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Annual Data Summary Report for the Chemical Speciation of PM2.5 Filter Samples Project

January 1 through December 31, 2010

Prepared for:
U.S. Environmental Protection Agency
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Research Triangle Park, NC 27711

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TABLE OF CONTENTS

Section **Page**

LIST OF APPENDICES

LIST OF TABLES

Table **Page**

LIST OF FIGURES

Figure **Page**

Executive Summary

Introduction

The U.S. Environmental Protection Agency (EPA) established a $PM_{2.5}$ Chemical Speciation Network (CSN) in 1999, and monitoring operations began in February, 2000. The CSN includes the Speciation Trends Network (STN), a core set of 54 speciation trends analysis sites, as well as a variable number of other sites. RTI re-won the CSN contract in 2003 and again in 2008, and the new contract became effective in early 2009.

On this continuing program, RTI supports EPA/OAQPS by shipping ready-to-use filter packs and denuders to all the field sites and by conducting gravimetric analysis of Teflon filters and chemical analyses of several types of filters used in the samplers. RTI is also responsible for scheduling shipments of filters to the monitoring sites and for data reporting. RTI staff perform an extensive array of quality assurance/quality control (QA/QC) activities to ensure that the data provided to EPA and the States are of the highest quality. Laboratory QA activities and results in terms of accuracy, precision, completeness and sensitivity are summarized in this report, along with any corrective actions taken between January 1 to December 31, 2010.

Data Quality Overview

Analytical completeness exceeded 95%, and laboratory accuracy and precision were under control as demonstrated by routine QC samples, laboratory audits, and instrument intercomparison. The RTI International laboratories were audited by EPA personnel during September 2009, but no on-site audit was conducted by EPA during 2010. The Gravimetric Laboratory was audited by the National Environmental Laboratory accreditation Program (NELAP) in December 2010. RTI reported results of Performance Evaluation samples as part of a multi-lab study conducted by EPA's Montgomery Laboratory in late 2009, and the results were reported in 2010. These PE samples encompassed all the major analyses being performed under the CSN contract. The RTI team's results (RTI and DRI laboratories) compared well with results from the other speciation laboratories and the EPA reference laboratory (which only performed EDXRF analyses).

Laboratory Performance

Section 3.0 of this report provides the details of accuracy, precision, and other measures of laboratory performance. The laboratories consistently met their QC goals of routine analyses, which are detailed in Sections 3.1 (Gravimetry Laboratory), 3.2 (Ion Analysis), 3.3 (CSN Organic and Elemental Carbon), 3.4 (Organic and Elemental Carbon by IMPROVE_A), and 3.5 (X-ray Fluorescence).

Data quality for gravimetric mass results was generally found to be satisfactory during 2010. Issues included problems with the weighing chamber environmental controls and static control. These issues were dealt with aggressively so that a minimum of data had to be flagged as outside holding time or environmental criteria, as described in Section 3.1. One old balance was retired and two balances came into use for the CSN program. In addition, the Standard Operating Procedure (SOP) for gravimetric analysis was updated during 2010 to decrease the frequency of duplicate weighing. The frequency of duplicate weighings had been increased in 2005 in response to a debris problem noted with a manufacturer's lot of Teflon filters. The increased duplicate weighing frequency was designed to enable the laboratory to recognize and correct any future filter debris problems more quickly. The laboratory reduced the frequency of initial duplicate weighings to 33%, and final duplicates to 10%. These reductions were based on the very low rate of problems that had been detected by the enhanced weighing frequency over several years.

Minimal problems with laboratory operations and filter media were reported by the Ion and Organic and Elemental Carbon (OC/EC) laboratories (RTI and DRI) during 2010 (Sections 3.3 and 3.4). Interlaboratory performance comparison results were satisfactory. New URG 3000N samplers have now been deployed throughout the entire CSN network to sample quartz filters for OC/EC. DRI analyzes all filters from the 3000N samplers using the IMPROVE_A protocol. Until April 2010, RTI continued analyzing a small number of quartz filters from selected sites by the original STN/CSN method as part of a study to establish comparability between the data produced by the old and new methods.

The XRF laboratories operated by RTI and subcontractor Chester LabNet (CLN) generally met the prescribed QC criteria for analysis (Sections 3.5.1 and 3.5.2). Both laboratories had equipment downtime, which affected sample analysis logistics, but this had no effect on data quality. The RTI and CLN laboratories participate in an intercomparison (round-robin) program described in Section 3.5.2.4. Interlaboratory performance comparison results performed by EPA's National Air and Radiation Environmental Laboratory were satisfactory.

Operations in RTI's Sampling Handling and Archiving Laboratory (SHAL) proceeded normally during 2010. A small number of samples were missed due to late return of shipping containers ("coolers") from the field sites. No significant differences in receipt temperatures between 2010 and previous years was observed. No significant quality issues were reported by the denuder refurbishment laboratory (Section 3.7).

No significant quality issues were reported by the data processing and data validation functions during 2010 (Sections 4.0 and 5.0). Data continues to be reviewed and posted to a secure Web site on a monthly basis for review. Finalized data are posted to the EPA AQS database approximately 60 days after initial posting (Section 4.0). A number of data users contacted SHAL, data processing, and QA personnel with questions about specific data items, or to request explanations about apparent discrepancies. RTI attempts to answer such questions promptly, and works with the agencies to determine the most appropriate data flags for particular situations.

Estimation of MDLs and Uncertainties

Method Detection Limits (MDLs) for all laboratory methods are provided in Appendix A. Uncertainties are estimated based on laboratory QC data, augmented by a 5% concentration-proportional term to account for field handling and sample volume uncertainties. Results from collocated samplers (Section 5.3) indicate that this uncertainty model is reasonable for most chemical species.

Quality Issues

There were three Corrective Action Requests (CARs) issued during 2010. Also, there are some ongoing issues that have not been assigned CARs because there was no specific action that RTI could take, or because they required input and cooperation from others outside RTI. These issues are summarized in the following table.

CAR Number	Lab	Description	Response	Effect on Data
001	Grav Lab	Balance B	Retired Balance B in May	none
002	Grav Lab	Balance E	Repair Balance E in August	none
None	Grav Lab	Static issue	Implemented additional grounding devices	minor, see Gravimetric Laboratory section
None	Grav Lab	Balance F	Put Balance F into service in July	minor, see Gravimetric Laboratory section
None	SHAL	Late-arriving coolers	DOPO and others are notified whenever coolers are received late from the field	Data are flagged as missing

1.0 Introduction

1.1 Program Overview

In 1997, the U.S. Environmental Protection Agency (EPA) promulgated the new National Ambient Air Quality Standards (NAAQS) for particulate matter (PM). The regulations (given in 40 CFR Parts 50, 53, and 58) apply to the mass concentrations (µg/m^3 of air) of particles with aerodynamic diameters less than 10 micrometers (the PM_{10} standard) and less than 2.5 micrometers (the PM2.5 standard).

Currently, a mass measurements network of approximately 900 sites and a chemical speciation network (currently supporting 182 sites) have been established to monitor levels of PM2.5 in the U.S. The mass measurement data from the first network is used for identifying areas that meet or do not meet the NAAQS criteria and supporting designation of an area as attainment or non-attainment. The PM2.5 Chemical Speciation Network (CSN), which is supported by RTI International (RTI), includes the Speciation Trends Network (STN), a core set of 54 speciation trends monitoring sites located primarily in urban areas and a variable number of other sites operated by State, Local and Tribal air monitoring agencies.

This data summary report covers the quality assurance (QA) aspects of the collection and chemical analysis of samples from the CSN sites from January 1 through December 31, 2010. RTI is supporting the PM2.5 CSN by shipping ready-to-use filter packs and denuders to the field sites and by conducting gravimetric and chemical analyses of the several types of filters used in the samplers. The details of the QA activities that are performed for the CSN are described in the RTI QA Project Plan (QAPP) for this project, along with the Standard Operating Procedures (SOPs).

1.2 Project/Task Description

The CSN laboratory contract involves four broad areas:

1. Supplying each site or State with sample collection media (loaded filter packs, denuders, and absorbent cartridges) and field data documentation forms. RTI ships the collection media to monitoring agencies on a schedule specified by the Delivery Order Project Officer (DOPO).

2. Receiving the samples from the field sites and analyzing the sample media for gravimetric mass and for an array of chemical constituents, including elements (by energy-dispersive x-ray fluorescence [EDXRF]), and soluble anions and cations (by ion chromatography). Desert Research Institute (DRI), a subcontractor to RTI, is performing analysis of carbonaceous material using the IMPROVE_A thermal-optical analysis method in both the reflectance and transmittance modes. Analysis of semi-volatile organic compounds, optical density and examination of particles by electron or optical microscopy are included in RTI's contract with EPA/OAQPS, but have not been performed to date.

3. Assembling validated sets of data from the analyses, preparing data reports for EPA management and the State Agencies within 45 days of sampling, and for entering data into the Air Quality System (AQS) data bank 60 days after initial data reports are first submitted to the DOPO and the State Agencies.

4. Establishing and applying a comprehensive QA/quality control (QC) system. RTI's Quality Management Plan (QMP), QAPP, and associated Standard Operating Procedures (SOPs) provide the documentation for RTI's quality system.

1.3 Major Laboratories and Operational Areas

This report addresses the operation of RTI's Sample Handling and Archiving Laboratory (SHAL) and QA/QC for the four major analytical areas active during the time period of January 1 through December 31, 2010. These analytical areas are: (1) gravimetric determination of particulate mass on Teflon® filters; (2) determination of 33 elements on Teflon® filters using X-ray fluorescence (XRF) spectrometry; (3) determination of nitrate, sulfate, sodium, ammonium, and potassium on nylon or Teflon filters using ion chromatography; and (4) determination of organic carbon, elemental carbon, total carbon, and individual peaks for OC, EC, and pyrolysis carbon on quartz filters using thermal optical reflectance (TOR) and transmittance (TOT). RTI laboratories conduct the gravimetric, ions, and XRF measurements. DRI performs the IMPROVE_A carbon analysis for the quartz filters. Denuder refurbishment, data processing, and QA and data validation are also major elements of this program, and are also included in this report.

2.0 Quality Issues and Corrective Actions

2.1 Data Quality

RTI staff perform an extensive array of QA/QC activities to ensure that the data provided to EPA and the States are of the highest quality. Further, RTI makes every effort to provide data that can serve as the basis for making important decisions.

Data quality for the CSN has several dimensions, but the primary goal should be usefulness to data users and understanding of the data set's characteristics. There are several metrics that are typically considered in assessing the quality of the CSN data set:

- Accuracy. All analyses standardized to reference values that are traceable to the National Institute of Standards and Technology (NIST.)
- Precision. Measured both as laboratory and whole-system through regular QC replicates and results from samplers collocated at the same site.
- Completeness. Excellent completeness (>95%) is demonstrated overall. Some individual sites may have lower completeness, typically due to site maintenance or shipping problems.
- Spatial coverage. Selection of sites for CSN is outside of RTI's control. The CSN sites are generally selected to evaluate population-based health effects and tend to be in populated areas. Because of this, the CSN has relatively little coverage of rural sites in the western United States, where IMPROVE sites predominate.
- Comparability. Intercomparison studies recently conducted by EPA have shown good agreement with programs such as the Federal Reference Methods (FRM) network for mass, and IMPROVE results for mass and for most of the major chemical species.
- Representativeness. Primary site selection and field-sampling operations are out of RTI's control.
- Sensitivity/Detection. The ability to quantify major species, such as gravimetric mass, organic carbon, sulfate, nitrate, ammonium, and iron, is adequate; however, many of the trace elements are routinely below limits of detection. Data users should carefully screen out species that are present in such low levels that their inclusion would only add noise to their analysis. Method Detection Limits (MDLs) are provided in **Appendix A** of this report.

In addition to these data quality assessment criteria, there are other issues that affect data usability. The following quality-related issues and other characteristics of the data set should be taken into account in an overall assessment of the data set:

- Lack of blank correction. The main concern is the artifact in organic carbon (OC) measurement. The IMPROVE network includes blank correction for OC in its reported data. This is a fundamental difference between the data reported by CSN and IMPROVE.

- Intermittent media contamination issues. Equipment and media contamination issues arise from time to time and may cause the occasional outliers reported by the monitoring agencies, in which the CSN mass differs from the mass reported by a nearby FRM sampler. RTI makes an effort to flag data, retroactively if necessary, to invalidate or mark as suspicious any events reported by the monitoring agencies.
- Estimation of Uncertainty.
  - Comparability between CSN and other networks. RTI worked XRF experts at the University of California at Davis (UC Davis) and EPA to define an acceptable method for determining XRF uncertainty. This work resulted in a White Paper that was delivered to EPA in 2006.[1] A peer-reviewed publication based on this work published in the Journal of the Air and Waste Management Association in early 2010.[2]
  - Realism of total uncertainty estimates based on statistics from sites with side-by-side collocation of samplers. Uncertainties calculated from collocation results agree with uncertainties reported to AQS within a factor of 2x for most major species. Average uncertainties currently being reported to AQS agree with the calculated uncertainties within a factor of 3x for the majority of other species.[3]

2.2 Summary of Data Completeness

Data completeness network-wide exceeded 95% for **2010**. Completeness is defined as the number of valid measurement values divided by the potential number of values. Data records with AQS validity status codes ("suspicious" data) are included in the completeness figure, but data records with an AQS null value code are counted as missing data.

Appendix B of this report includes more details of the sampling events and completeness for the Reporting Batches delivered in 2010. Table B-1 provides the completeness for the "core" STN sites. Table B-2 summarizes completeness for the non-STN sites that are supported on the CSN contract with EPA.

2.3 Corrective Actions

To ensure ongoing quality work, RTI reacts quickly and decisively to any unacceptable changes in data quality. These reactions are usually in the form of corrective actions. Most of these corrective actions have been in response to very short-term problems, such that very few

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[1] Gutknecht, W. F., J. B. Flanagan, and A. McWilliams, "Harmonization of Interlaboratory X-ray Fluorescence Measurement Uncertainties." RTI/0208858/TO2/04D, August 4, 2006.
[2] Gutknecht, W.F., J.B. Flanagan, A. McWilliams, R.K.M. Jayanty, et al. 2009. Harmonization of uncertainties of X-ray fluorescence data from $PM_{2.5}$ air filter analysis. *Journal of the Air and Waste Management Association*, February, 2010.
[3] Flanagan, James B., R.K.M. Jayanty, E. Edward Rickman, Jr., and Max R. Peterson, "PM2.5 Speciation Trends Network: Evaluation of Whole-system Uncertainties Using Data from Sites with Collocated Samplers," *Journal of the Air and Waste Management Association,* 2006, 56, 492-499.

results were impacted negatively. The following subsections describe corrective actions undertaken in each laboratory area during 2010.

2.3.1 Gravimetric Mass

No pervasive problem with extraneous contaminating debris was identified in 2010 in either enhanced inspection or in routine visual inspection in the chamber. As a result of continuing good results for filters examined, the intensity of filter screening were reduced to meet the baseline criteria of Section 2.12 guidelines beginning in early 2010. One balance was retired from service and two others were put into service during 2010. A concern about static electricity was raised during 2010. Static electricity can cause weighing errors on the sensitive microbalances used for the CSN filters. These concerns were met with preventive measures such as the use of grounding straps and antistatic laboratory coats by the analysts.

2.3.2 Elemental Analysis

See Section 3.4.1.1 for a description of quality issues and maintenance from Chester Labnet, which performs some of the elemental analysis by XRF for the CSN contract.

There were no quality issues or corrective actions during the reporting period.

2.3.3 Ion Analysis

There were no quality issues or corrective actions taken during this reporting period.

2.3.4 Organic Carbon/Elemental Carbon Analysis

RTI's OC/EC laboratory reports no quality issues or corrective actions during this reporting period. RTI's OC/EC laboratory only analyzed a relatively small number of the total samples during 2010 because of the changeover to the IMPROVE_A analysis method. As a result of the changeover, virtually all of the reportable STN/CSN carbon analyses are being performed by Desert Research Institute (DRI), which is a subcontractor on the CSN contract. DRI reports that no corrective actions were necessary during 2010.

2.3.5 Sample Handling and Archiving Laboratory (SHAL)

There were no quality issues or corrective actions taken in the SHAL during 2010.

2.3.6 Data Processing

There were no quality issues or corrective actions taken during this reporting period. The uncertainties for the carbon values for the samples collected by URG 3000N have not yet been posted into AQS, pending direction from EPA about the method to be used for calculations. Blank-corrected IMPROVE_A carbon measurements rely on the same set of calculations, and these have also not been posted, pending direction from EPA.

Uploading of revised values for Organic and Elemental Carbon to AQS, begun under work assignment 1-10 of contract EP-D-08-047, was completed in 2010. The purpose of the updates was to ensure that the data produced during 2000 through July, 2003, were calculated with the same software as later data. The instrument vendor, Sunset Labs, implemented new software in 2003 which had some subtle effects on blank values for some of the analytes. To ensure consistency between the two time periods, the raw instrument data was reprocessed with the newer version of the software.

2.4 Other Quality Issues

None.

3.0 Laboratory Quality Control Summaries

3.1 Gravimetric Laboratory

The RTI Gravimetric Laboratory's two weigh chambers were used to tare 17,543 Teflon filters for the $PM_{2.5}$ speciation program between January 1 and December 31, 2010. During the same time period, the laboratory performed final (post-sampling) weighings of 17,082 Teflon filters for the program. The difference between the number of tared filters and the number of final filters is partly due to the inherent lag time between the initial and final weighing sessions. Determination of $PM_{2.5}$ mass is based on two separate weighings performed several weeks apart. The total also reflects a contingency buffer factored into the number of filters tared each week to ensure an adequate number of tared filters for sampling and extra filters for use in-house blanks contamination monitoring. Filter weighing totals given in this report are those recorded by the laboratory's database application.

3.1.1 Quality Issues and Corrective Actions

No significant filter quality issues were identified in the Gravimetric Laboratory in 2010. The laboratory continued to proactively monitor mass balance data and to perform enhanced inspection of the Teflon filters purchased for use in the program. This inspection is performed in RTI's Optical Microscopy Laboratory on randomly selected filters. A technician examines filters under enhanced lighting using a stereomicroscope at magnifications of 10x to 45x. No pervasive problem with extraneous contaminating debris was identified in 2010 in either this enhanced inspection or in the routine visual inspection in the chamber. Lot stability tests indicated the five Teflon filter lots used for the program in 2010 did not have issues with debris or outgassing.

The laboratory's environmental chambers experienced little downtime due to system failure in 2010. Two inoperable fan motors in Chamber 1's bank of six fans were not replaced in 2010 because the motors currently sold by the vendor are no longer compatible with the chamber's original system installation. The chamber can maintain temperature and humidity controls even when multiple fan motors are burned out, so no loss of acceptable conditioning environment was experienced. Motors in the existing system will be repaired by an electrical shop if another motor burns out. Although the chamber continues to function appropriately to maintain a stable environment, retrofit of the system to accommodate the new design will be necessary if an efficient process for maintaining the current motors cannot be implemented.

During the Annual Chamber Calibration and Service, which was conducted on January 13, 2010 by Bahnson Environmental Specialties, Chamber 2 failed to come back online after restart. It was discovered that the chamber motherboard did not come back online. Environmental Specialties quickly replaced the part.

During the course of 2010, the high bay that houses the chambers had minor problems with the building's chilled water supply and air compressor. The chambers' temperature and humidity controls could not maintain the chamber setpoints when the building conditions became unstable after the chilled water to the entire building was lost and the high bay's air compressor tripped a circuit. RTI's Facilities and Maintenance HVAC team quickly responded to reset the chiller and air compressor, which brought the chambers back into specification. RTI Facilities and Maintenance staff also installed an alarm on the air compressors to have instant notification of a tripped circuit. In all cases, weighing was suspended pending repair and stabilization of the chamber environment.

