- variance	

Table SC2

Section		Revision Date	Title	Current Status	Sent to EPA	EPA Approved	External Review	EPA Submit
Appendix	Part							
B		Oct-84	Electronic Calibration for Maintenance Section					
G		Jun-08	Automated Data Units		7/17/2008	9/11/2008		
H		Sep-85	Data Reduction and Quality Control					
I		Sep-85	Data Handling	7/14 rev needs review 15 TSA				
K		Jun-99	Chain-of-Custody and Documentation		0/26/2012	5/18/2007		
P		Dec-91	Total Suspended Particulates	Divided/in process	11/27/1989			
	P-5		High -Volume TSP sampler	Complete- ready for management Review				
Q		Feb-87	Samples & Analysis of Lead in Ambient Air	Divided				
	Q-1		High Volume Filter Extraction Procedure	Complete- In External review (BAQ)	9/26/2012	9/12/2008		
	Q-4		High Volume Filter Lead Data Handling Procedure	Not yet assigned				
	Q.5		High Volume Filter Analysis for Lead Using Graphite Furnace AA	Complete- In External review (BAQ)				
AD		Oct-84	Operation and Maintenance of Precipitation Chemistry Measurements System	Divided (3)				
	AD.1		Field Procedures	reviewed 4/10				
	AD.2		Laboratory Procedures					
	AD.3	Feb-13	Data Handling Procedures	Writing				
AE		Apr-96	Microscopic Analysis of a Particulate Filter					
	AE-1	Mar-11	Airborne Particulate on TSP Filters		4/19/2010	5/8/2012		
	AE-2	Mar-11	Airborne Complaint Samples		4/19/2010	5/8/2012		
AF		Aug-96	High Volume, Size Selective Inlet, Mass Flow Controlled, PM10 Sampling	Complete- ready for management Review				
AI		Feb-96	Method for the Determination of Semi-Volatile Organics in Ambient Air	Divided (2)				
	AI-1	Aug-07	Field Procedures	Update ready for review	4/19/2010	9/28/2007		

Section		Revision Date	Title	Current Status	Sent to EPA	EPA Approved	External Review	EPA Submit
Appendix	Part							
	AI-2		Laboratory Procedures	Revise for new GC/MS installed 11/15 15 TSA				6/30/16
AJ		Aug-90	Thermo Environmental Model 48 GFC Ambient CO Analyzer			9/15/1993		
AK		Jul-93	Thermo Environmental Model 42S Continuous Chemiluminescence NO/NO2/NOY Analyzer	Revising		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	Needs complete revision		9/22/1993		
AN		Jul-93	Thermo Environmental Model 49 U.V. Photometric Ambient Ozone Monitor	Final	9/26/2012	11/28/2012		3/31/2016
AP		Aug-95	Determination of Volatile Organic Compounds in Ambient Air	Revise for new GC/MS installed 11/15/16 15 TSA	8/15/1995	9/21/1995		
	AP-1		Sample Collection Procedures					
AR		Oct-96	Method for the Determination of Carbonyl Compounds in Ambient Air	Divided (2)				
	AR-1		Field Procedures	Management Rev				
	AR-2		Laboratory Procedures	Return for revision 15 TSA	2/13/2008	6/2/2008		6/30/16
	AR-3		ATEC 800 Carbonyl Samper	Writing				
	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	Complete	9/26/2012	6/7/2010		
AV		May-03	PM2.5 Lab Procedures	Divided (2)		5/29/2003		
	AV.1	Sep-09	PM2.5 Laboratory Procedrues		9/24/2009	6/7/2010		1/1/16
	AV.2		Maintenance and Documentation of Weigh Room Conditions					
AX			Gravimetric Analysis of Hi-Vol Particulate Filters	Complete ready for management Review	1/23/2006	5/8/2012		