There were three balance changes in the Gravimetric Laboratory during 2010: one retirement and two deployments. These are summarized in **Table 3-1**.

Table 3-1. Summary of Microbalance Retirement/Deployment in the Gravimetric Laboratory

Lab Designation	Model / S/N	Readability / Repeatability	Retired / Deployed	Comments
B	Metter Toledo UMT2 / 1118311244	0.1 µg / 0.25 µg	Retired April 2010	Age-related failure; end of service life for balance purchased in 1999.
E	Mettler Toledo XP2U / 1129203985	0.1 µg / 0.25 µg	Deployed August 2010	Required repair at MT after storage from 2008-2010.
F	Sartorius ME 5-F / 17508245	1 µg / 1 µg	Deployed July 2010	Filter-weighing balance purchased 2005 had been regularly calibrated but had not been used for routine project weighing.

During the beginning of 2010, data review for post-sampled weigh sessions revealed one analyst having an issue with weighing higher than the other three analysts. The speciation program QA Officer performed an analysis in the database to find out how long the problem had been apparent, but it was specific to a few dates in November and December 2009. No indication was found that the analyst had more outliers than the other analysts. A full investigation was completed to identify the cause of these anomalous results. Through discussions with the analyst and in-house tests by multiple analysts, it was determined to be an issue with static electricity. In response, the laboratory implemented the use of electrostatic discharge devices (ESD) to decrease the effect of static electricity on weigh sessions. The ESD devices employed by the Gravimetric Laboratory are grounding wrist straps, continuous wrist strap monitors, and anti-static laboratory coats. These devices are in addition to the MT U-shaped ionizers that have been used during weigh sessions for many years. A separate performance evaluation was then designed to evaluate the analyst's ability to negate static electricity effects. It was found that in Chamber 1 the analyst had no problems with static electricity. This was also supported by review of data from previous weigh sessions, which demonstrated that the analyst had never had issues with data when weighing in this chamber. However, even with the additional ESD devices, the analyst's results still did not agree well with those of the other analysts on test filters. This was deemed to be a continuing issue with static charge when weighing in Chamber 2 based on the analyst weighing test batches that showed static effects only in one chamber. This test was completed by three analysts. A batch of 10 filters was weighed by two analysts with no history of static effects prior the analyst with static charge. The filters were then reweighed by the first analyst. In Chamber 2, the weights of the first two analysts agreed, while the analyst with static charge weights were higher. When the first analyst reweighed the filters, the weights would start high then after repeat weighings the value settled at the initial weight. In

Chamber 1, all three analysts had the same filter weights. This test was repeated on two occasions to support this conclusion. The analyst was instructed to only weigh filters in Chamber 1 until this could be resolved. This phenomenon is not fully understood at this time despite conferencing with local ESD professionals. The laboratory will continue to proactively monitor data quality and troubleshoot this issue. As a precaution, all analysts continue to use ESDs in both chambers.

Three 100-mg and one 200-mg working mass standards were removed from use during the year pending re-verification by the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) Standards Laboratory. The tolerance interval for one 200-mg weight removed from service was accidentally miscalculated by the RTI laboratory and posted in the lab with the incorrect interval, resulting in a period of 7 months in which weighing staff did not realize the weight was not within the acceptable range. The purpose of the working mass standards is to validate the performance and stability of the balance. During this period, the weight data collected for this 200-mg standard weight were stable indicating the balance was stable. The lab blanks, field blanks, and 100-mg working mass standard weighed on this balance had weight data within specification illustrating that while using the 200-mg standard weight was a deviation from our Standard Operating Procedure, it did not impact data quality. The laboratory maintains several sets of working mass standards and substituted verified standards when the standards in question were removed from service. The laboratory's staggered (spring and fall) re-verification schedule ensures that verified weights are available when a working set is removed from routine use in the chambers. NCDA&CS verifications have already been scheduled for April 2011 and August 2011.

3.1.2 Description of QC Checks Applied

Internal QC checks applied in the Gravimetric Laboratory are described in **Table 3-2**, along with results achieved during this reporting period.

3.1.3 Summary of QC Results

Internal QC values generated by the laboratory usually met the criteria shown in **Table 3-2**; however, a small number of outliers were noted. Nine of the 32 outlier laboratory blank weighings fell above the upper warning limit, suggesting dust fall-out. The chamber continued to be wet-wiped monthly to minimize chances of dust contamination on the filters. Twenty-three of the outlier laboratory blank weighings for 8 individual laboratory blank filters fell below the lower warning limit. These weighings occurred over the course of the entire year; therefore, it is not believed to be a systematic issue of debris on Teflon. In the case of outlier replicates, Gravimetric Laboratory analysts reweighed outliers to validate weights. Although the balance test weights used in the laboratory are working standards and may fall out of tolerance due to wear (scratches or nicks during handling) or environmental contamination, the weights were quite stable in 2010. The laboratory's primary standards are maintained by RTI's Quality Systems personnel and are used to audit the microbalances and verify the working mass standards annually.

Table 3-2. Summary of QC Checks Applied and Results Achieved in the Gravimetric Laboratory

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
Working standard reference weights (mass reference standards)	Verified value ± 3 µg [Standard reference weights initially calibrated by Troemner. Verified by the NCDA&CS in 2010. Verified by the laboratory in conjunction with 2010 internal balance audit performed by RTI Quality Systems Program.	Chamber 1 100-mg S/N 41145 04/23/10 Verification: 99.99672 mg ± 0.00078 Laboratory Tolerance Interval: 99.994 – 100.000 mg	Average = 99.997 mg Std Dev = 0.0016 for 236 weighings	Laboratory average falls within tolerance interval. Eight individual weighings of 100.002 mg fell 2 µg above upper limit. Weight was removed from service.
		100-mg S/N 58096 04/23/10 Verification: 100.00012 mg ± 0.00078 Laboratory Tolerance Interval: 99.997–100.003 mg	Average = 100.003 mg Std Dev = 0.0007 for 757 weighings	Laboratory average falls within tolerance interval. Two individual weighings of 99.996 mg fell 1 µg below lower limit.
		100-mg S/N 14059 07/28/09 Verification: 99.99072 mg ± 0.00081 Laboratory Tolerance Interval: 99.988–99.994 mg	Average = 99.989 mg Std Dev = 0.0010 for 1220 weighings	Laboratory average falls within tolerance interval. Sixteen individual weighings of 99.986 mg fell 2 µg below lower limit. Weight was removed from service.
		08/10/10 Verification: 99.98877 mg ± 0.00078 Laboratory Tolerance Interval: 99.986–99.992 mg	Average = 99.989 mg Std Dev = 0.0008 for 297 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		200-mg S/N 41147 04/23/10 Verification: 200.00781 mg ± 0.0008 Laboratory Tolerance Interval: 200.005–200.011 mg	Average = 200.005 mg Std Dev = 0.0008 for 236 weighings	Laboratory average falls within tolerance interval. Sixty-nine individual weighings of 200.004 mg fell 1 µg below lower limit. Weight was removed from service.
		200-mg S/N 58098 04/23/10 Verification: 200.00291 mg ± 0.00086 Laboratory Tolerance Interval: 200.000-200.006 mg	Mean = 200.002 mg Std Dev = 0.0007 for 756 weighings	Laboratory average falls within tolerance interval. One individual weighing of 200.007 mg fell 1 µg above upper limit.
		200-mg S/N 14056 07/28/09 Verification: 199.99277 mg ± 0.00078 Laboratory Tolerance Interval: 199.990-199.996 mg	Average = 199.989 mg Std Dev = 0.0008 for 1220 weighings	Laboratory average does not fall within tolerance interval. 949 weighings were 1 µg below laboratory tolerance interval due to miscalculation of the interval. Weight was removed from service.

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
		08/10/10 Verification: 199.98948 mg ± 0.0008 Laboratory Tolerance Interval: 199.986-199.992 mg	Average = 199.991 mg Std Dev = 0.0007 for 297 weighings	Laboratory average falls within tolerance interval. One individual weighing of 199.993 mg fell 1 μg above upper limit.
		Chamber 2 100-mg S/N 58096 4/11/09 Verification: 100.00051 mg ± 0.00081 Laboratory Tolerance Interval: 99.997–100.004 mg	Average = 99.999 mg Std Dev = 0.0008 for 343 weighings	Laboratory average falls within tolerance interval. One individual weighing of 100.005 mg fell 1 μg above upper limit.
		100-mg S/N 58097 04/11/09 Verification: 99.998 mg ± 0.00081 Laboratory Tolerance Interval: 99.996–100.004 mg	Average = 100.000 mg Std Dev = 0.0006 for 278 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval
		04/23/10 Verification: 100.0001 mg ± 0.00078 Laboratory Tolerance Interval: 99.997–100.003 mg	Average = 99.999 mg Std Dev = 0.0009 for 271 weighings	Laboratory average falls within tolerance interval. One individual weighing of 99.996 mg fell 1 μg below lower limit.
		100-mg S/N RTI01 07/28/09 Verification: 99.98548 mg ± 0.00081 Laboratory Tolerance Interval: 99.982–99.989 mg	Average = 99.986 mg Std Dev = 0.0007 for 679 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval
		8/10/10 Verification: 99.98584 mg ± 0.00078 Laboratory Tolerance Interval: 99.983–99.989 mg	Average = 99.985 mg Std Dev = 0.0007 for 252 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval
		100-mg S/N 41143 04/23/10 Verification: 99.9906 mg ± 0.00078 Laboratory Tolerance Interval: 99.988 – 99.994 mg	Mean = 99.989 mg Std Dev = 0.0008 for 299 weighings	Laboratory average falls within tolerance interval. Twelve individual weighings of 99.984 mg fell 4 μg below lower limit.
		100-mg S/N 41144 07/29/09 Verification: 99.99771 mg ± 0.00078 Laboratory Tolerance Interval: 99.995 – 100.001 mg	Mean = 99.998 mg Std Dev = 0.0006 for 211 weighings	Laboratory average falls within tolerance interval.

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
		200-mg S/N 58098 04/11/09 Verification: 200.00415 mg ± 0.00078 Laboratory Tolerance Interval: 200.000–200.008 mg	Mean = 200.005 mg Std Dev = 0.0008 for 344 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		200-mg S/N 58099 04/11/09 Verification: 200.00371 mg ± 0.00078 Laboratory Tolerance Interval: 200.000 – 200.007 mg	Mean = 200.003 mg Std Dev = 0.0008 for 248 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		04/23/10 Verification: 200.00314 mg ± 0.0008 Laboratory Tolerance Interval: 199.999 – 200.006 mg	Mean = 200.003 mg Std Dev = 0.0009 for 271 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		200-mg S/N 18659 07/28/09 Verification: 199.97805 mg ± 0.0008 Laboratory Tolerance Interval: 199.975 – 199.981 mg	Mean = 199.979 mg Std Dev = 0.0008 for 681 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		08/10/10 Verification: 199.97531mg ± 0.0008 Laboratory Tolerance Interval: 199.972 – 199.978 mg	Mean = 199.976 mg Std Dev = 0.0008 for 252 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		200-mg S/N 41148 07/28/09 Verification: 199.9996 mg ± 0.0008 Laboratory Tolerance Interval: 199.996 – 200.003 mg	Mean = 200.000 mg Std Dev = 0.0006 for 211 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
Balance calibrations	Auto (internal) calibration daily	Daily	N/A	
	External calibration annually or as needed	All balances inspected and externally calibrated by Mettler Toledo on August 13, 2010, using NIST-traceable weight	N/A	Next inspection and external calibration scheduled for August 2011
Balance audits	Annually	Audits of all balances performed by RTI Quality Systems Program personnel on December 1, 2010, using Class S-1 NIST-traceable weights	N/A	Audit included environmental evaluation, level test, scale-clarity test, zero-adjustment test, off-center (corner load) test, precision test, and accuracy test; all balances performed satisfactorily.

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
RH/T monitoring devices calibrations	Annually	Chamber temperature and humidity sensors, temperature and humidity controllers, and process alarm control board (mother board) calibrated by Environmental Specialties – LUWA on January 13, 2010 Chamber data loggers calibrated by Veriteq Data Logger Test and Calibration Services on August 27, 2010	N/A N/A	Chamber sensors, controllers, and process boards are calibrated on-site annually by Environmental Specialties Next calibration due August 2011
Laboratory (Filter) blanks	Initial weight ± 15 µg	2,027 total replicate weighings of 316 individual laboratory blanks	Average difference between final and initial weight = 2.1 µg Std Dev = 5.6 Min wt change = -55 µg Max wt change = 46 µg	32 total replicate weighings of 12 individual laboratory blank filters (1.6% of the replicate weighings; 3.8% of the individual laboratory blanks) exceeded the 15 µg criterion.
Replicates	Initial weight ± 15 µg	11,967 individual filters were weighed as pre-sampling (tared) replicates 4,416 individual filters were weighed as post-sampling replicates	Average = 0.4 µg Average = -0.08 µg	2 replicate weighings (0.02% of the weighings) exceeded the 15 µg criterion on the first pass. Outliers were reweighed in order to confirm a mass value with two weights within 5 µg of each other. The third weighings of the 2 individual outlier filters were within the 15 µg acceptance range. 27 replicate weighings (0.6% of the weighings) exceeded the 15 µg criterion. These outliers were reweighed to confirm value with two weights within 5 µg of each other. The third weighings of the 27 individual outlier filters were all within the 15 µg acceptance range.

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
Lot blanks (Lot stability filters) [Lot stability tests are performed to ensure filters are conditioned at least as long as the stability test indicates. All lot stability tests performed on 12 filters – 2 filters randomly selected from each of 6 randomly selected boxes]	The filters are weighed until a 24-hour weight change < ± 5 µg is demonstrated.	Whatman Lot 9155021 (rec'd 7/1/2009)	24 hours = -1 µg 48 hours = +3 µg 72 hours = -2 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = +3 µg 72 hours = -2 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +4 µg 72 hours = -2 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = +4 µg 72 hours = -1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = +3 µg 72 hours = -1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = +3 µg 72 hours = -1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = +2 µg 72 hours = 0 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = +6 µg 72 hours = -5 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +4 µg 72 hours = 0 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +2 µg 72 hours = -1 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = +2 µg 72 hours = -2 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = +2 µg 72 hours = -2µg 96 hours = +2 µg	Weight changes fall within required range

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
Lot blanks (Lot stability filters) (cont'd)	The filters are weighed until a 24-hour weight change < ± 5 µg is demonstrated.	Whatman Lot 9173007 (rec'd 8/31/2009)	24 hours = -1 µg 48 hours = -6 µg 72 hours = -3 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +2 µg 72 hours = 0 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = +3 µg 48 hours = +5 µg 72 hours = -2 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = +5 µg 72 hours = -1 µg 96 hours = +4 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +2 µg 72 hours = 0 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +3 µg 72 hours = -1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +2 µg 72 hours = -1 µg 96 hours = -2 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +3 µg 72 hours = -2 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +1 µg 72 hours = -1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +5 µg 72 hours = +2 µg 96 hours = -2 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +2 µg 72 hours = -2 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +1 µg 72 hours = 0 µg 96 hours = +1 µg	Weight changes fall within required range

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
Lot blanks (Lot stability filters) (cont'd)	The filters are weighed until a 24-hour weight change < ± 5 µg is demonstrated.	Whatman Lot 9203044 (rec'd 8/31/2009)	24 hours = 0 µg 48 hours = +2 µg 72 hours = -1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +2 µg 72 hours = -1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -3 µg 48 hours = +3 µg 72 hours = -2 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +2µg 72 hours = -1µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +1 µg 72 hours = -1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -3 µg 48 hours = +3 µg 72 hours = -1µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +2 µg 72 hours = -2 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -3 µg 48 hours = +2 µg 72 hours = -2 µg 96 hours = +3 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = 0 µg 72 hours = -1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +5 µg 72 hours = -3 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = 2 µg 72 hours = -1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +3 µg 72 hours = -5 µg 96 hours = 0 µg 24 hours = -18 µg	Weight changes fall within required range

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
Lot blanks (Lot stability filters) (cont'd)	The filters are weighed until a 24-hour weight change < ± 5 µg is demonstrated.	Whatman Lot 9245012 (rec'd 9/25/2009)	48 hours = 0 µg 72 hours = +2 µg 96 hours = -3 µg	Weight changes fall within required range
			24 hours = -37 µg 48 hours = -2 µg 72 hours = 0 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = -108 µg 48 hours = -13 µg 72 hours = +1 µg 96 hours = -2 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +1 µg 72 hours = -2 µg 96 hours = +4 µg	Weight changes fall within required range
			24 hours = -19 µg 48 hours = -1 µg 72 hours = +3 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -20 µg 48 hours = -1 µg 72 hours = 0 µg 96 hours = -3 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = -1 µg 72 hours = -1 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = -25 µg 48 hours = -18 µg 72 hours = 0 µg 96 hours = -4 µg	Weight changes fall within required range
			24 hours = +7 µg 48 hours = -8 µg 72 hours = +3 µg 96 hours = -2 µg	Weight changes fall within required range
			24 hours = +8 µg 48 hours = -16 µg 72 hours = -2 µg 96 hours = +5 µg	Weight changes fall within required range
			24 hours = -7 µg 48 hours = -1 µg 72 hours = -1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -8 µg 48 hours = +3 µg 72 hours = 0 µg 96 hours = -2 µg	Weight changes fall within required range

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
Lot blanks (Lot stability filters) (cont'd)	The filters are weighed until a 24-hour weight change < ± 5 µg is demonstrated.	Whatman Lot 9307004 (rec'd 11/24/2009)	24 hours = -62 µg 48 hours = -4 µg 72 hours = +1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -9 µg 48 hours = +2 µg 72 hours = +2 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = -27 µg 48 hours = -4 µg 72 hours = +1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -3 µg 48 hours = +1 µg 72 hours = +1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -7 µg 48 hours = 0 µg 72 hours = +2 µg 96 hours = -2 µg	Weight changes fall within required range
			24 hours = -9 µg 48 hours = 1 µg 72 hours = -1 µg 96 hours = +3 µg	Weight changes fall within required range
			24 hours = -10 µg 48 hours = -1 µg 72 hours = +3 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = -6 µg 48 hours = -1 µg 72 hours = +1 µg 96 hours = +4 µg	Weight changes fall within required range
			24 hours = -18 µg 48 hours = +3 µg 72 hours = +1 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = -4 µg 48 hours = +5 µg 72 hours = -2 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -10 µg 48 hours = -1 µg 72 hours = +1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -5 µg 48 hours = +1 µg 72 hours = +8 µg 96 hours = +2 µg	Weight changes fall within required range

3.1.4 Determination of Uncertainties and Method Detection Limits

The Gravimetric Laboratory's MDL calculations are based on replicate weighings of a large number of filters from filter lot acceptance batches. Because determination of gravimetric mass requires two separate weighings, each of which contributes to the total uncertainty, a multiplicative factor of 1.414 is included to account for the fact that each filter must be weighed twice to generate the final net mass. MDLs reported to AQS are shown in Appendix A. The three Mettler Toledo balances use the same MDL, while the Sartorius balance MDL is slightly different as expected with a different design.

3.1.5 Audits, Performance Evaluations, Training, and Accreditations

Table 3-3 contains information regarding audits, performance evaluations (PEs), training, and accreditations for the Gravimetric Laboratory.

Table 3-3. Description of Audits, PEs, Training, and Accreditations

Type of Evaluation	Date	Administered By	Significant Findings/Comments
Internal Audit	January 25, 2010	RTI FRM Project QA Officer	The auditor noted that the gravimetric chambers were clean and that the log books and records were up to date.
Proficiency Evaluation (PE)	June 16, 2010 (results finalized) December 2010	EPA National Air and Radiation Environmental Laboratory (NAREL)	EPA NAREL finalized and published the results of the experimental inter-comparison of speciation laboratories completed in the winter of 2009. Analyses were performed on real-world samples collected in Montgomery, AL. RTI's Gravimetric Laboratory performance in the study was good, with the RTI laboratory agreeing with the EPA NAREL laboratory within 5 µg on exposed (sampled) filters. EPA NAREL initiated an experimental inter-comparison of speciation laboratories. Analyses were performed on real-world samples collected in Montgomery, AL. RTI's analysis and report of the PT samples will be submitted to NAREL in February 2011 and results are expected 2011.
Accreditation	Certificate issued July 1, 2010	National Environmental Laboratory Accreditation Program (NELAP)	RTI maintains accreditation in the National Environmental Laboratory Accreditation Program (NELAP) through the Louisiana Department of Environmental Quality (LDEQ) Louisiana Environmental Laboratory Accreditation Program (LELAP).

Type of Evaluation	Date	Administered By	Significant Findings/Comments
External Audit	December 16-17, 2010	National Environmental Laboratory Accreditation Program (NELAP)	An assessor from the LDEQ LELAP, RTI's primary NELAP accrediting authority, assessed the Gravimetric Laboratory and Trace Inorganics Laboratory. RTI has requested LELAP add the metals field of testing to RTI's NELAP scope of accreditation. Although the final assessment report has not been received as of this writing, the preliminary report issued in the assessor's exit briefing, indicated only two minor findings for the Gravimetric Laboratory related to FRM data reporting spreadsheets and a finding that the FRM QAPP does not mention compliance with Louisiana Administrative Code. Findings for ICP-MS or XRF metals analysis were also minor.

3.2 Ions Analysis Laboratory

The Ion Analysis Laboratory used ten ion chromatographs to analyze 21,461 filter samples for cations (sodium, potassium, and ammonium) and 21,930 filter samples for anions (nitrate and sulfate). The analyses were performed for the CSN program during the period January 1 through December 31, 2010.

3.2.1 Quality Issues and Corrective Actions

There were no quality issues or corrective actions during the reporting period.

3.2.2 Description of QA/QC Checks Applied

Ion chromatographic analyses are performed by personnel from RTI's Environmental Industrial Sciences Division - Chemistry Department (EISD-CD). Ten Dionex ion chromatographic systems were used for performance of the measurements and are summarized in **Table 3-4**. Distribution of samples among these ten instruments was determined by laboratory workload and instrument availability.

Table 3-4. Description of Ion Chromatographic Systems Used for Analysis of $PM_{2.5}$ Filter Samples

System No.	Dionex IC Model	Ions Measured
A1	DX-500	SO_4, NO_3
A2	DX-500	SO_4, NO_3
A3	DX-600	SO_4, NO_3
A4	DX-600	SO_4, NO_3
A5	DX-600	SO_4, NO_3
A6	ICS-2000	SO_4, NO_3
C1	DX-500	Na, NH_4, K
C2	DX-600	Na, NH_4, K
C3	ICS-2000	Na, NH_4, K
C4	DX-600	Na, NH_4, K

QA/QC checks for ion analyses are summarized in **Table 3-5**. For ion analyses, a daily multipoint calibration (7 points for cations; 8 points for anions) is performed over the range 0.05 to 25.0 ppm for each ion (Na^+, NH_4^+, and K^+ for cation analyses; NO_3^- and SO_4^{2-} for anion analyses) followed by QA/QC samples, including (1) an RTI-prepared QC sample containing concentrations of each ion in the mid- to high-range of the calibration standard concentrations, (2) an RTI-prepared QC sample containing concentrations of each ion at the lower end of the calibration standard concentrations, and (3) a commercially-prepared, NIST-traceable QA sample containing known concentrations of each ion.

The regression parameters (a,b,c, and correlation coefficient, r) for the standard curve for each ion are compared with those obtained in the past. Typically, a correlation coefficient of 0.999 or better is obtained for each curve. If the correlation coefficient is < 0.999, the analyst carefully examines the individual chromatograms for the calibration standards and reruns any standard that is judged to be out of line with respect to the other standards or to values (peak area and/or height) obtained in the past for the same standard. Possible causes for an invalid standard run include instrumental problems, such as incomplete sampling by the autosampler. If necessary, a complete recalibration is performed.

When all individual calibrations have been judged acceptable, the results for the QA/QC samples are carefully examined. If the observed value for any ion being measured differs by more than 10% from the known value, the problem is identified and corrected. Any field samples are then analyzed.

Table 3-5. Ion Analysis of PM2.5 Quality Control/ Quality Assurance Checks

QA/QC Check	Frequency	Requirements
Calibration Regression Parameters	Daily	r ≥0.999
Initial QA/QC Checks: ▪ RTI prepared QC sample at mid- to high-range concentration ▪ RTI prepared QC sample at lower-end concentration ▪ Commercially prepared, NIST traceable QA sample	Daily, immediately after calibration Daily, immediately after calibration Daily, immediately after calibration	Measured concentrations within 10% of known values Measured concentrations within 10% of known values Measured concentrations within 10% of known values
Periodic QA/QC Checks: ▪ Replicate sample † ▪ QA/QC sample ▪ Matrix spiked sample extract ▪ Duplicates ‡	Every 20 samples Every 20 samples Every 20 samples At least one per day	RPD = 5% at 100x MDL* RPD = 10% at 10x MDL* RPD = 100% at MDL* Measured concentrations within 10% of known values Recoveries within 90 to 100% of target values No limit set. This data gathered for comparability studies.
▪ Reagent Blanks	One reagent blank per reagent used (DI H20 and/or eluent sample set extracted)	No limit set. This data gathered for comparability studies.

* MDL = Minimum Detectable Limit

†Replicates indicate a specific sample is run twice on the same instrument.

‡Duplicates indicate a specific sample is run on two different instruments

During an analysis run, a replicate sample, a QA/QC sample, and a spiked sample are analyzed at the rate of at least one for every 20 field samples. Precision objectives for replicate analyses are ±5% for concentrations that equal or exceed 100 times the MDL, ±10% for concentrations at 10 times the MDL, and ±100% for concentrations at the MDL. MDLs for each instrument and analyte are listed in **Table 3-6**. The observed value for any ion being measured must be within 10% of the known value for the QA/QC samples (**Table 3-7**), and ion recoveries for the spiked samples must be within 90 to 110% of the target value. If these acceptance criteria are not met for any QA/QC or spiked sample, the problem is identified and corrected. All field samples analyzed since the last acceptable check sample are then reanalyzed

.

Table 3-6. Minimum Detection Limit* for Each Instrument and Analyte

Instrument	Nitrate	Sulfate	Sodium	Ammonium	Potassium
A1	0.059	0.066	na	na	na
A2	0.058	0.090	na	na	na
A3	0.066	0.074	na	na	na
A4	0.070	0.100	na	na	na
A5	0.070	0.100	na	na	na
A6	0.211	0.036	na	na	na
C1	na	na	0.290	0.160	0.134
C2	na	na	0.290	0.160	0.134
C3	na	na	0.109	0.244	0.228
C4	na	na	0.290	0.160	0.134

* In µg/filter

Table 3-7. Definitions and Specifications for QA/QC Samples

Ion	Sample ID	Description/Specification
Anions	QA-CPI_LOW	0.6 ppm nitrate, 1.2 ppm sulfate
	QA-CPI_MED-HI	3.0 ppm nitrate, 6.0 ppm sulfate
	RTI-QC-HIGH	6.0 ppm nitrate, 12.0 ppm sulfate
	RTI-QC-LOW	0.6 ppm nitrate, 1.2 ppm sulfate
	RTI-QC-MED	1.5 ppm nitrate, 3.0 ppm sulfate
Cations	GFS 0.4 PPM QA	0.4 ppm each sodium, ammonium, and potassium
	GFS 4.0 PPM QA	4.0 ppm each sodium, ammonium, and potassium
	RTI 2.0 PPM QC Reg Std	2.0 ppm each sodium, ammonium, and potassium
	RTI 5.0 PPM QC	5.0 ppm each sodium, ammonium, and potassium

3.2.3 Summary of QC Results

QC checks performed included the following:

- Percent recovery for QC samples (standards prepared by RTI)
- Percent recovery for QA samples (commercial standards)
- Relative percent difference (RPD) for replicates
- Spike recovery
- Reagent blank (elution solution and DI water).

Table 3-8 shows recoveries for all five analytes (nitrate, sulfate, sodium, ammonium, and potassium) with low, medium, and high QC (prepared by RTI) samples and with low and medium-high QA samples (commercially prepared and NIST-traceable) for all of the instruments used for analysis.

Table 3-8. Average Percent Recovery for QA and QC Samples

Analyte	Sample ID	Count	Conc. µg/mL	Avg % Rec *	SD	Min	Max
Nitrate	QA-CPI_LOW	427	0.6	97.8%	2.3%	0.534	0.649
	QA-CPI_MED-HI	293	3.0	101.0%	1.5%	2.945	3.181
	RTI-QC-HIGH	287	6.0	102.3%	1.5%	5.748	6.334
	RTI-QC-LOW	575	0.6	98.0%	2.0%	0.541	0.663
	RTI-QC-MED	722	1.5	99.1%	1.6%	1.375	1.646
Sulfate	QA-CPI_LOW	427	1.2	98.3%	2.0%	1.093	1.306
	QA-CPI_MED-HI	293	6.0	101.1%	1.3%	5.850	6.343
	RTI-QC-HIGH	287	12.0	102.2%	1.3%	11.369	12.697
	RTI-QC-LOW	575	1.2	99.3%	1.6%	1.112	1.297
	RTI-QC-MED	722	3.0	100.6%	1.4%	2.775	3.227
Sodium	GFS 0.4 PPM QA	309	0.4	102.3%	2.0%	0.385	0.438
	GFS 4.0 PPM QA	291	4.0	100.4%	0.8%	3.837	4.166
	RTI 2.0 PPM QC Reg Std	224	2.0	100.4%	1.1%	1.946	2.120
	RTI 5.0 PPM QC	207	5.0	101.0%	0.8%	4.877	5.147
Ammonium	GFS 0.4 PPM QA	309	0.4	101.9%	2.2%	0.376	0.437
	GFS 4.0 PPM QA	291	4.0	100.0%	1.1%	3.696	4.128
	RTI 2.0 PPM QC Reg Std	224	2.0	100.1%	1.4%	1.885	2.056
	RTI 5.0 PPM QC	207	5.0	101.0%	1.5%	4.619	5.352
Potassium	GFS 0.4 PPM QA	309	0.4	102.2%	1.9%	0.383	0.485
	GFS 4.0 PPM QA	291	4.0	101.8%	0.7%	3.906	4.149
	RTI 2.0 PPM QC Reg Std	224	2.0	100.5%	1.3%	1.931	2.066
	RTI 5.0 PPM QC	207	5.0	100.9%	0.7%	4.915	5.135

* Acceptance criteria for average percent recovery is ± 10%.

Average recoveries for the QC samples ranged from 98.0 to 102.3% for the year. Average recoveries for the QA samples ranged from 97.8 to 102.3% for the year.

Table 3-9 shows percent recovery for all analyte spikes for the year. Average recoveries for the spikes ranged from 100.4 to 101.1%.

Table 3-9. Average Percent Recovery for Spikes

Analyte	Avg Recovery *	StDev	Count	Min	Max
Nitrate	100.9%	1.7%	708	93.2%	109.5%
Sulfate	101.1%	1.6%	708	95.1%	107.8%
Sodium	100.4%	1.2%	362	97.3%	109.0%
Ammonium	100.8%	1.4%	362	94.2%	109.4%
Potassium	100.4%	1.4%	362	94.6%	109.2%

* Acceptance criteria for average percent recovery is ± 10%

Table 3-10 presents filter blank (NQC BLANK) and reagent blank statistics for all analytes over the 12-month period.

Table 3-10. Filter Blank (NQC) and Reagent Blank Values (ppm) for all Analytes

Analyte	Type	Count	Avg	StDev	Min	Max
Nitrate	Reagent	707	0.008	0.008	-0.032	0.038
	NQC	493	0.009	0.009	0.000	0.039
Sulfate	Reagent	707	0.007	0.010	-0.021	0.040
	NQC	493	0.007	0.010	-0.028	0.040
Sodium	Reagent	173	0.005	0.006	-0.007	0.028
	NQC	27	0.001	0.004	-0.009	0.012
Ammonium	Reagent	175	0.000	0.000	0.000	0.005
	NQC	29	0.000	0.000	0.000	0.000
Potassium	Reagent	177	0.000	0.000	0.000	0.000
	NQC	31	0.000	0.000	0.000	0.000

* NQC is a blank filter extract analyzed to test the acceptability of the cleaned nylon filter batches. One nylon filter is tested from each bottle used for filter cleaning. If the ion loading for any ion is >1 µg, the filters from that bottle are rejected.

** Reagent is a 25-ml aliquot of either deionized water that has been pipetted into an extraction tube and carried through the same extraction procedure as the filters.

3.2.4 Assessment of Between-instrument Comparability

Anion duplicates were analyzed on all anion instruments and cation duplicates were analyzed on all cation instruments. A comparison of the ranges reported between the two instruments indicates very close results.

Table 3-11 compares QA and QC samples run on separate instruments on the same day. Each day, the anion instruments ran at least two QC and three QA samples. Similarly, the cation instruments ran at least two QC and two QA samples on each instrument each day. This Table shows that the difference between two instruments analyzing the same QA or QC sample are very small. The calculated average difference and standard deviation indicate a high level of between-instrument comparability.

Table 3-11. Between-instrument Comparability: IC Systems A3 vs. A4 and C1 vs. C2

Analyte	QA/QC Type	Conc., ppm	Count	Average * Difference	Standard Deviation of Diff.	Minimum Diff.	Maximum Diff.
Nitrate	QA-CPI_LOW	1.2	57	0.003	0.011	-0.030	0.031
	QA-CPI_MED-HI	6.0	25	0.007	0.028	-0.060	0.075
	RTI-QC-HIGH	12.0	22	-0.015	0.067	-0.224	0.068
	RTI-QC-LOW	1.2	86	0.004	0.009	-0.011	0.031
	RTI-QC-MED	3.0	152	0.004	0.014	-0.024	0.056
Sulfate	QA-CPI_LOW	1.2	57	-0.003	0.022	-0.066	0.039
	QA-CPI_MED-HI	6.0	25	0.006	0.058	-0.091	0.117
	RTI-QC-HIGH	12.0	22	-0.005	0.129	-0.434	0.238
	RTI-QC-LOW	1.2	86	0.002	0.016	-0.052	0.032
	RTI-QC-MED	3.0	152	0.003	0.024	-0.066	0.077
Sodium	GFS 0.4 PPM QA	0.4	137	0.000	0.011	-0.034	0.032
	GFS 4.0 PPM QA	4.0	131	0.001	0.043	-0.161	0.110
	RTI 2.0 PPM QC	2.0	93	0.009	0.024	-0.040	0.074
	RTI 5.0 PPM QC	5.0	83	0.007	0.062	-0.138	0.201
Ammonium	GFS 0.4 PPM QA	0.4	137	0.002	0.012	-0.046	0.023
	GFS 4.0 PPM QA	4.0	131	-0.002	0.086	-0.253	0.311
	RTI 2.0 PPM QC	2.0	93	0.012	0.041	-0.066	0.140
	RTI 5.0 PPM QC	5.0	83	0.036	0.152	-0.217	0.604
Potassium	GFS 0.4 PPM QA	0.4	137	-0.001	0.006	-0.021	0.014
	GFS 4.0 PPM QA	4.0	131	0.006	0.034	-0.153	0.112
	RTI 2.0 PPM QC	2.0	93	0.002	0.026	-0.069	0.127
	RTI 5.0 PPM QC	5.0	83	0.013	0.051	-0.101	0.174

* Differences are calculated as Concentration of A3 – Concentration of A4 for Anions and Concentration of C1 – Concentration of C2 for Cations.

3.2.4 Determination of Uncertainties and MDLs

Detection limits are determined by analyzing the lowest calibration standard 7 times and the detection limit, in µg/mL (or ppm), is calculated as 3 times the standard deviation of the 7 measurements. This detection limit is multiplied by 25mL, which is the extraction volume for each filter, to determine the detection limits in µg/filter. These calculations are performed for each instrument so that the detection limits are reported by instrument. Since most samples are not analyzed in replicate, analytical uncertainties must be estimated based on historical data and scientific judgment. A simple formula of the form $U = a \cdot C + b$ is used, where U is the uncertainty and C is the concentration. The coefficients a and b vary by instrument and by analyte. The b coefficient is essentially MDL/3. The value for a is assumed to be 0.05 (5%). MDLs for the STN Program are summarized in Appendix A.

3.2.5 Audits, Performance Evaluations, Training, and Accreditations

On September 1, 2009, EPA/NAREL conducted a Technical Systems Audit (TSA) at RTI International as a part of the quality assurance oversight of the PM2.5 Chemical Speciation Network. Anion and cation spike solutions that had been prepared by NAREL were given to an ion chromatography analyst the morning of the audit. The solutions were analyzed during the day of the audit and the analysis results were given to the auditors during their debriefing with RTI staff. The auditors also were given aliquots of anion and cation calibration standards used by the RTI IC lab, and the calibration standards were analyzed at NAREL the following week. RTI's results were in excellent agreement with NAREL's results for all comparisons.

The IC laboratory also participated in NAREL's most recent inter-laboratory comparison study in which several laboratories analyzed replicate sets of single-blind filter samples for ions. Results from the proficiency testing study indicated good performance by RTI's IC lab. The auditors reported that they found no deficiencies associated with the IC laboratory and that the laboratory appeared to be well-managed with good laboratory practices, including good documentation.

3.3 Organic Carbon/Elemental Carbon Laboratory

The CSN/TOT method using 47 mm quartz filters was phased out of the CSN program in three stages during 2007-2009. The only filters analyzed by this method during 2010 were generated by a collocation study which was completed in April. From May through December, a small number of CSN/TOT samples were analyzed at the request of sites when the URG 3000N sampler at a particular site was out of service for an extended period of time.

The RTI OC/EC Laboratory staff analyzed and reported 617 quartz filter aliquots by the STN or CSN/TOT method for the CSN contract during the period January 1, 2010, through December 31, 2010. **Table 3-12** lists the CSN sites that ran the CSN/TOT method during 2010. The balance of samples were for other clients or for QC. Three Sunset Laboratory Carbon Aerosol Analyzers (designated by the letters R, T, and F) were used for CSN/TOT analyses during 2010. No significant modifications to these analyzers were performed during 2010.

Table 3-12. CSN Sites with Filters Analyzed by the CSN/TOT Method During 2010.

Site - POC	Last Sampling Month for CSN/TOT Method	Comment
Allen Park - 5	March	IMPROVE_A - CSN/TOT Intercomparison Study
Beacon Hill - Met One - 6	April	IMPROVE_A - CSN/TOT Intercomparison Study
Com Ed - Met One - 5	April	IMPROVE_A - CSN/TOT Intercomparison Study
Commerce City - 5	April	IMPROVE_A - CSN/TOT Intercomparison Study
G.T. Craig - 5	September	IMPROVE_A - CSN/TOT Intercomparison Study
IS 52 - Met One - 5	April	IMPROVE_A - CSN/TOT Intercomparison Study
Kingston - 5	continuing	EPA Special Sudy - non-CSN
Newark - 5	URG 3000N down	URG 3000N to be installed in 2011
North Birmingham - 5	April	IMPROVE_A - CSN/TOT Intercomparison Study
Queens College - Met One - 6	March	IMPROVE_A - CSN/TOT Intercomparison Study
Riverside-Rubidoux - 5	April	IMPROVE_A - CSN/TOT Intercomparison Study
Sacramento - Del Paso Manor - 5	March	IMPROVE_A - CSN/TOT Intercomparison Study
South DeKalb - Met One - 5	March	IMPROVE_A - CSN/TOT Intercomparison Study
St Theo - 6	September	Extended downtime of URG 3000N

3.3.1 Quality Issues and Corrective Actions

No issues that affected the quality of reported data arose during the reporting period.