Section		Revision Date	Title	Current Status	Sent to EPA	EPA Approved	External Review	EPA Submit
Appendix	Part							
AY		Apr-01	MetOne SASS PM2.5 Speciation Sampler		3/27/2001	4/23/2001		
AZ		Jan-14	R&P TEOM 1400A	Complete ready for management Review	2/20/2014			
BA		Jan-06	Writing of Standard Operating Procedures	Revised 01/24/06	N/A	N/A		
BB			Thermo Environmental Model 43A Pulsed Fluorescent Ambient SO2 Analyzer	Complete-ready for management Review				
BD			Tekran Model 2537A Mercury Vapour Analyzer	Needs new format				
BE			Thermo Environmental Model 146 Dynamic Gas Calibration System	Needs new format				
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		8/14/2008	10/31/2008		
BK		Jun-08	Troubleshooting, Maintenance, & Repair of the TSP, PM10, & PUF Samplers		7/17/2008	N/A		
BL		Jun-08	Troubleshooting, Maintenance & Repair of the Thermo-Environmental Model 49 Series Ozone Monitors		7/17/2008	N/A		
BM			Thermo Environmental Model 49c U.V. Photometric Ambient Ozone Monitor	External Review				
BN			Thermo Environmental Model 42 Continuous Chemiluminescence NO/NO2/NOx Analyzer	Writing				
BO		Jun-11	Troubleshooting, Maintenance & Repair of the R&P Model 2025 PM2.5 Sampler		7/17/2008	N/A		
BP		Nov-04	Air Monitoring Site Infrastructure Maintenance		7/17/2008	N/A		
BQ		Jun-08	Troubleshooting, Maintenance & Repair of the Thermo-Environmental Model 42 NOX Monitor		7/17/2008	N/A		
BR			Aethalometer	Writing				
BS		Jun-09	ChartLog		N/A	N/A		
BT		Jun-09	Inventory		N/A	N/A		
BU			PCAS	Writing				
BV		Mar-09	NullData		N/A	N/A		
BW		Mar-09	YellowCard		N/A	N/A		

Section		Revision Date	Title	Current Status	Sent to EPA	EPA Approved	External Review	EPA Submit
Appendix	Part							
BX			Ion Chromatographic Analysis of Anions and Cations of Acid Precipitation Samples	Writing				
BY		Aug-08	Troubleshooting, Maintenance & Repair of the Thermo Environmental Model 43 SO2 Monitor		8/14/2008	N/A		
BZ		Jul-08	Troubleshooting, Maintenance & Repair of the Thermo Environmental Model 48 CO Monitor		7/30/2008	N/A		
CA		Jul-08	Troubleshooting, Maintenance & Repair of the ESC 8816 Data Logger		7/30/2008	N/A		
CB			Method for the Determination of Volatile Organic Compounds in Ambient Air					
	CB.1	Sep-09	Active		9/24/2009	7/21/2010		
	CB.2	Sep-09	Passive		9/24/2009	7/21/2010		3/31/16
CC		Jul-09	Continuous Particulate Speciation Reduction/Verification		7/30/2008	N/A		
CD		Mar-09	Site Evaluation		3/3/2009	3/31/2009		
CE		Jul-08	Hourly Rain Data Validation		7/30/2008	N/A		
CF			BGI frmOmni Particulate Sampler	Complete- ready for management Review				
CG			Teledyne CO Analyzer Model 300EU					
CH			MetOne EBAM Particulate Monitor	Writing				
CI			Environics 6103 Multi Gas Calibrator	Complete				
CJ			Teledyne API Model 400E Photometric Ambient Ozone Monitor	Final				3/31/16
CK			URG 3000	Writing				
CL			Inlet Retention Time Check					
CM			Thermo Environmental Model 49i UV Photometric Ozone Monitor	Initial Draft (BAQ)				3/31/16
CN			Thermo Environmental Model1405F/1405DF TEOM Continuous Particulate Monitor	Formatted needs completion				
CO			Thermo Environmental Model 2025i Particulate Sampler					
CP			Thermo Environmental Model 43i-TLE SO2 Monitor	Formatted - needs completion				

Section		Revision Date	Title	Current Status	Sent to EPA	EPA Approved	External Review	EPA Submit
Appendix	Part							
CQ			Thermo Environmental Model 42i NO/NOx Analyzer	Formatted -needs completion				
CR			Teledyne API Model T300U CO Analyzer	Formatted - needs completion				
			QAPP for Chesterfield, SC National Air Toxics Trend Station	FY16 rev complete – in ext review (BEHS) 15 TSA	5/2/2010	7/21/2010		1/15/16
			QAPP for the PM2.5 Ambient Air Monitoring Program	2015 rev complete – ready for review 15 TSA	2/10/1999	2/17/1999	6/30/16	9/30/16
			QAPP: PM2.5 Speciatian Trends Network (STN) Field Sampling	Revise or incorporate	3/26/2001	4/10/2001	1/15/16	
			QAPP: Lead in Ambient Air EPA Contract Analysis	15 TSA			1/31/16	