3.3.2 Description of QC Checks Applied

Quality control (QC) checks, acceptance criteria, and corrective actions for the OC/EC Laboratory are summarized in **Table 3-13**.

Table 3-14 contains a list of all data flags assigned to carbon analysis data and the number of filter analysis results assigned each flag in the OC/EC Laboratory during the reporting period. Only flags assigned in OC/EC Laboratory data reports to RTI's SPIMS database are included in the table. The Sample Handling and Archiving Laboratory (SHAL) or the QA Officer may have assigned additional flags to the quartz filter samples based on field data or additional data validation checks.

Table 3-13. OC/EC Laboratory QC Checks, Acceptance Criteria, and Corrective Actions

QC Element	Frequency	Acceptance Criteria	Response When Outside Criteria
Method Detection Limit	After oven replacement or annually, whichever comes first	MDL 0.5 µg C/cm^2	Investigate the source of the problem and initiate corrective action, if necessary, to correct the problem before analyzing samples.
Calibration Peak Area	Every analysis	Within 95% to 105% of average calibration peak area for that day	Discard the results of that analysis and, if necessary, repeat the analysis with a second punch from the same filter.
Instrument Blank	Daily and after about 30 samples	(1) Blank 0.3 µg/cm^2, and (2) calibration peak area 90% to 110% of average for the weekly three-point calibration.	Determine if the problem is with the filter or the instrument and, if necessary, initiate corrective action to identify and solve any instrument problem, and run an acceptable instrument blank before analyzing samples.
Three-Point Calibration	Weekly	(1) Correlation Coefficient (R^2) 0.998 [with force-fit through 0,0], (2) 93% to 107% recovery for all three standards, and (3) FID response factor is 90% to 110% of the average response factor for all three standards.	Determine the cause of the nonlinearity, and initiate actions that will identify and solve any problem that may have arisen. Then repeat the three-point calibration, which must yield satisfactory results before samples are analyzed.
Calibration Check	Daily	(1) 93% to 107% recovery, (2) calibration peak area 90% to 110% of average for the weekly three-point calibration, and (3) FID response factor is 90% to 110% of average response factor for last three-point calibration.	Initiate corrective action, if necessary, to solve the problem before analyzing samples.
Duplicate Analyses	10% of all samples	(1) TC Values greater than 10 µg C/cm^2-- Less than 10% RPD, (2) TC Values 5 - 10 µg C/cm^2-- Less than 15% RPD, (3) TC Values less than 5 µg C/cm^2-- Within 0.75 µg C/cm^2.	Flag analysis results for that filter with non-uniform filter deposit (LFU) flag.

Table 3-14. OC/EC Laboratory-Assigned Data Flags

Flag	Description	Number of Filters
LFU	Filter inspection flag - non-uniformity (Duplicate analysis failed applicable duplicate criterion.)	3
	Total Number of Analyses Flagged by OC/EC Analysts	3
	Total Number of OC/EC Analyses Reported to SPIMS	617
	Percent of OC/EC Analyses Flagged by Analysts	0.5%

3.3.3 Summary of QC Results

3.3.3.1 Instrument Blanks

Table 3-15 contains the number of instrument blanks run during the reporting period and the average, minimum, and maximum measured blank values for the three Sunset Labs carbon analyzers used to analyze CSN filters during 2010.

Table 3-15. OC/EC Instrument Blank Statistics

Statistic	R	T	F
Number of Instrument Blanks	96	76	88
Mean Response (µg C/cm^2)	0.0126	-0.0277	0.0480
Standard Deviation	0.0152	0.0986	0.0478
Minimum Response (µg C/cm^2)	0.0000	-0.7884	-0.0476
Maximum Response (µg C/cm^2)	0.1191	0.0725	0.256

For all reported data, the last instrument blank run before reported samples were analyzed is verified to have met the blank criterion for TC, and the internal standard peak area (IS) was within 90% to 110% of the average IS area for the most recent full FID calibration for that analyzer.

3.3.3.2 Calibrations

Table 3-16 provides a summary of the full 3-point calibrations of FID response by analyzer. All reportable data for CSN were run with acceptable 3-point calibrations. Acceptance criteria for full 3-point calibrations are as follows:

1. FID response to the internal standard (expressed as a percentage of the average FID response to the internal standard for the 3-point calibration): 90 – 110%

2. Recovery (mass of carbon measured expressed as a percentage of the mass of carbon in the spiked volume of standard used): 93 – 107%

3. FID response factor (expressed as a percentage of the average FID response factor for the 3-point calibration): 90 – 110%

Table 3-17 provides the counts of daily calibration checks by analyzer. Only days when samples were run for CSN are included. CSN filter results are not reported unless all daily calibration checks are within acceptance limits. Acceptance criteria for daily calibration checks are as follows:

1. Internal standard area (as a percentage of the average internal standard area for the last 3-point calibration): 90 – 110%

2. Recovery (mass of carbon measured expressed as a percentage of the mass of carbon in the spiked volume of standard used): 95 – 105%

3. FID response factor (as a percentage of the average response factor for the last 3-point calibration): 90 – 105%

A calibration check is acceptable only if it meets all three criteria, and an acceptable daily calibration check was run on each analyzer before any filter samples were analyzed on that analyzer.

Table 3-16. OC/EC Three-Point Calibration Counts

Variable or Statistic	R	T	F
Number of Three-point Calibrations Passing All Criteria during 2010 (typically performed weekly)	50	43	55
Number of Full Calibrations Failing Any Criterion during 2010	0	0	0

Table 3-17. OC/EC Daily Calibration Check Counts

Variable/Statistic	R	T	F
Number of Daily Cal Checks Passing All Criteria (calculated as number of days when CSN filters were analyzed and reported)	53	38	48
Number of Cal Checks Failing Any Criterion	0	0	0

3.3.3.3 Duplicate Analyses

A duplicate analysis was run on the same analyzer on about every 10th filter. During 2010, three CSN filters failed the duplicates test, two on analyzer T, and one on analyzer F. These were responsible for the three LFU flags shown in Table 3-14.

3.3.3.4 Assessment of Between-Instrument Comparability

Because of the small number of CSN filters run during 2010, the number of replicate analysis results (two or more punches from the same filter run on different analyzers) was very limited; therefore new figures for between-instrument comparability were not determined. No samples were flagged or invalidated due to poor replicate filter analysis results during 2010. Please refer to the 2009 report for a more detailed discussion of between-instrument comparability.

http://www.epa.gov/ttn/amtic/files/ambient/pm25/spec/2009ADSReport.pdf

3.3.4 Determination of Uncertainties and MDLs

Table 3-18 gives estimated constant and proportional components of uncertainty for OC, EC, TC, and the five OC Peaks measured on multiple analyzers in RTI's OC/EC Laboratory.[4,5,6] The constant component of uncertainty appears to be essentially independent of filter loading and can be easily estimated in plots of absolute difference (y-axis) vs. average value (x-axis) for sample-duplicate pairs of analyses run on the same analyzer. The proportional component of uncertainty is most evident in plots of individual measurements of replicate analyses of filter samples across multiple analyzers (y-axis) vs. the average measured values across analyzers for those filter samples (x-axis). Please refer to the citations mentioned above and the 2009 Annual Report for more information.

Table 3-18. Estimated Uncertainties for CSN/TOT Carbon Fractions

Fraction	"Best Fit" Uncertainty (µgC/cm²)
OC	(0.20 + 0.05*OC)
EC	(0.20 + 0.05*EC)
TC	(0.30 + 0.05*TC)
Pk1 C	(0.20 + 0.05*Pk1 C)
Pk2 C	(0.20 + 0.05*Pk2 C)
Pk3 C	(0.30 + 0.05*Pk3 C)
Pk4 C	(0.30 + 0.10*Pk4 C)
Pyrol C	(0.20 + 1.40*Pyrol C)

Table 3-19 gives target MDL's for all reported carbon fractions. MDL values for the five OC Peaks were taken from the constant components of uncertainty in Table 3-17. This same approach was used to determine reasonable target MDL's for OC, EC, and TC, all of which have proven to be attainable when an analyzer is functioning properly and all operating conditions are under control.

[4] Peterson, M.R., and M.H. Richards. 2006. *Estimation of Uncertainties for Organic Carbon Peaks Data in Thermal-Optical-Transmittance Analysis of PM2.5 by the Speciation Trends Network Method*. Presented at the A&WMA Symposium on Air Quality Measurement Methods and Technology, May 9-11, 2006, Durham, NC.
[5] Peterson, M.R., J.B. Flanagan, and M.H. Richards. 2008. *Estimating Uncertainties for Non-Independent Analytes--Thermal-Optical Analysis of Carbon in PM2.5*. Presented at Air & Waste Management Association (A&WMA) 101st Annual Conference & Exhibition, Portland, OR, June 23-27.
[6] Peterson, M.R., and M.H. Richards. 2008. *Evaluating Nonuniformity of Carbon Fractions in PM2.5 Collected on Quartz Fiber Filters*. Presented at Air & Waste Management Association (A&WMA) Symposium on Air Quality Measurement Methods and Technology, Chapel Hill, NC, November 3-6.

Table 3-19. Target MDLs for OC/EC Carbon Fractions

Carbon Fraction	Target MDL (μgC/cm²)
OC	0.20
EC	0.20
TC	0.30
Pk1 C	0.20
Pk2 C	0.20
Pk3 C	0.30
Pk4 C	0.30
Pyrol C	0.20

3.3.5 Audits, PEs, Training, and Accreditations

3.3.5.1 System Audits

RTI's chemical speciation laboratories were last audited on September 1, 2009. EPA did not perform a TSA of RTI's CSN laboratories in 2010. The 2009 audit report section for RTI's OC/EC Laboratory concluded: "Good laboratory practices, good QC practices, and good record keeping are performed in the Carbon laboratory. No deficiencies were observed for the Carbon laboratory during the TSA." The 2009 audit report is posted on the EPA website at the following URL:

http://www.epa.gov/ttn/amtic/files/ambient/pm25/spec/RTI_TSA_2009.pdf

3.3.5.2 Performance Evaluations

RTI's OC/EC Laboratory received a set of Performance Evaluation (PE) quartz filters from EPA/NAREL. Both CSN/TOT and IMPROVE_A analysis results for the PE samples were reported in February 2010. RTI's results were generally comparable to those from other laboratories receiving PE samples. The final report containing the PE results is posted on the EPA website at the following URL:

http://www.epa.gov/ttn/amtic/files/ambient/pm25/spec/multilabspeciationpt2009.pdf

3.3.5.3 Training

No new analysts were trained for the CSN/TOT method during 2010.

3.3.5.4 Accreditations

There are no accreditation programs for OC/EC analysis.

3.4 DRI Carbon Analysis Laboratory

The DRI Carbon Analysis Laboratory, as a subcontractor to RTI for EPA's Chemical Speciation Network (CSN), received 18,803 quartz-fiber filters in batches 92 through 114 during the period January 1, 2010 through December 31, 2010. (Batch numbers refer to sets of quartz filters sent from RTI to DRI twice per month.) DRI performed 22,714 analyses on these quartz-fiber filter samples in the batches using the IMPROVE_A method (Chow et al. 2007) and reported the results of those analyses to RTI. The statistics included in this report cover only those samples analyzed in 2010. Eleven DRI Model 2001 Thermal/Optical Carbon Analyzers (designated as units # 6 – 13, 16, 18, and 19) were used for the CSN IMPROVE_A analyses.

3.4.1 Quality Issues and Corrective Actions

Of the 18,803 filters sent from RTI in barcoded petrislides, the ID labels for 300+ samples (approximately 1.6%) could not be read by DRI's automated barcode reader. DRI was able to enter these ID numbers manually, so this problem had no impact on data quality. RTI will issue a Corrective Action Request (CAR) to look at barcode compatibility issues between RTI and DRI. The results of this CAR will be included in the 2011 Annual Report.

3.4.2 Description of QC Checks Applied

Samples received at the DRI Carbon Laboratory follow the chain-of-custody procedure specified in DRI SOP #2-111.4. Samples are analyzed following DRI SOP # 2-216r2, revised in July 2008. Quality control (QC) measures for the DRI carbon analysis are summarized in **Table 3-20.** It specifies the frequency and standards required for the specified checks, along with the acceptance criteria and corrective actions.

Table 3-21 contains a list of quality-related data flags assigned to carbon analysis data and the number of filter analysis results assigned each flag by the DRI Carbon Laboratory during the reporting period. Out of 22,714 runs, there were 1,563 runs flagged as invalid. In addition, 5,650 runs were assigned blank or backup flags (i.e., backup filters, trip blanks, trip blank backup filters, SHAL blanks, and 24-hour field blanks) based on information that RTI provided to DRI on January 14, 2011. Blanks are not identified in the data files that RTI sends to DRI at the time the filters are to be analyzed. A complete list of sample IDs for blank filters was provided to DRI in January 2011, after all the 2010 data had been processed and validated.

Table 3-20. DRI Carbon Analysis QC Measures

Requirement	Calibration Standard	Calibration Range	Calibration Frequency	Performed By	Acceptance Criteria	Corrective Action
System Blank Check	N/A	N/A	Beginning of analysis day.	Carbon Analyst	≤0.2 µg C/cm^2.	Check instrument and filter lots; bake oven.
Leak Check	N/A	N/A	Beginning of analysis day.	Carbon Analyst	Oven pressure drops less than 0.52 mmHg/s.	Locate leaks and fix.
Laser Performance Check	N/A	N/A	Beginning of analysis day.	Carbon Analyst	Transmittance >700 mV; Reflectance >1500 mV	Check laser and filter holder position.
Calibration Peak Area Check	NIST 5% CH_4/He gas standard.	20 µg C (Carle valve injection loop, 1000 µl).	Every analysis.	Carbon Analyst	Counts >20,000 and 95-105% of average calibration peak area of the day.	Discard analysis result and repeat analysis with second filter punch.
Auto-Calibration Check	NIST 5% CH_4/He gas standard.	20 µg C (Carle valve injection loop, 1000 µl).	Beginning of analysis day.	Carbon Analyst	95-105% recovery and calibration peak area 90-110% of weekly average.	Troubleshoot and correct system before analyzing samples.
Manual Injection Calibration	NIST 5% CH_4/He or NIST 5% CO_2/He gas standards.	20 µg C (Certified gas-tight syringe, 1000 µl).	End of analysis day.	Carbon Analyst	95-105% recovery and calibration peak area 90-110% of weekly average.	Troubleshoot and correct system before analyzing samples
Sucrose Calibration Check	10µL of 1800 ppm C sucrose standard.	18 µg C.	Thrice per week (began March, 2009).	Carbon Analyst	95-105% recovery and calibration peak area 90-110% of weekly average.	Troubleshoot and correct system before analyzing samples
Multiple Point Calibrations	1800 ppm C Potassium hydrogen phthalate (KHP) and sucrose; NIST 5% CH_4/He, and NIST 5% CO_2/He gas standards.	9-36 µg C for KHP and sucrose; 2-30 µg C for CH_4 and CO_2.	Every 6-months or after major instrument repair.	Carbon Analyst	All slopes ±5% of average.	Troubleshoot instrument and repeat calibration until results within stated tolerances.
Sample Replicates	N/A	N/A	Every 10 analyses.	Carbon Analyst on same or different analyzer	±10% when OC, TC ≥10 µg C/cm^2 and ±20% when EC ≥10 µg C/cm^2 or <±1 µg/cm^2 when OC, TC <10 µg C/cm^2 and <±2 µg/cm^2 when EC <10 µg C/cm^2 *	Investigate instrument and sample anomalies and rerun replicate when criteria exceeded
Temperature Calibrations	Tempilaq (Tempil, Inc., South Plainfield, NJ, USA).	Three replicates each of 121, 184, 253, 510, 704, and 816 °C.	Every 6-months, or whenever the thermocouple is replaced.	Carbon Analyst	Linear relationship between thermocouple and Tempilaq values (i.e., slope within 5% of 1and r^2 >0.99).	Troubleshoot instrument and repeat calibration until results are within stated tolerances.
Oxygen Level in Helium Atmosphere	Certified gas-tight syringe.	0-100 ppmv.	Every 6-months, or whenever leak is detected.	Carbon Analyst using a GC/MS system.	Less than the certified amount of He cylinder (typically < 50 ppmv)	Replace the He cylinder and/or O_2 scrubber.

* Correction to current SOP (#2-216r2); included in revised SOP in progress.

Table 3-21. DRI Carbon Laboratory-Assigned Data Flags

Validation Flag Category	Validation Flag Subcategory	Description	No. of Sample Runs
n		Foreign substance on sample	5
s		Suspect analysis result	5
v		Void (invalid) analysis result	1563
	v2	Replicate analysis failed acceptable limit	355
	v3	Potential contamination	6
	v5	Analytical instrument error	1065
	v6	Analyst error	68
	v7	Software malfunction	67
		Total no. of sample runs (incl. blank and replicate flags)	22714

There were 2,348 runs with replicate (and duplicate) flags. In many cases, there was more than one flag for a sample run. The flag categories "s" and "v" will generally result in additional runs. Only flags assigned in DRI Carbon Laboratory data reports to RTI are included in the table. RTI interprets the DRI Carbon Laboratory validation flags and assigns AQS null value codes or validity status codes when reporting the data to AQS.

3.4.3 Summary of QC Results

3.4.3.1 Blanks

Tables 3-22 and **3-23** contain the number of instrument system blanks run during the reporting period and the average, standard deviation, maximum, minimum, and median measured blank values for the eleven carbon aerosol analyzers used in the program. Specifically, **Table 3-22** gives the system blank values by month for all eleven analyzers and **Table 3-23** gives the system blank values for each of the eleven carbon analyzers used during this reporting period.

System blanks are run at the beginning of each analysis day for each operating analyzer. They may be rerun until the analyzer gives readings lower than 0.20 µg C/cm2 of TC. However, they are also run to check instrument performance after repairs and adjustments. In addition, system blanks are assigned to the instrument and not to the project. The data in Tables 3-22 and 3-23 include all reported system blank data that met the blank criterion for TC before reported samples were analyzed using the IMPROVE_A method for this and other projects.

Table 3-22. DRI Carbon Laboratory System Blank Statistics for All Analyzers by Month

			IMPROVE_A Parameter (units are µg C/cm²)													
Month	No.*	Statistic*	O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
Jan	147	Mean	0.001	0.006	0.030	0.000	0.000	0.000	0.037	0.037	0.000	0.001	0.001	0.002	0.002	0.038
		StdDev	0.002	0.012	0.025	0.002	0.000	0.000	0.034	0.034	0.004	0.004	0.003	0.008	0.008	0.037
		Max	0.015	0.073	0.123	0.016	0.001	0.002	0.197	0.197	0.043	0.035	0.030	0.079	0.079	0.197
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.025	0.000	0.000	0.000	0.029	0.029	0.000	0.000	0.000	0.000	0.000	0.029
Feb	158	Mean	0.001	0.005	0.025	0.000	0.000	0.000	0.030	0.030	0.000	0.001	0.001	0.002	0.002	0.032
		StdDev	0.005	0.011	0.026	0.002	0.000	0.000	0.035	0.035	0.001	0.005	0.005	0.007	0.007	0.038
		Max	0.056	0.070	0.136	0.016	0.000	0.000	0.169	0.169	0.005	0.048	0.055	0.059	0.059	0.181
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.018	0.000	0.000	0.000	0.019	0.019	0.000	0.000	0.000	0.000	0.000	0.020
Mar	186	Mean	0.001	0.004	0.019	0.001	0.000	0.000	0.025	0.025	0.000	0.000	0.001	0.002	0.002	0.027
		StdDev	0.005	0.012	0.023	0.003	0.001	0.000	0.031	0.031	0.003	0.002	0.009	0.011	0.011	0.035
		Max	0.039	0.136	0.119	0.025	0.008	0.005	0.184	0.184	0.030	0.025	0.104	0.108	0.108	0.189
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.013	0.000	0.000	0.000	0.016	0.015	0.000	0.000	0.000	0.000	0.000	0.016
Apr	116	Mean	0.001	0.005	0.018	0.000	0.000	0.000	0.024	0.024	0.000	0.000	0.000	0.001	0.000	0.024
		StdDev	0.002	0.016	0.028	0.003	0.000	0.003	0.038	0.038	0.002	0.001	0.001	0.003	0.002	0.038
		Max	0.019	0.138	0.130	0.022	0.002	0.028	0.185	0.185	0.022	0.011	0.008	0.028	0.011	0.185
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.001	0.000	0.000	0.000	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.008
May	59	Mean	0.000	0.002	0.015	0.000	0.000	0.000	0.018	0.018	0.001	0.000	0.003	0.004	0.004	0.022
		StdDev	0.002	0.006	0.025	0.002	0.000	0.001	0.029	0.029	0.003	0.001	0.020	0.020	0.020	0.034
		Max	0.010	0.025	0.129	0.013	0.000	0.011	0.154	0.154	0.022	0.007	0.153	0.153	0.153	0.154
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.004	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.004
Jun	35	Mean	0.000	0.001	0.009	0.001	0.000	0.000	0.011	0.011	0.000	0.003	0.001	0.004	0.003	0.014
		StdDev	0.001	0.003	0.014	0.004	0.000	0.002	0.018	0.018	0.000	0.008	0.003	0.009	0.009	0.025
		Max	0.007	0.014	0.044	0.025	0.000	0.011	0.075	0.075	0.001	0.043	0.019	0.046	0.046	0.121
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
Jul	41	Mean	0.000	0.001	0.014	0.001	0.000	0.000	0.016	0.016	0.000	0.002	0.003	0.005	0.005	0.021
		StdDev	0.001	0.003	0.024	0.005	0.000	0.002	0.028	0.028	0.002	0.011	0.012	0.016	0.015	0.035
		Max	0.006	0.016	0.078	0.033	0.000	0.015	0.111	0.111	0.015	0.068	0.069	0.070	0.070	0.139
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aug	37	Mean	0.000	0.007	0.020	0.001	0.000	0.000	0.028	0.028	0.000	0.000	0.005	0.006	0.006	0.033
		StdDev	0.000	0.017	0.024	0.005	0.000	0.002	0.038	0.038	0.001	0.002	0.020	0.022	0.022	0.046
		Max	0.002	0.078	0.091	0.027	0.000	0.014	0.178	0.178	0.005	0.012	0.113	0.125	0.125	0.178
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.015	0.000	0.000	0.000	0.017	0.017	0.000	0.000	0.000	0.000	0.000	0.017
Sep	198	Mean	0.001	0.002	0.008	0.001	0.000	0.002	0.012	0.014	0.002	0.001	0.003	0.005	0.003	0.017
		StdDev	0.002	0.006	0.018	0.007	0.003	0.011	0.023	0.026	0.007	0.004	0.011	0.017	0.013	0.032
		Max	0.024	0.048	0.099	0.051	0.044	0.105	0.099	0.134	0.057	0.040	0.096	0.108	0.108	0.175
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Oct	289	Mean	0.000	0.004	0.013	0.001	0.001	0.002	0.018	0.019	0.001	0.002	0.002	0.004	0.002	0.022
		StdDev	0.002	0.012	0.024	0.006	0.004	0.010	0.033	0.035	0.002	0.007	0.009	0.014	0.011	0.037
		Max	0.023	0.100	0.121	0.075	0.047	0.097	0.191	0.191	0.024	0.072	0.093	0.114	0.114	0.193
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.002
Nov	261	Mean	0.000	0.002	0.009	0.000	0.000	0.001	0.012	0.013	0.000	0.001	0.002	0.003	0.003	0.015
		StdDev	0.002	0.009	0.019	0.002	0.001	0.005	0.026	0.027	0.002	0.006	0.012	0.016	0.015	0.032
		Max	0.017	0.088	0.108	0.033	0.008	0.068	0.196	0.196	0.024	0.083	0.126	0.180	0.180	0.196
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dec	305	Mean	0.001	0.002	0.007	0.001	0.000	0.002	0.011	0.013	0.000	0.001	0.002	0.003	0.001	0.014
		StdDev	0.005	0.009	0.018	0.008	0.000	0.012	0.028	0.031	0.002	0.004	0.011	0.013	0.006	0.032
		Max	0.048	0.086	0.106	0.116	0.005	0.158	0.193	0.199	0.017	0.041	0.130	0.158	0.081	0.199
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2010	1832	Mean	0.001	0.003	0.014	0.001	0.000	0.001	0.019	0.020	0.000	0.001	0.002	0.003	0.002	0.022
		StdDev	0.003	0.011	0.023	0.005	0.002	0.008	0.031	0.032	0.003	0.005	0.010	0.013	0.011	0.036
		Max	0.056	0.138	0.136	0.116	0.047	0.158	0.197	0.199	0.057	0.083	0.153	0.180	0.180	0.199
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.004	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.000	0.000	0.000	0.000	0.000	0.004

* Excludes replicates

Table 3-23. DRI Carbon Laboratory System Blank Statistics for Each Analyzer

Analyzer No.	No.*	Statistic*	IMPROVE_A Parameter (units are µg C/cm²) O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
6	179	Mean	0.001	0.002	0.017	0.001	0.000	0.000	0.020	0.020	0.000	0.001	0.001	0.002	0.002	0.022
		StdDev	0.004	0.006	0.022	0.003	0.002	0.001	0.028	0.028	0.002	0.005	0.006	0.008	0.008	0.030
		Max	0.056	0.046	0.106	0.027	0.029	0.016	0.142	0.142	0.024	0.048	0.061	0.062	0.067	0.142
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.005	0.000	0.000	0.000	0.006	0.006	0.000	0.000	0.000	0.000	0.000	0.009
7	181	Mean	0.000	0.002	0.011	0.001	0.000	0.002	0.017	0.017	0.000	0.000	0.001	0.002	0.001	0.018
		StdDev	0.002	0.008	0.021	0.005	0.001	0.013	0.028	0.028	0.000	0.001	0.007	0.008	0.007	0.029
		Max	0.014	0.073	0.130	0.051	0.008	0.158	0.171	0.171	0.006	0.014	0.081	0.081	0.081	0.171
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.005
8	261	Mean	0.001	0.002	0.011	0.001	0.000	0.002	0.014	0.016	0.000	0.001	0.002	0.003	0.002	0.018
		StdDev	0.003	0.008	0.021	0.005	0.001	0.013	0.028	0.030	0.002	0.005	0.013	0.015	0.009	0.032
		Max	0.046	0.073	0.130	0.051	0.008	0.158	0.197	0.197	0.022	0.043	0.130	0.158	0.108	0.197
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.004	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.002
9	132	Mean	0.000	0.000	0.004	0.000	0.000	0.000	0.005	0.005	0.000	0.000	0.001	0.000	0.000	0.005
		StdDev	0.001	0.004	0.013	0.001	0.004	0.004	0.016	0.016	0.001	0.001	0.005	0.002	0.002	0.017
		Max	0.008	0.050	0.099	0.005	0.047	0.047	0.123	0.123	0.005	0.011	0.051	0.022	0.022	0.123
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	173	Mean	0.001	0.002	0.011	0.001	0.000	0.001	0.016	0.016	0.000	0.000	0.002	0.002	0.001	0.018
		StdDev	0.003	0.008	0.024	0.010	0.003	0.007	0.032	0.034	0.001	0.002	0.010	0.011	0.009	0.036
		Max	0.024	0.088	0.108	0.116	0.044	0.073	0.196	0.199	0.016	0.012	0.109	0.117	0.117	0.199
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
11	183	Mean	0.000	0.003	0.013	0.000	0.000	0.001	0.016	0.016	0.000	0.001	0.000	0.001	0.000	0.017
		StdDev	0.003	0.009	0.022	0.000	0.001	0.005	0.028	0.028	0.001	0.003	0.004	0.006	0.002	0.028
		Max	0.038	0.064	0.117	0.002	0.008	0.054	0.176	0.176	0.010	0.030	0.040	0.054	0.027	0.177
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	188	Mean	0.001	0.004	0.019	0.002	0.000	0.001	0.025	0.026	0.001	0.001	0.004	0.007	0.006	0.032
		StdDev	0.003	0.009	0.025	0.006	0.001	0.007	0.033	0.034	0.005	0.005	0.014	0.018	0.017	0.040
		Max	0.027	0.059	0.119	0.046	0.008	0.068	0.144	0.144	0.051	0.030	0.113	0.125	0.125	0.178
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.006	0.000	0.000	0.000	0.010	0.010	0.000	0.000	0.000	0.000	0.000	0.015
13	118	Mean	0.001	0.002	0.015	0.001	0.001	0.003	0.020	0.023	0.002	0.003	0.003	0.008	0.005	0.028
		StdDev	0.005	0.007	0.025	0.005	0.003	0.016	0.032	0.035	0.007	0.012	0.012	0.023	0.018	0.042
		Max	0.029	0.046	0.129	0.053	0.034	0.094	0.169	0.169	0.057	0.072	0.094	0.114	0.114	0.179
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.001	0.000	0.000	0.000	0.005	0.007	0.000	0.000	0.000	0.000	0.000	0.007
16	125	Mean	0.000	0.007	0.020	0.001	0.000	0.001	0.028	0.028	0.001	0.002	0.003	0.005	0.005	0.033
		StdDev	0.002	0.017	0.026	0.007	0.000	0.002	0.040	0.040	0.004	0.010	0.018	0.023	0.023	0.046
		Max	0.013	0.100	0.121	0.075	0.002	0.016	0.193	0.193	0.043	0.083	0.153	0.180	0.180	0.193
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.003	0.000
		Median	0.000	0.000	0.006	0.000	0.000	0.000	0.011	0.014	0.000	0.000	0.000	0.000	0.000	0.018
18	155	Mean	0.001	0.008	0.018	0.001	0.000	0.002	0.029	0.030	0.001	0.001	0.001	0.003	0.001	0.032
		StdDev	0.005	0.018	0.023	0.005	0.000	0.009	0.037	0.039	0.005	0.002	0.009	0.012	0.008	0.042
		Max	0.048	0.136	0.093	0.043	0.001	0.097	0.191	0.191	0.044	0.015	0.093	0.097	0.059	0.191
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.009	0.000	0.000	0.000	0.014	0.014	0.000	0.000	0.000	0.000	0.000	0.014
19	137	Mean	0.000	0.004	0.018	0.000	0.000	0.000	0.023	0.023	0.000	0.001	0.000	0.001	0.001	0.024
		StdDev	0.003	0.015	0.026	0.001	0.000	0.000	0.035	0.035	0.001	0.004	0.001	0.005	0.005	0.037
		Max	0.039	0.138	0.119	0.006	0.000	0.003	0.185	0.185	0.011	0.041	0.015	0.041	0.041	0.185
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.001	0.000	0.000	0.000	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.003
All	1832	Mean	0.001	0.003	0.014	0.001	0.000	0.001	0.019	0.020	0.000	0.001	0.002	0.003	0.002	0.022
		StdDev	0.003	0.011	0.023	0.005	0.002	0.008	0.031	0.032	0.003	0.005	0.010	0.013	0.011	0.036
		Max	0.056	0.138	0.136	0.116	0.047	0.158	0.197	0.199	0.057	0.083	0.153	0.180	0.180	0.199
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.004	0.000
		Median	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003	0.000	0.000	0.000	0.000	0.000	0.004

* Excludes replicates

Tables 3-24 through **3-27** give the analysis results by analyzer for the 24-hour (field), backup filter, trip blanks, and SHAL lab blanks, respectively. These blank filters were identified based upon the list of blank filters IDs provided to DRI by RTI on January 14, 2011. There were only four trip blank backup filters, so there is no separate table showing their analysis results by analyzer. SHAL blanks for IMPROVE_A analyses are a new addition to the CSN report. SHAL blanks are cleaned filters that have never been sent to the field, and which are packaged and labeled by RTI to look like the other filters in a shipment. SHAL blanks are intended to diagnose the amount of carbon picked up during the filter storage, shipping, and handling processes at and between RTI and DRI. There is little instrument to instrument variation among the 24-hour (field), backup filters, or trip blanks. Differences between means for each instrument were typically less than one standard deviation. Some differences between means may be due to the influence of high outliers, some of which may be sampled filters that were incorrectly identified as blanks. For all types of blanks, it was found that nearly all the TC was in OC, with negligible quantities of EC.

Table 3-28 summarizes the results for each type of blank, including trip blank backup filters, combined over all analyzers. Average TC concentration for the 2,525 field blanks was 1.3 ± 1.0 $\mu g/cm^2$, while it was 3.1 ± 2.0 $\mu g/cm^2$ for the 2,519 backup filters, 1.2 ± 0.9 $\mu g/cm^2$ for the 494 trip blanks, 1.0 ± 0.5 $\mu g/cm^2$ for the four trip blank backup filters, and 0.3 ± 0.2 $\mu g/cm^2$ for the SHAL lab blanks.

3.4.3.2 Calibrations

Table 3-29 provides summary statistics for full multi-point calibrations by analyzer covering or bracketing the period during which the project samples were analyzed. The multipoint calibrations are performed semi-annually or whenever major repairs or changes are made to the instruments. Separate calibrations are performed using four different sources of carbon: methane (CH_4), carbon dioxide (CO_2), sucrose ($C_{12}H_{22}O_{11}$), and potassium hydrogen phthalate (KHP). The average of the regression slopes through zero is obtained and used for converting counts to µg C. The slope represents the response of the entire analyzer to generic carbon compounds and includes the efficiencies of the oxidation and methanator zones and sensitivity of the FID. The slope and correlation are for a least squares fit to all points in calibration curves using the four sources of carbon while the scatter is the standard deviation (root mean square of the variance) of the actual points from the fitted curve.

Table 3-30 provides summary statistics for the multi-point temperature calibrations of each carbon analyzer. The temperature calibrations are performed every six months or after a major instrument repair. Criteria for an acceptable calibration are given in **Table 3-20**.

Table 3-31 provides a summary of the oxygen leak tests that are performed every six months or after major instrument repairs. The results are considered acceptable if the O_2 concentration is < 100 ppm. The O_2 contents were well below 100 ppm, in the range of 8-46 ppm.

Table 3-24. DRI Carbon Analysis Statistics for 24-Hour Field Blanks

Analyzer			IMPROVE_A Parameter (units are μg C/cm^2)													
No.	No.*	Statistic*	O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
6	326	Mean	0.225	0.352	0.560	0.065	0.003	0.006	1.205	1.208	0.014	0.006	0.000	0.017	0.015	1.222
		StdDev	0.167	0.179	0.491	0.149	0.024	0.042	0.798	0.817	0.050	0.018	0.002	0.048	0.038	0.833
		Max	1.706	1.480	4.637	1.382	0.289	0.500	7.106	7.357	0.500	0.154	0.015	0.327	0.291	7.421
		Min	0.000	0.000	0.154	0.000	0.000	0.000	0.154	0.154	0.000	0.000	0.000	0.000	0.000	0.154
		Median	0.189	0.315	0.445	0.020	0.000	0.000	1.015	1.010	0.000	0.000	0.000	0.000	0.000	1.022
7	238	Mean	0.160	0.371	0.544	0.067	0.010	0.019	1.151	1.160	0.031	0.007	0.001	0.029	0.020	1.180
		StdDev	0.226	0.212	0.391	0.160	0.121	0.157	0.885	0.921	0.228	0.029	0.003	0.131	0.097	0.988
		Max	2.018	1.858	3.041	1.777	1.845	2.324	9.514	9.993	3.446	0.237	0.028	1.834	1.355	11.348
		Min	0.000	0.055	0.150	0.000	0.000	0.000	0.423	0.423	0.000	0.000	0.000	0.000	0.000	0.423
		Median	0.113	0.326	0.432	0.006	0.000	0.000	0.929	0.929	0.000	0.000	0.000	0.000	0.000	0.948
8	225	Mean	0.182	0.376	0.758	0.090	0.010	0.037	1.416	1.443	0.039	0.007	0.000	0.037	0.009	1.453
		StdDev	0.138	0.186	0.714	0.197	0.088	0.159	1.047	1.114	0.170	0.034	0.002	0.132	0.054	1.132
		Max	0.810	1.444	6.177	1.740	1.207	1.755	9.093	9.432	2.058	0.412	0.027	1.263	0.715	9.432
		Min	0.000	0.127	0.215	0.000	0.000	0.000	0.467	0.467	0.000	0.000	0.000	0.000	0.000	0.467
		Median	0.160	0.334	0.550	0.021	0.000	0.000	1.091	1.091	0.000	0.000	0.000	0.000	0.000	1.091
9	219	Mean	0.119	0.397	0.578	0.060	0.029	0.051	1.183	1.205	0.046	0.011	0.001	0.030	0.008	1.212
		StdDev	0.245	0.366	0.578	0.198	0.377	0.542	1.515	1.658	0.506	0.101	0.009	0.234	0.067	1.720
		Max	3.415	4.984	6.065	2.078	5.565	7.978	19.898	22.311	7.468	1.468	0.095	3.370	0.958	23.269
		Min	0.000	0.100	0.117	0.000	0.000	0.000	0.263	0.263	0.000	0.000	0.000	0.000	0.000	0.263
		Median	0.092	0.343	0.462	0.000	0.000	0.000	0.905	0.905	0.000	0.000	0.000	0.000	0.000	0.905
10	239	Mean	0.157	0.371	0.572	0.061	0.001	0.014	1.162	1.174	0.019	0.002	0.001	0.021	0.009	1.183
		StdDev	0.138	0.174	0.630	0.163	0.013	0.109	0.906	0.985	0.116	0.011	0.014	0.117	0.046	0.999
		Max	0.749	1.118	6.798	1.740	0.205	1.595	9.269	10.864	1.595	0.123	0.216	1.595	0.494	10.864
		Min	0.000	0.065	0.115	0.000	0.000	0.000	0.264	0.264	0.000	0.000	0.000	0.000	0.000	0.264
		Median	0.134	0.330	0.426	0.004	0.000	0.000	0.935	0.935	0.000	0.000	0.000	0.000	0.000	0.935
11	241	Mean	0.108	0.363	0.534	0.041	0.002	0.005	1.047	1.051	0.004	0.003	0.000	0.005	0.002	1.053
		StdDev	0.152	0.181	0.339	0.098	0.023	0.031	0.575	0.582	0.026	0.014	0.000	0.022	0.011	0.584
		Max	1.029	1.409	3.409	1.142	0.344	0.392	5.485	5.533	0.355	0.136	0.003	0.218	0.136	5.533
		Min	0.000	0.070	0.155	0.000	0.000	0.000	0.249	0.249	0.000	0.000	0.000	0.000	0.000	0.249
		Median	0.057	0.339	0.439	0.000	0.000	0.000	0.934	0.937	0.000	0.000	0.000	0.000	0.000	0.937
12	245	Mean	0.161	0.369	0.664	0.081	0.003	0.014	1.279	1.290	0.023	0.012	0.001	0.034	0.023	1.313
		StdDev	0.138	0.159	0.478	0.134	0.036	0.088	0.770	0.811	0.070	0.049	0.006	0.085	0.059	0.835
		Max	1.066	1.381	4.713	1.323	0.546	1.241	6.947	7.232	0.627	0.615	0.048	0.703	0.599	7.232
		Min	0.000	0.043	0.224	0.000	0.000	0.000	0.350	0.350	0.000	0.000	0.000	0.000	0.000	0.350
		Median	0.136	0.344	0.548	0.049	0.000	0.000	1.113	1.112	0.000	0.000	0.000	0.000	0.000	1.118
13	202	Mean	0.132	0.469	0.759	0.087	0.002	0.016	1.449	1.463	0.020	0.012	0.002	0.032	0.018	1.481
		StdDev	0.117	0.230	0.520	0.127	0.018	0.069	0.795	0.825	0.058	0.048	0.009	0.093	0.061	0.850
		Max	0.672	2.376	4.023	0.889	0.194	0.747	5.887	5.989	0.434	0.469	0.083	0.759	0.597	5.996
		Min	0.000	0.132	0.178	0.000	0.000	0.000	0.489	0.489	0.000	0.000	0.000	0.000	0.000	0.489
		Median	0.113	0.439	0.638	0.049	0.000	0.000	1.252	1.253	0.000	0.000	0.000	0.000	0.000	1.275
16	183	Mean	0.144	0.467	0.630	0.093	0.002	0.021	1.338	1.356	0.018	0.008	0.001	0.025	0.006	1.363
		StdDev	0.123	0.168	0.374	0.137	0.018	0.053	0.646	0.676	0.054	0.030	0.004	0.063	0.035	0.687
		Max	0.605	1.161	2.601	1.068	0.230	0.364	4.519	4.647	0.440	0.296	0.035	0.415	0.296	4.666
		Min	0.000	0.133	0.113	0.000	0.000	0.000	0.245	0.245	0.000	0.000	0.000	0.000	0.000	0.245
		Median	0.140	0.434	0.542	0.052	0.000	0.000	1.158	1.162	0.000	0.000	0.000	0.000	0.000	1.162
18	210	Mean	0.232	0.462	0.664	0.121	0.000	0.027	1.480	1.507	0.038	0.018	0.001	0.057	0.030	1.537
		StdDev	0.178	0.211	0.486	0.171	0.003	0.084	0.845	0.901	0.083	0.042	0.007	0.116	0.077	0.928
		Max	0.917	1.154	4.560	1.429	0.031	0.685	7.017	7.621	0.550	0.318	0.069	0.724	0.616	7.621
		Min	0.000	0.000	0.173	0.000	0.000	0.000	0.173	0.173	0.000	0.000	0.000	0.000	0.000	0.173
		Median	0.200	0.422	0.545	0.064	0.000	0.000	1.310	1.329	0.000	0.000	0.000	0.001	0.000	1.347
19	197	Mean	0.144	0.373	0.697	0.083	0.001	0.025	1.297	1.321	0.026	0.011	0.000	0.036	0.012	1.333
		StdDev	0.119	0.144	0.882	0.178	0.010	0.179	1.111	1.269	0.119	0.083	0.003	0.195	0.039	1.288
		Max	0.910	1.104	11.355	1.800	0.133	2.371	13.610	15.981	1.422	1.132	0.036	2.554	0.296	16.164
		Min	0.000	0.093	0.172	0.000	0.000	0.000	0.401	0.401	0.000	0.000	0.000	0.000	0.000	0.401
		Median	0.128	0.347	0.536	0.039	0.000	0.000	1.129	1.129	0.000	0.000	0.000	0.000	0.000	1.129
All	2525	Mean	0.163	0.393	0.627	0.076	0.006	0.020	1.264	1.279	0.025	0.009	0.001	0.029	0.014	1.293
		StdDev	0.169	0.211	0.555	0.159	0.121	0.189	0.933	0.999	0.184	0.048	0.007	0.124	0.058	1.027
		Max	3.415	4.984	11.355	2.078	5.565	7.978	19.898	22.311	7.468	1.468	0.216	3.370	1.355	23.269
		Min	0.000	0.000	0.113	0.000	0.000	0.000	0.154	0.154	0.000	0.000	0.000	0.000	0.000	0.154
		Median	0.135	0.351	0.493	0.023	0.000	0.000	1.062	1.062	0.000	0.000	0.000	0.000	0.000	1.068

* Excludes replicates

Table 3-25. DRI Carbon Analysis Statistics for Backup Filters

Analyzer			IMPROVE_A Parameter (units are µg C/cm^2)													
No.	No.*	Statistic*	O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
6	176	Mean	0.422	1.157	1.324	0.399	0.029	0.132	3.331	3.433	0.097	0.039	0.001	0.108	0.005	3.438
		StdDev	0.422	0.572	0.631	0.273	0.151	0.201	1.453	1.517	0.160	0.056	0.004	0.135	0.015	1.519
		Max	2.384	3.927	3.389	1.584	1.256	1.443	9.683	9.762	1.163	0.394	0.048	0.794	0.086	9.762
		Min	0.000	0.262	0.385	0.000	0.000	0.000	0.681	0.681	0.000	0.000	0.000	0.000	0.000	0.681
		Median	1.025	1.207	0.351	0.000	0.064	0.050	3.133	3.231	0.050	0.011	0.000	0.063	0.000	3.231
7	240	Mean	0.523	0.957	1.205	0.338	0.053	0.090	3.075	3.112	0.097	0.038	0.001	0.084	0.047	3.159
		StdDev	0.507	0.439	0.766	0.289	0.248	0.292	1.550	1.613	0.266	0.075	0.007	0.145	0.092	1.656
		Max	3.557	2.586	6.125	1.859	2.010	2.214	10.178	10.308	2.059	0.526	0.059	1.130	0.683	10.538
		Min	0.000	0.116	0.183	0.000	0.000	0.000	0.621	0.621	0.000	0.000	0.000	0.000	0.000	0.621
		Median	0.373	0.908	1.026	0.253	0.000	0.000	2.757	2.760	0.005	0.000	0.000	0.013	0.000	2.784
8	228	Mean	0.595	0.917	1.351	0.390	0.051	0.154	3.304	3.407	0.179	0.024	0.000	0.151	0.049	3.456
		StdDev	0.882	1.005	1.053	0.731	0.409	0.996	3.801	4.382	1.410	0.059	0.001	1.068	0.463	4.826
		Max	11.284	12.441	12.934	7.962	5.003	13.590	49.622	58.210	19.351	0.494	0.005	14.842	6.254	64.464
		Min	0.000	0.000	0.155	0.000	0.000	0.000	0.155	0.155	0.000	0.000	0.000	0.000	0.000	0.155
		Median	0.388	0.828	1.204	0.280	0.000	0.009	2.831	2.866	0.004	0.000	0.000	0.006	0.000	2.887
9	226	Mean	0.450	0.923	1.125	0.260	0.016	0.044	2.774	2.802	0.040	0.013	0.001	0.038	0.010	2.812
		StdDev	0.415	0.403	0.600	0.220	0.081	0.121	1.262	1.284	0.096	0.036	0.008	0.082	0.026	1.292
		Max	2.728	3.365	4.283	1.432	0.806	1.036	7.938	8.168	0.819	0.218	0.076	0.479	0.182	8.168
		Min	0.000	0.197	0.217	0.000	0.000	0.000	0.437	0.437	0.000	0.000	0.000	0.000	0.000	0.474
		Median	0.331	0.835	1.015	0.209	0.000	0.000	2.652	2.655	0.000	0.000	0.000	0.000	0.000	2.661
10	241	Mean	0.462	1.062	1.210	0.352	0.032	0.062	3.118	3.149	0.066	0.022	0.000	0.056	0.026	3.175
		StdDev	0.360	0.489	0.694	0.272	0.217	0.239	1.462	1.497	0.211	0.083	0.002	0.107	0.082	0.082
		Max	2.603	3.980	4.677	1.600	2.574	2.719	11.529	11.673	2.321	1.063	0.024	1.063	1.063	1.063
		Min	0.000	0.000	0.082	0.000	0.000	0.000	0.082	0.082	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.394	1.034	1.040	0.269	0.000	0.000	2.935	2.976	0.000	0.000	0.000	0.003	0.000	0.000
11	242	Mean	0.393	0.913	1.071	0.293	0.027	0.081	2.696	2.751	0.073	0.015	0.000	0.062	0.008	2.759
		StdDev	0.478	0.443	0.619	0.263	0.198	0.249	1.401	1.479	0.220	0.040	0.002	0.126	0.021	1.483
		Max	3.842	4.343	4.684	1.707	2.939	3.315	12.659	13.035	2.925	0.390	0.029	1.118	0.123	13.035
		Min	0.000	0.125	0.203	0.000	0.000	0.000	0.345	0.345	0.000	0.000	0.000	0.000	0.000	0.345
		Median	0.249	0.851	0.909	0.222	0.000	0.000	2.440	2.479	0.000	0.000	0.000	0.000	0.000	2.482
12	228	Mean	0.481	0.958	1.266	0.330	0.024	0.083	3.058	3.118	0.084	0.036	0.002	0.099	0.039	3.157
		StdDev	0.345	0.399	0.518	0.207	0.097	0.142	1.172	1.225	0.119	0.059	0.009	0.121	0.065	0.065
		Max	2.059	2.257	3.777	1.140	0.891	1.005	6.667	6.781	1.033	0.357	0.083	0.699	0.400	0.400
		Min	0.000	0.327	0.427	0.000	0.000	0.000	0.815	0.815	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.413	0.910	1.190	0.305	0.000	0.020	2.908	2.908	0.046	0.007	0.000	0.054	0.004	0.004
13	224	Mean	0.367	1.054	1.405	0.349	0.022	0.083	3.197	3.258	0.063	0.045	0.002	0.088	0.027	3.285
		StdDev	0.413	0.399	0.704	0.233	0.136	0.211	1.266	1.311	0.143	0.140	0.007	0.174	0.061	1.329
		Max	2.758	2.627	5.819	1.256	1.521	2.057	10.150	9.769	1.473	1.938	0.045	2.057	0.421	10.190
		Min	0.000	0.000	0.253	0.000	0.000	0.000	0.292	0.292	0.000	0.000	0.000	0.000	0.000	0.292
		Median	0.234	0.983	1.273	0.293	0.000	0.020	3.057	3.102	0.022	0.012	0.000	0.040	0.000	3.113
16	176	Mean	0.422	1.157	1.324	0.399	0.029	0.132	3.331	3.433	0.097	0.039	0.001	0.108	0.005	3.438
		StdDev	0.422	0.572	0.631	0.273	0.151	0.201	1.453	1.517	0.160	0.056	0.004	0.135	0.015	1.519
		Max	2.384	3.927	3.389	1.584	1.256	1.443	9.683	9.762	1.163	0.394	0.048	0.794	0.086	9.762
		Min	0.000	0.262	0.385	0.000	0.000	0.000	0.681	0.681	0.000	0.000	0.000	0.000	0.000	0.681
		Median	0.326	1.025	1.207	0.351	0.000	0.064	3.133	3.231	0.050	0.011	0.000	0.063	0.000	3.231
18	223	Mean	0.605	0.893	1.181	0.344	0.029	0.120	3.052	3.142	0.127	0.050	0.002	0.150	0.059	3.201
		StdDev	0.519	0.414	0.640	0.271	0.195	0.276	1.452	1.544	0.234	0.091	0.011	0.208	0.140	1.593
		Max	2.646	2.613	4.059	1.598	1.996	2.596	9.627	10.270	2.063	0.752	0.118	1.486	1.486	10.432
		Min	0.000	0.160	0.265	0.000	0.000	0.000	0.752	0.752	0.000	0.000	0.000	0.000	0.000	0.752
		Median	0.461	0.857	1.034	0.272	0.000	0.014	2.833	2.870	0.060	0.012	0.000	0.076	0.000	2.938
19	196	Mean	0.485	0.903	1.191	0.333	0.041	0.108	2.953	3.020	0.094	0.030	0.000	0.083	0.016	3.036
		StdDev	0.430	0.446	0.659	0.264	0.246	0.290	1.488	1.560	0.245	0.072	0.002	0.127	0.035	1.570
		Max	2.287	3.263	5.469	1.829	2.561	2.908	10.999	11.346	2.620	0.525	0.026	0.940	0.190	11.452
		Min	0.000	0.299	0.219	0.000	0.000	0.000	0.662	0.662	0.000	0.000	0.000	0.000	0.000	0.662
		Median	0.381	0.836	1.054	0.279	0.000	0.032	2.679	2.729	0.043	0.000	0.000	0.043	0.000	2.737
All	2519	Mean	0.516	0.949	1.208	0.331	0.032	0.090	3.037	3.095	0.092	0.032	0.001	0.092	0.034	3.130
		StdDev	0.537	0.521	0.704	0.329	0.214	0.372	1.765	1.925	0.466	0.076	0.006	0.351	0.159	2.037
		Max	11.284	12.441	12.934	7.962	5.003	13.590	49.622	58.210	19.351	1.938	0.118	14.842	6.254	64.464
		Min	0.000	0.000	0.082	0.000	0.000	0.000	0.082	0.082	0.000	0.000	0.000	0.000	0.000	0.082
		Median	0.381	0.880	1.060	0.265	0.000	0.000	2.794	2.814	0.021	0.000	0.000	0.027	0.000	2.842

* Excludes replicates

Table 3-26. DRI Carbon Analysis Statistics for Trip Blanks

Analyzer			IMPROVE_A Parameter (units are µg C/cm^2)													
No.	No.*	Statistic*	O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
6	48	Mean	0.255	0.273	0.379	0.026	0.000	0.001	0.933	0.934	0.003	0.001	0.000	0.004	0.003	0.937
		StdDev	0.099	0.116	0.148	0.039	0.000	0.010	0.291	0.293	0.008	0.006	0.001	0.012	0.007	0.294
		Max	0.601	0.515	0.977	0.210	0.000	0.068	1.700	1.700	0.031	0.038	0.004	0.068	0.031	1.700
		Min	0.098	0.056	0.157	0.000	0.000	0.000	0.404	0.404	0.000	0.000	0.000	0.000	0.000	0.404
		Median	0.237	0.257	0.361	0.013	0.000	0.000	0.925	0.925	0.000	0.000	0.000	0.000	0.000	0.938
7	37	Mean	0.195	0.333	0.513	0.059	0.000	0.002	1.100	1.103	0.009	0.005	0.000	0.014	0.011	1.114
		StdDev	0.126	0.144	0.282	0.127	0.000	0.014	0.495	0.502	0.044	0.018	0.000	0.057	0.056	0.528
		Max	0.570	0.679	1.612	0.618	0.000	0.084	2.648	2.733	0.256	0.078	0.000	0.334	0.334	2.733
		Min	0.000	0.058	0.179	0.000	0.000	0.000	0.419	0.419	0.000	0.000	0.000	0.000	0.000	0.419
		Median	0.170	0.349	0.434	0.003	0.000	0.000	0.981	0.981	0.000	0.000	0.000	0.000	0.000	0.981
8	52	Mean	0.247	0.270	0.533	0.043	0.000	0.007	1.093	1.100	0.012	0.001	0.000	0.013	0.007	1.107
		StdDev	0.101	0.113	0.326	0.092	0.000	0.029	0.508	0.520	0.056	0.004	0.000	0.057	0.029	0.533
		Max	0.509	0.637	2.210	0.570	0.002	0.191	3.637	3.651	0.381	0.025	0.000	0.381	0.191	3.651
		Min	0.082	0.129	0.259	0.000	0.000	0.000	0.548	0.548	0.000	0.000	0.000	0.000	0.000	0.548
		Median	0.220	0.247	0.474	0.003	0.000	0.000	0.995	1.001	0.000	0.000	0.000	0.000	0.000	1.001
9	19	Mean	0.178	0.379	0.518	0.031	0.000	0.010	1.107	1.116	0.016	0.000	0.000	0.016	0.007	1.123
		StdDev	0.091	0.119	0.348	0.057	0.000	0.040	0.448	0.474	0.047	0.001	0.001	0.046	0.027	0.476
		Max	0.297	0.691	1.578	0.209	0.000	0.173	2.276	2.450	0.173	0.006	0.003	0.173	0.117	2.450
		Min	0.000	0.230	0.193	0.000	0.000	0.000	0.559	0.559	0.000	0.000	0.000	0.000	0.000	0.559
		Median	0.181	0.340	0.408	0.000	0.000	0.000	0.918	0.918	0.000	0.000	0.000	0.000	0.000	0.918
10	61	Mean	0.180	0.345	0.558	0.072	0.001	0.020	1.156	1.175	0.019	0.008	0.000	0.025	0.006	1.181
		StdDev	0.100	0.190	0.545	0.154	0.008	0.099	0.780	0.844	0.087	0.024	0.000	0.103	0.025	0.850
		Max	0.441	0.957	3.315	0.801	0.059	0.731	4.774	4.961	0.658	0.137	0.003	0.731	0.141	4.961
		Min	0.000	0.055	0.000	0.000	0.000	0.000	0.240	0.240	0.000	0.000	0.000	0.000	0.000	0.240
		Median	0.175	0.292	0.411	0.010	0.000	0.000	0.966	0.966	0.000	0.000	0.000	0.000	0.000	0.966
11	30	Mean	0.136	0.269	0.396	0.030	0.000	0.003	0.831	0.833	0.005	0.001	0.000	0.006	0.003	0.836
		StdDev	0.105	0.133	0.173	0.043	0.001	0.009	0.371	0.374	0.013	0.004	0.002	0.013	0.011	0.375
		Max	0.485	0.641	0.917	0.151	0.006	0.047	1.662	1.690	0.047	0.019	0.012	0.042	0.042	1.690
		Min	0.000	0.045	0.043	0.000	0.000	0.000	0.154	0.154	0.000	0.000	0.000	0.000	0.000	0.154
		Median	0.104	0.250	0.418	0.009	0.000	0.000	0.745	0.745	0.000	0.000	0.000	0.000	0.000	0.745
12	65	Mean	0.231	0.356	0.653	0.105	0.000	0.011	1.345	1.356	0.056	0.009	0.001	0.067	0.056	1.412
		StdDev	0.209	0.346	0.500	0.351	0.000	0.066	1.292	1.306	0.319	0.033	0.007	0.324	0.319	1.592
		Max	1.436	2.810	3.358	2.774	0.000	0.521	10.377	10.377	2.568	0.254	0.056	2.576	2.576	12.954
		Min	0.000	0.110	0.192	0.000	0.000	0.000	0.460	0.460	0.000	0.000	0.000	0.000	0.000	0.460
		Median	0.183	0.263	0.509	0.019	0.000	0.000	1.104	1.128	0.000	0.000	0.000	0.002	0.000	1.164
13	51	Mean	0.202	0.355	0.875	0.100	0.005	0.024	1.537	1.556	0.047	0.009	0.000	0.051	0.032	1.589
		StdDev	0.107	0.236	0.899	0.151	0.024	0.104	1.086	1.153	0.139	0.021	0.001	0.139	0.096	1.209
		Max	0.563	1.603	5.147	0.648	0.157	0.735	6.240	6.975	0.742	0.092	0.009	0.742	0.595	6.983
		Min	0.046	0.087	0.183	0.000	0.000	0.000	0.406	0.406	0.000	0.000	0.000	0.000	0.000	0.406
		Median	0.183	0.312	0.561	0.049	0.000	0.000	1.173	1.174	0.000	0.000	0.000	0.000	0.000	1.174
16	37	Mean	0.197	0.479	0.622	0.087	0.000	0.041	1.385	1.427	0.027	0.016	0.000	0.044	0.002	1.429
		StdDev	0.146	0.224	0.393	0.140	0.000	0.140	0.727	0.815	0.087	0.060	0.002	0.141	0.012	0.820
		Max	0.612	1.117	2.031	0.604	0.000	0.802	3.850	4.085	0.495	0.307	0.015	0.802	0.073	4.085
		Min	0.000	0.120	0.195	0.000	0.000	0.000	0.547	0.547	0.000	0.000	0.000	0.000	0.000	0.547
		Median	0.161	0.412	0.484	0.038	0.000	0.000	1.165	1.177	0.000	0.000	0.000	0.000	0.000	1.177
18	50	Mean	0.291	0.363	0.574	0.107	0.000	0.017	1.335	1.352	0.039	0.013	0.001	0.053	0.036	1.388
		StdDev	0.148	0.162	0.295	0.136	0.000	0.069	0.538	0.573	0.100	0.038	0.005	0.137	0.099	0.629
		Max	0.586	0.662	1.535	0.775	0.000	0.454	2.780	3.234	0.594	0.215	0.031	0.746	0.547	3.526
		Min	0.000	0.051	0.209	0.000	0.000	0.000	0.341	0.341	0.000	0.000	0.000	0.000	0.000	0.341
		Median	0.274	0.359	0.486	0.076	0.000	0.000	1.275	1.275	0.000	0.000	0.000	0.000	0.000	1.286
19	44	Mean	0.167	0.276	0.442	0.041	0.000	0.006	0.927	0.933	0.009	0.000	0.000	0.009	0.003	0.936
		StdDev	0.098	0.124	0.207	0.060	0.000	0.031	0.387	0.398	0.034	0.002	0.000	0.034	0.015	0.403
		Max	0.467	0.740	1.077	0.194	0.000	0.199	1.972	2.007	0.199	0.013	0.000	0.199	0.098	2.007
		Min	0.000	0.063	0.185	0.000	0.000	0.000	0.379	0.379	0.000	0.000	0.000	0.000	0.000	0.379
		Median	0.139	0.250	0.412	0.004	0.000	0.000	0.821	0.821	0.000	0.000	0.000	0.000	0.000	0.826
All	494	Mean	0.213	0.334	0.565	0.068	0.001	0.013	1.181	1.194	0.025	0.006	0.000	0.031	0.018	1.211
		StdDev	0.136	0.205	0.466	0.168	0.008	0.071	0.776	0.809	0.137	0.027	0.003	0.146	0.126	0.891
		Max	1.436	2.810	5.147	2.774	0.157	0.802	10.377	10.377	2.568	0.307	0.056	2.576	2.576	12.954
		Min	0.000	0.045	0.000	0.000	0.000	0.000	0.154	0.154	0.000	0.000	0.000	0.000	0.000	0.154
		Median	0.190	0.295	0.444	0.016	0.000	0.000	1.037	1.042	0.000	0.000	0.000	0.000	0.000	1.042

* Excludes replicates

Table 3-27. DRI Carbon Analysis Statistics for SHAL Blanks

Analyzer			IMPROVE_A Parameter (units are µg C/cm^2)													
No.	No.*	Statistic*	O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
6	14	Mean	0.001	0.023	0.199	0.001	0.000	0.000	0.224	0.224	0.000	0.000	0.000	0.000	0.000	0.224
		StdDev	0.004	0.033	0.179	0.002	0.000	0.000	0.178	0.178	0.000	0.000	0.000	0.000	0.000	0.178
		Max	0.016	0.121	0.624	0.007	0.000	0.000	0.624	0.624	0.000	0.000	0.000	0.000	0.000	0.624
		Min	0.000	0.000	0.055	0.000	0.000	0.000	0.057	0.057	0.000	0.000	0.000	0.000	0.000	0.057
		Median	0.000	0.008	0.103	0.000	0.000	0.000	0.143	0.143	0.000	0.000	0.000	0.000	0.000	0.143
7	7	Mean	0.000	0.006	0.235	0.007	0.000	0.000	0.249	0.249	0.000	0.000	0.000	0.000	0.000	0.249
		StdDev	0.000	0.012	0.297	0.019	0.000	0.000	0.315	0.315	0.000	0.000	0.000	0.000	0.000	0.315
		Max	0.000	0.031	0.892	0.052	0.000	0.000	0.943	0.943	0.000	0.000	0.000	0.000	0.000	0.943
		Min	0.000	0.000	0.022	0.000	0.000	0.000	0.022	0.022	0.000	0.000	0.000	0.000	0.000	0.022
		Median	0.000	0.000	0.128	0.000	0.000	0.000	0.128	0.128	0.000	0.000	0.000	0.000	0.000	0.128
8	15	Mean	0.025	0.007	0.238	0.011	0.000	0.002	0.281	0.283	0.001	0.001	0.000	0.002	0.000	0.283
		StdDev	0.068	0.017	0.163	0.033	0.000	0.005	0.188	0.187	0.001	0.005	0.000	0.005	0.000	0.187
		Max	0.243	0.064	0.625	0.128	0.000	0.018	0.634	0.634	0.005	0.018	0.000	0.018	0.000	0.634
		Min	0.000	0.000	0.018	0.000	0.000	0.000	0.018	0.018	0.000	0.000	0.000	0.000	0.000	0.018
		Median	0.000	0.000	0.200	0.000	0.000	0.000	0.213	0.232	0.000	0.000	0.000	0.000	0.000	0.232
9	14	Mean	0.005	0.009	0.102	0.000	0.000	0.002	0.116	0.117	0.003	0.000	0.000	0.002	0.001	0.118
		StdDev	0.015	0.018	0.115	0.002	0.001	0.007	0.121	0.125	0.007	0.000	0.000	0.007	0.003	0.127
		Max	0.055	0.055	0.333	0.006	0.005	0.025	0.377	0.402	0.025	0.000	0.000	0.025	0.009	0.402
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.056	0.000	0.000	0.000	0.094	0.094	0.000	0.000	0.000	0.000	0.000	0.094
10	5	Mean	0.000	0.012	0.289	0.016	0.000	0.000	0.316	0.316	0.050	0.000	0.000	0.050	0.050	0.366
		StdDev	0.001	0.010	0.193	0.029	0.000	0.000	0.223	0.223	0.072	0.000	0.000	0.072	0.072	0.288
		Max	0.002	0.024	0.568	0.067	0.000	0.000	0.659	0.659	0.159	0.000	0.000	0.159	0.159	0.818
		Min	0.000	0.000	0.038	0.000	0.000	0.000	0.045	0.045	0.000	0.000	0.000	0.000	0.000	0.045
		Median	0.000	0.007	0.292	0.003	0.000	0.000	0.308	0.308	0.000	0.000	0.000	0.000	0.000	0.308
11	6	Mean	0.034	0.019	0.195	0.000	0.000	0.000	0.248	0.248	0.001	0.000	0.000	0.001	0.001	0.249
		StdDev	0.083	0.026	0.158	0.000	0.000	0.000	0.222	0.222	0.003	0.000	0.000	0.003	0.003	0.225
		Max	0.203	0.061	0.419	0.000	0.000	0.000	0.639	0.639	0.008	0.000	0.000	0.008	0.008	0.647
		Min	0.000	0.000	0.056	0.000	0.000	0.000	0.056	0.056	0.000	0.000	0.000	0.000	0.000	0.056
		Median	0.000	0.008	0.120	0.000	0.000	0.000	0.170	0.170	0.000	0.000	0.000	0.000	0.000	0.170
12	14	Mean	0.007	0.026	0.255	0.003	0.000	0.000	0.292	0.292	0.003	0.000	0.004	0.006	0.006	0.298
		StdDev	0.022	0.029	0.116	0.005	0.000	0.000	0.119	0.119	0.007	0.000	0.009	0.011	0.011	0.122
		Max	0.084	0.086	0.427	0.017	0.000	0.000	0.454	0.454	0.027	0.000	0.030	0.030	0.030	0.481
		Min	0.000	0.000	0.066	0.000	0.000	0.000	0.072	0.072	0.000	0.000	0.000	0.000	0.000	0.072
		Median	0.000	0.018	0.265	0.000	0.000	0.000	0.312	0.312	0.000	0.000	0.000	0.000	0.000	0.322
13	15	Mean	0.029	0.029	0.286	0.000	0.002	0.007	0.347	0.352	0.002	0.004	0.002	0.005	0.000	0.352
		StdDev	0.049	0.037	0.260	0.001	0.009	0.016	0.277	0.281	0.007	0.012	0.006	0.015	0.001	0.281
		Max	0.140	0.121	1.151	0.002	0.036	0.053	1.192	1.215	0.027	0.048	0.022	0.056	0.004	1.215
		Min	0.000	0.000	0.055	0.000	0.000	0.000	0.055	0.055	0.000	0.000	0.000	0.000	0.000	0.055
		Median	0.000	0.014	0.230	0.000	0.000	0.000	0.252	0.294	0.000	0.000	0.000	0.000	0.000	0.294
16	8	Mean	0.010	0.050	0.277	0.029	0.000	0.024	0.366	0.390	0.012	0.017	0.000	0.029	0.005	0.395
		StdDev	0.028	0.050	0.148	0.040	0.000	0.043	0.232	0.247	0.024	0.024	0.000	0.042	0.014	0.249
		Max	0.080	0.129	0.496	0.086	0.000	0.117	0.790	0.853	0.069	0.051	0.001	0.117	0.039	0.853
		Min	0.000	0.000	0.132	0.000	0.000	0.000	0.132	0.132	0.000	0.000	0.000	0.000	0.000	0.132
		Median	0.000	0.035	0.225	0.001	0.000	0.000	0.311	0.369	0.000	0.000	0.000	0.006	0.000	0.369
18	8	Mean	0.025	0.088	0.326	0.011	0.000	0.008	0.449	0.457	0.012	0.000	0.000	0.012	0.005	0.462
		StdDev	0.037	0.092	0.223	0.018	0.000	0.022	0.332	0.346	0.024	0.000	0.000	0.024	0.013	0.347
		Max	0.098	0.273	0.689	0.044	0.000	0.061	1.000	1.061	0.061	0.000	0.000	0.061	0.038	1.061
		Min	0.000	0.000	0.084	0.000	0.000	0.000	0.084	0.084	0.000	0.000	0.000	0.000	0.000	0.084
		Median	0.003	0.057	0.267	0.000	0.000	0.000	0.406	0.406	0.000	0.000	0.000	0.000	0.000	0.406
19	2	Mean	0.000	0.004	0.384	0.000	0.000	0.000	0.388	0.388	0.000	0.000	0.000	0.000	0.000	0.388
		StdDev	0.000	0.002	0.096	0.000	0.000	0.000	0.094	0.094	0.000	0.000	0.000	0.000	0.000	0.094
		Max	0.000	0.005	0.452	0.000	0.000	0.000	0.455	0.455	0.000	0.000	0.000	0.000	0.000	0.455
		Min	0.000	0.003	0.316	0.000	0.000	0.000	0.322	0.322	0.000	0.000	0.000	0.000	0.000	0.322
		Median	0.000	0.004	0.384	0.000	0.000	0.000	0.388	0.388	0.000	0.000	0.000	0.000	0.000	0.388
All	108	Mean	0.014	0.025	0.236	0.006	0.000	0.004	0.281	0.285	0.005	0.002	0.001	0.008	0.004	0.289
		StdDev	0.040	0.042	0.190	0.020	0.004	0.015	0.224	0.229	0.020	0.009	0.004	0.023	0.019	0.233
		Max	0.243	0.273	1.151	0.128	0.036	0.117	1.192	1.215	0.159	0.051	0.030	0.159	0.159	1.215
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.006	0.204	0.000	0.000	0.000	0.231	0.231	0.000	0.000	0.000	0.000	0.000	0.239

* Excludes replicates

Table 3-28. DRI Carbon Analysis Annual Statistics for CSN Blank Categories

Type of Blank	No.*	Statistic*	IMPROVE_A Parameter (units are µg C/cm^2)													
			O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
SHAL	108	Mean	0.014	0.025	0.236	0.006	0.000	0.004	0.281	0.285	0.005	0.002	0.001	0.008	0.004	0.289
		StdDev	0.040	0.042	0.190	0.020	0.004	0.015	0.224	0.229	0.020	0.009	0.004	0.023	0.019	0.233
		Max	0.243	0.273	1.151	0.128	0.036	0.117	1.192	1.215	0.159	0.051	0.030	0.159	0.159	1.215
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.006	0.204	0.000	0.000	0.000	0.231	0.231	0.000	0.000	0.000	0.000	0.000	0.239
		LQL	0.121	0.125	0.570	0.059	0.011	0.046	0.672	0.686	0.060	0.027	0.012	0.070	0.056	0.699
Trip	494	Mean	0.213	0.334	0.565	0.068	0.001	0.013	1.181	1.194	0.025	0.006	0.000	0.031	0.018	1.211
		StdDev	0.136	0.205	0.466	0.168	0.008	0.071	0.776	0.809	0.137	0.027	0.003	0.146	0.126	0.891
		Max	1.436	2.810	5.147	2.774	0.157	0.802	10.377	10.377	2.568	0.307	0.056	2.576	2.576	12.954
		Min	0.000	0.045	0.000	0.000	0.000	0.000	0.154	0.154	0.000	0.000	0.000	0.000	0.000	0.154
		Median	0.190	0.295	0.444	0.016	0.000	0.000	1.037	1.042	0.000	0.000	0.000	0.000	0.000	1.042
		LQL	0.408	0.615	1.399	0.503	0.025	0.214	2.328	2.428	0.410	0.080	0.010	0.439	0.379	2.673
Trip Backup	4	Mean	0.156	0.267	0.502	0.066	0.000	0.000	0.991	0.991	0.010	0.026	0.006	0.043	0.043	1.034
		StdDev	0.087	0.082	0.258	0.122	0.000	0.000	0.450	0.450	0.020	0.053	0.012	0.085	0.085	0.534
		Max	0.278	0.388	0.876	0.249	0.000	0.001	1.658	1.659	0.041	0.105	0.025	0.171	0.170	1.829
		Min	0.072	0.209	0.299	0.000	0.000	0.000	0.682	0.682	0.000	0.000	0.000	0.000	0.000	0.682
		Median	0.137	0.235	0.416	0.008	0.000	0.000	0.811	0.811	0.000	0.000	0.000	0.000	0.000	0.811
		LQL	0.261	0.245	0.773	0.366	0.000	0.001	1.349	1.350	0.061	0.158	0.037	0.256	0.255	1.603
24-Hour Field	2525	Mean	0.163	0.393	0.627	0.076	0.006	0.020	1.264	1.279	0.025	0.009	0.001	0.029	0.014	1.293
		StdDev	0.169	0.211	0.555	0.159	0.121	0.189	0.933	0.999	0.184	0.048	0.007	0.124	0.058	1.027
		Max	3.415	4.984	11.355	2.078	5.565	7.978	19.898	22.311	7.468	1.468	0.216	3.370	1.355	23.269
		Min	0.000	0.000	0.113	0.000	0.000	0.000	0.154	0.154	0.000	0.000	0.000	0.000	0.000	0.154
		Median	0.135	0.351	0.493	0.023	0.000	0.000	1.062	1.062	0.000	0.000	0.000	0.000	0.000	1.068
		LQL	0.507	0.634	1.664	0.476	0.364	0.568	2.798	2.997	0.553	0.145	0.020	0.373	0.173	3.082
Backup	2519	Mean	0.516	0.949	1.208	0.331	0.032	0.090	3.037	3.095	0.092	0.032	0.001	0.092	0.034	3.130
		StdDev	0.537	0.521	0.704	0.329	0.214	0.372	1.765	1.925	0.466	0.076	0.006	0.351	0.159	2.037
		Max	11.284	12.441	12.934	7.962	5.003	13.590	49.622	58.210	19.351	1.938	0.118	14.842	6.254	64.464
		Min	0.000	0.000	0.082	0.000	0.000	0.000	0.082	0.082	0.000	0.000	0.000	0.000	0.000	0.082
		Median	0.381	0.880	1.060	0.265	0.000	0.000	2.794	2.814	0.021	0.000	0.000	0.027	0.000	2.842
		LQL	1.612	1.564	2.113	0.988	0.641	1.116	5.296	5.775	1.399	0.228	0.018	1.053	0.478	6.110

* Excludes replicates

Table 3-29. DRI Multi-Point Calibration Statistics

Analyzer No.	Date	Slope	Scatter	Correlation
6	12/29/09	20.53	0.66	0.9928
	06/04/10	20.17	0.21	0.9936
	12/08/10	21.57	0.25	0.9904
7	09/14/09	21.88	0.74	0.9931
	03/24/10	21.24	0.20	0.9919
	08/31/10	21.53	4.48	0.9873
	02/10/11	21.42	0.20	0.9932
8	07/10/09	20.95	1.17	0.9861
	01/30/10	21.35	0.19	0.9944
	08/01/10	22.15	4.48	0.9937
	09/16/10	21.27	0.19	0.9943
9	10/26/09	20.78	0.29	0.9976
	01/30/10	20.14	0.19	0.9978
	03/08/10	20.97	0.20	0.9939
	09/01/10	21.77	4.47	0.9932
	11/07/10	21.03	0.20	0.9934
	01/28/11	21.57	0.26	0.9954
10	07/20/09	21.43	1.07	0.9897
	01/05/10	20.74	0.91	0.9898
	01/27/10	21.50	0.19	0.9962
	08/31/10	21.97	4.47	0.9899
	02/10/11	22.11	0.26	0.9882
11	10/08/09	21.98	1.13	0.9770
	03/23/10	21.07	0.20	0.9956
	10/04/10	21.65	0.22	0.9924
12	07/31/09	21.79	1.15	0.9911
	01/27/10	21.70	0.18	0.9932
	02/11/10	21.99	0.19	0.9968
	04/06/10	21.27	0.21	0.9802
	10/05/10	21.87	0.24	0.9905
13	10/28/09	20.65	0.75	0.9945
	01/30/10	21.62	0.20	0.9711
	02/11/10	21.88	0.19	0.9967
	05/18/10	20.66	0.20	0.9848
	09/13/10	21.48	0.20	0.9929
	11/07/10	21.96	0.23	0.9948
16	09/28/09	21.05	0.59	0.9957
	02/24/10	21.84	0.20	0.9953
	04/07/10	21.38	0.20	0.9918
	09/01/10	21.91	0.15	0.9938
	12/07/10	21.89	0.23	0.9922
18	10/08/09	21.97	0.37	0.9976
	01/10/10	22.37	0.28	0.9980
	01/25/10	21.49	0.19	0.9890
	04/07/10	21.26	0.21	0.9857
	10/01/10	22.41	0.20	0.9915
19	10/08/09	20.37	0.38	0.9978
	04/05/10	19.52	0.20	0.9878
	05/06/10	19.84	0.21	0.9858
	07/01/10	21.27	4.37	0.9868
	11/07/10	20.49	0.24	0.9908

Table 3-30. DRI Temperature Calibration Statistics

			Analyzer No.										
Cal No.	**Param.**	**Units**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**16**	**18**	**19**
1	Slope		1.017	1.045	1.044	1.013	1.022	1.009	1.009	1.022	1.005	1.039	1.021
	Intercept	° C	4.506	-8.704	-0.569	-0.197	4.185	4.471	7.261	2.704	13.482	4.514	-0.617
	r^2		0.9996	0.9998	0.9982	0.9994	0.9990	0.9994	0.9995	0.9993	0.9996	0.9994	0.9994
	Date		Nov-09	Dec-09	May-09	Oct-09	Jul-09	Oct-09	Jul-09	Jul-09	Oct-09	Oct-09	Oct-09
2	Slope		1.030	1.021	1.014	1.033	0.998	1.012	1.024	1.012	1.005	1.008	1.016
	Intercept	° C	1.011	-0.380	5.740	-1.724	3.163	8.219	3.224	8.316	13.482	5.006	8.954
	r^2		0.9997	0.9995	0.9995	0.9995	0.9993	0.9995	0.9995	0.9997	0.9996	0.9996	0.9987
	Date		Jun-10	Mar-10	Jan-10	Mar-10	Jan-10	Mar-10	Jan-10	Jan-10	Feb-10	Mar-10	Mar-10
3	Slope		1.016	1.023	1.031	1.017	1.036	1.050	1.031	1.007	1.017	1.000	1.0234
	Intercept	° C	3.506	0.592	4.887	-0.240	8.378	0.721	5.906	12.512	15.789	5.470	10.02
	r^2		0.9997	0.9996	0.9993	0.9993	0.9994	0.9997	0.9992	0.9988	0.9987	0.9994	0.9993
	Date		Dec-10	Jul-10	Jul-10	Aug-10	Jul-10	Sep-10	Mar-10	May-10	Aug-10	Sep-10	May-10
4	Slope			1.013	1.037	1.014	1.046		1.016	1.016	1.010		1.016
	Intercept	° C		2.273	1.690	2.456	6.643		2.916	3.976	4.815		9.361
	r^2			0.9998	0.9988	0.9995	0.9990		0.9995	0.9996	0.9960		0.9996
	Date			Feb-11	Feb-11	Dec-10	Feb-11		Sep-10	Nov-10	Dec-10		Nov-10
5	Slope								1.020				
	Intercept	° C							9.162				
	r^2								0.9983				
	Date								Feb-11				

Table 3-31. DRI Oxygen Test Statistics

Analyzer No.	Date Temp	(°C)	January 2010 140	January 2010 580	June 2010 140	June 2010 580	December 2010 140	December 2010 580
6	Mean O_2	(ppm)	12.2	11.6	11.4	13.0	22.9	23.2
	Std Dev	(ppm)	0.5	0.3	0.2	0.9	1.0	0.6
7	Mean O_2	(ppm)	18.3	18.3	14.9	15.1	25.3	29.6
	Std Dev	(ppm)	0.5	0.5	0.8	0.1	1.6	1.4
8	Mean O_2	(ppm)	18.2	16.6	26.2	18.7	39.1	2.2
	Std Dev	(ppm)	0.6	0.3	1.2	0.6	26.9	2.1
9	Mean O_2	(ppm)	20.0	22.2	19.1	13.1	23.3	21.0
	Std Dev	(ppm)	0.4	0.5	0.5	0.6	0.9	0.8
10	Mean O_2	(ppm)	23.5	23.2	5.8	5.8	17.6	18.0
	Std Dev	(ppm)	1.1	0.6	0.6	0.5	2.1	1.1
11	Mean O_2	(ppm)	36.3	30.4	13.9	12.8	9.2	8.0
	Std Dev	(ppm)	1.1	0.7	0.7	0.7	2.1	2.1
12	Mean O_2	(ppm)	26.1	31.2	8.4	11.1	27.7	8.9
	Std Dev	(ppm)	0.3	0.6	0.3	0.4	2.1	1.5
13	Mean O_2	(ppm)	12.3	10.8	22.6	22.3	21.6	16.4
	Std Dev	(ppm)	0.4	0.1	0.5	0.8	1.8	1.1
16	Mean O_2	(ppm)	18.6	19.6	26.6	34.0	46.4	46.0
	Std Dev	(ppm)	0.4	0.4	1.0	1.1	1.5	1.2
18	Mean O_2	(ppm)	24.6	20.6	11.8	25.5	12.8	15.2
	Std Dev	(ppm)	0.3	0.3	0.7	1.0	0.4	1.2
19	Mean O_2	(ppm)	23.8	21.3	11.9	11.6	16.3	17.4
	Std Dev	(ppm)	0.4	0.4	1.8	0.9	0.8	0.4

Figure 3-1 shows the daily autocalibration response during the reporting period for each analyzer. Using the Carle valve, the methane standard is injected once in a He-only atmosphere, once in a He/O_2 atmosphere, and finally the normal calibration peak at the end. The three peaks should have similar peak areas if the catalysts are in good condition and the calibration factor holds. Thermogram peaks are compared and the calibration peak area is examined. Counts that fall below 20,000 result in instrument maintenance. Details of instrument maintenance performed during the reporting period as a result of the autocalibration check are included in **Table 3-32**.

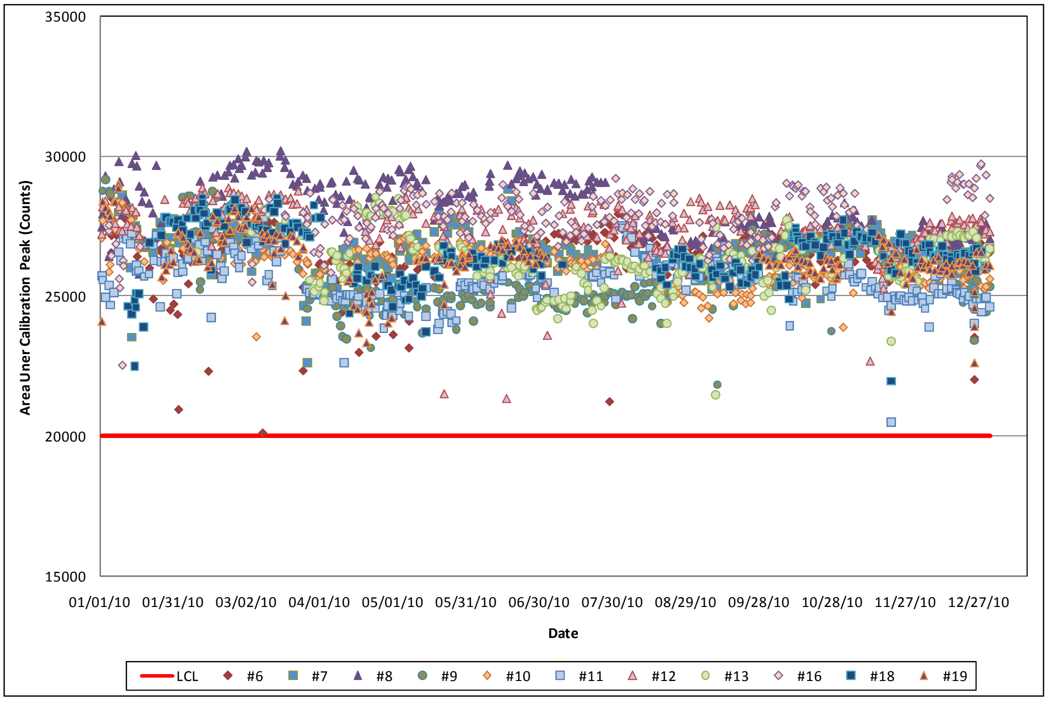


Figure 3-1. DRI Carbon Analyzer Daily AutoCalibration Response for 2010

Table 3-32. Summary of Instrument Maintenance Performed as a Result of Autocalibration Peak Response

Analyzer No.	Date	Resolution
6	05/03/10 11/22/10	Calibration gas was off – adjusted rotameter Reset calibration gas flows
7	03/29/10 09/20/10	Reset calibration gas flows Balanced gas flows
8	02/01/10 03/15/10	Flow and standards checked; replaced septum Readjusted back valve wiring connection
11	04/27/10 10/07/10	Balanced pressure Fixed leak by replacing nut and ferrule at sample oven outlet
12	11/12/10	Fixed leak and adjusted gas levels
13	09/10/10	Replaced methanator
16	01/10/10 02/25/10 03/22/10	Adjusted rotameter valve opening Replaced FID assembly Replaced faulty o-ring
19	03/01/10 03/25/10 04/21/10	Adjusted hydrogen flow Adjusted flow balance on He/O2 valve Adjusted balance

3.4.3.3 Replicate and Duplicate Analyses

Replicate analysis results are from two or more punches from the same sample run on different analyzers. Duplicate analysis results are from two punches from the same sample run on the same analyzer. **Table 3-33** gives the criteria and summary statistics for replicate and duplicate IMPROVE_A carbon analyses run on all analyzers for the CSN filter samples during the reporting period. A replicate or duplicate analysis was selected randomly from every group of 10 samples. A total of 2,348 replicate or duplicate analyses were analyzed during the reporting period. Of the 2,348 replicates or duplicates, 33 contained f, g, h, or i analysis flags for filter damaged or ripped, filter deposit damaged, filter holder assembly problem, and inhomogeneous sample deposit, respectively. These were not included in the replicate and duplicate statistical summary. Of the 2,315 remaining, 58 were duplicate analyses and 2,257 were replicate analyses.

Table 3-33. DRI Replicate Analysis Criteria and Statistics

			Replicates				Duplicates				
Range	Criteria	Statistic	No.	TC	OC	EC	No.	TC	OC	EC	Units
All		Count	2257				58				
TC, OC, & EC < 10 µg C/cm^2	< ±1.0 µg C/cm^2	Count		488	628	1864		15	17	44	
		No. Fail		3	8	114		1	0	0	
		%Fail		0.6	1.3	6.1		6.7	0.0	0.0	%
		Mean		0.307	0.308	0.336		0.261	0.267	0.157	µg C/cm^2
		StdDev		0.263	0.254	0.348		0.250	0.247	0.177	µg C/cm^2
		Max		2.337	1.998	2.149		1.014	0.983	0.970	µg C/cm^2
		Min		0.000	0.000	0.000		0.002	0.010	0.000	µg C/cm^2
		Median		0.249	0.245	0.223		0.218	0.207	0.106	µg C/cm^2
TC, OC, & EC ≥ 10 µg C/cm^2	TC, OC %RPD < 10% EC %RPD < 20%	Count		1769	1629	393		43	41	14	
		No. Fail		23	47	14		0	1	0	
		%Fail		1.3	2.9	3.6		0.0	2.4	0.0	%
		Mean		3.63	4.18	7.50		2.60	3.18	3.31	%RPD
		StdDev		2.48	2.98	5.69		1.78	2.74	2.65	%RPD
		Max		15.27	22.75	26.77		8.08	15.38	9.31	%RPD
		Min		0.00	0.00	0.03		0.02	0.01	0.61	%RPD
		Median		3.22	3.72	6.31		2.69	2.88	2.57	%RPD

* Correction to criteria in current SOP (#2-216r2); included in revised SOP in preparation.

3.4.4 Assessment of Duplicate and Replicate Analyses

Duplicate and replicate analysis results for TC, OC, and EC agree well, with higher relative percent differences (RPD) at loading levels below 10.0 µg C/cm^2. Replicate analyses results are more variable than duplicate analyses, but remain within acceptable limits. The small size (25 mm) of the filter used in the IMPROVE_A carbon analysis method does not permit more than three punches (each ~0.5 cm^2) to be taken from the filter. Samples not meeting replicate criteria (i.e., for TC, OC, or EC < 10 µg C/cm^2, TC, OC < ± 1.0 µg C/cm^2 and EC < ± 2.0 µg C/cm^2; and for TC, OC or EC $\geq$ 10 µg C/cm^2, TC or OC< 10% RPD and EC < 20% RPD) are re-analyzed or examined for inhomogeneities.

The SOP states that the criteria for EC < 10 µg C/cm^2 is ± 1.0 µg C/cm^2, but consistency with EC criteria of an RPD < 20% for EC ≥ 10 µg C/cm^2, would indicate that the criteria should be < ± 2.0 µg C/cm^2 instead. The change is included in the pending revision to the SOP. Instrument performance is also verified to eliminate instrument issues as a source of replicate or duplicate variation. Higher percent errors in OC and TC may be due to inhomogeneous sample deposit and organic artifact. Higher percent error in EC may be due to the low EC loadings on the samples.

3.4.5 Determination of MDLs and LQLs

Table 3-34 gives estimated minimum detection limits (MDLs) for IMPROVE_A parameters for 2010. The MDLs are determined as three times the standard deviation of laboratory and SHAL blanks. **Table 3-34** also gives estimated lower quantifiable limits (LQLs) for the IMPROVE_A parameters. These LQLs are determined as three times the standard deviation of the 24-hour (field) blanks, backup filters, and trip blanks, based on blank identification information provided to DRI after the analyses were completed.

Table 3-34. Estimated MDLs and LQLs for IMPROVE_A Parameters for 2010

Type of Blank	No.*	Statistic*	IMPROVE_A Parameter (units are µg C/cm^2)													
			O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
Lab	614	Mean	0.005	0.023	0.173	0.009	0.001	0.007	0.210	0.216	0.006	0.005	0.002	0.013	0.007	0.223
		StdDev	0.031	0.057	0.253	0.054	0.016	0.060	0.332	0.370	0.055	0.031	0.023	0.082	0.056	0.394
		Max	0.587	0.589	4.494	1.016	0.343	1.170	5.527	6.697	1.170	0.480	0.465	1.170	1.027	6.697
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.000	0.115	0.000	0.000	0.000	0.137	0.137	0.000	0.000	0.000	0.000	0.000	0.139
		MDL	0.092	0.171	0.759	0.161	0.047	0.179	0.995	1.110	0.165	0.094	0.070	0.245	0.169	1.182
SHAL	108	Mean	0.014	0.025	0.236	0.006	0.000	0.004	0.281	0.285	0.005	0.002	0.001	0.008	0.004	0.289
		StdDev	0.040	0.042	0.190	0.020	0.004	0.015	0.224	0.229	0.020	0.009	0.004	0.023	0.019	0.233
		Max	0.243	0.273	1.151	0.128	0.036	0.117	1.192	1.215	0.159	0.051	0.030	0.159	0.159	1.215
		Min	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Median	0.000	0.006	0.204	0.000	0.000	0.000	0.231	0.231	0.000	0.000	0.000	0.000	0.000	0.239
		MDL	0.121	0.125	0.570	0.059	0.011	0.046	0.672	0.686	0.060	0.027	0.012	0.070	0.056	0.699
Trip	494	Mean	0.213	0.334	0.565	0.068	0.001	0.013	1.181	1.194	0.025	0.006	0.000	0.031	0.018	1.211
		StdDev	0.136	0.205	0.466	0.168	0.008	0.071	0.776	0.809	0.137	0.027	0.003	0.146	0.126	0.891
		Max	1.436	2.810	5.147	2.774	0.157	0.802	10.377	10.377	2.568	0.307	0.056	2.576	2.576	12.954
		Min	0.000	0.045	0.000	0.000	0.000	0.000	0.154	0.154	0.000	0.000	0.000	0.000	0.000	0.154
		Median	0.190	0.295	0.444	0.016	0.000	0.000	1.037	1.042	0.000	0.000	0.000	0.000	0.000	1.042
		LQL	0.408	0.615	1.399	0.503	0.025	0.214	2.328	2.428	0.410	0.080	0.010	0.439	0.379	2.673
Trip Backup	4	Mean	0.156	0.267	0.502	0.066	0.000	0.000	0.991	0.991	0.010	0.026	0.006	0.043	0.043	1.034
		StdDev	0.087	0.082	0.258	0.122	0.000	0.000	0.450	0.450	0.020	0.053	0.012	0.085	0.085	0.534
		Max	0.278	0.388	0.876	0.249	0.000	0.001	1.658	1.659	0.041	0.105	0.025	0.171	0.170	1.829
		Min	0.072	0.209	0.299	0.000	0.000	0.000	0.682	0.682	0.000	0.000	0.000	0.000	0.000	0.682
		Median	0.137	0.235	0.416	0.008	0.000	0.000	0.811	0.811	0.000	0.000	0.000	0.000	0.000	0.811
		LQL	0.261	0.245	0.773	0.366	0.000	0.001	1.349	1.350	0.061	0.158	0.037	0.256	0.255	1.603
24-Hour Field	2525	Mean	0.163	0.393	0.627	0.076	0.006	0.020	1.264	1.279	0.025	0.009	0.001	0.029	0.014	1.293
		StdDev	0.169	0.211	0.555	0.159	0.121	0.189	0.933	0.999	0.184	0.048	0.007	0.124	0.058	1.027
		Max	3.415	4.984	11.355	2.078	5.565	7.978	19.898	22.311	7.468	1.468	0.216	3.370	1.355	23.269
		Min	0.000	0.000	0.113	0.000	0.000	0.000	0.154	0.154	0.000	0.000	0.000	0.000	0.000	0.154
		Median	0.135	0.351	0.493	0.023	0.000	0.000	1.062	1.062	0.000	0.000	0.000	0.000	0.000	1.068
		LQL	0.507	0.634	1.664	0.476	0.364	0.568	2.798	2.997	0.553	0.145	0.020	0.373	0.173	3.082
Backup	2519	Mean	0.516	0.949	1.208	0.331	0.032	0.090	3.037	3.095	0.092	0.032	0.001	0.092	0.034	3.130
		StdDev	0.537	0.521	0.704	0.329	0.214	0.372	1.765	1.925	0.466	0.076	0.006	0.351	0.159	2.037
		Max	11.284	12.441	12.934	7.962	5.003	13.590	49.622	58.210	19.351	1.938	0.118	14.842	6.254	64.464
		Min	0.000	0.000	0.082	0.000	0.000	0.000	0.082	0.082	0.000	0.000	0.000	0.000	0.000	0.082
		Median	0.381	0.880	1.060	0.265	0.000	0.000	2.794	2.814	0.021	0.000	0.000	0.027	0.000	2.842
		LQL	1.612	1.564	2.113	0.988	0.641	1.116	5.296	5.775	1.399	0.228	0.018	1.053	0.478	6.110

* Excludes replicates

3.4.6 Audits, PEs, Training, and Accreditations

3.4.6.1 System Audits

EPA's National Air and Radiation Laboratory (NAREL) conducts periodic technical system audits (TSAs), performance evaluations (PEs), and inter-comparisons of $PM_{2.5}$ chemical speciation laboratories, including DRI. TSAs are conducted approximately once every three years and inter-comparisons/PEs approximately yearly. These audits, PEs, and inter-comparisons cover the analysis of mass by gravimetry, elements by x-ray fluorescence (XRF), ions by ion chromatography (IC), and carbon analysis by thermo-optical methods, including the (now phased out) STN thermo-optical transmittance (TOT) and thermo-optical reflectance methods of IMPROVE (also phased out) and IMPROVE_A. DRI has participated in these programs since 2005. The last TSA of DRI's EAF, including its Carbon Laboratory, was conducted on July 27, 2010, but a final report has not been issued. The previous report for the TSA conducted in 2007 found that DRI's Carbon laboratory was a modern facility with state-of-the art instrumentation, good documentation, and well-qualified staff, and that it met or exceeded compliance with good laboratory practices and SOPs.

3.4.6.2 Performance Evaluations

Inter-laboratory comparisons and PEs, including DRI's Carbon Laboratory, have been conducted annually from 2005 through 2009. The results for the 2010 comparison are currently being summarized. These reports are available at EPA's Ambient Monitoring Technical Information center (AMTIC) website at:

http://www.epa.gov/ttn/amtic/qapollutant.html

3.4.6.3 Training

DRI's carbon analysis laboratory currently operates 24 hours a day, 6 days a week. Analysis staff includes two full-time technicians, three students from the University of Nevada, Reno, three hourly technicians, and one post-doctoral research associate who serves as an instrument specialist and research analyst, overseeing calibration, maintenance, operation, instrument, QA/QC software, and instrument performance upgrades. All are fully trained in carbon analysis and all new technicians undergo a rigorous two-week training program which includes a complete review of SOPs, filter analysis training and documentation, filter shipping and receiving, and basic equipment maintenance and operation.

3.4.6.4 Accreditations

There are no accreditation programs specifically for thermal/optical carbon analysis, but since 2008, DRI has been accredited annually by the Texas Commission on Environmental Quality (TCEQ) through the National Environmental Laboratory Accreditation Program (NELAP) for the gravitational analysis of TSP, PM_{10}, and $PM_{2.5}$.

3.4.6.5 References

Chow, J.C.; Watson, J.G.; Chen, L.W.; Chang, M.C..; Robinson, N.F..; Dana Trimble; Steven Kohl. (2007). The IMPROVE_A Temperature Protocol for Thermal/Optical Carbon Analysis: Maintaining Consistency with a Long-Term Database. *J. Air Waste Manage. Assoc.*, **57**:1014-1023.

3.5 X-ray Fluorescence Laboratories

The two XRF laboratories, RTI and CLN used 4 and 1 XRF instruments, respectively, to analyze an estimated 15,606 filters for 33 elements during the period of January 1 through December 31, 2010.

Beginning January 1, 2010, the RTI XRF Laboratory received approval from the EPA to begin using XRF 4 in the PM2.5 CSN Program. An inter-comparison study was performed of XRF 4, with other instruments that have been accepted for the USEPA CSN program.

3.5.1 RTI International XRF Laboratory

3.5.1.1 Quality Issues and Instrument Maintenance and Repairs

The following repairs and maintenance were performed for XRF 1:

- 03/18/10 – Replaced E/I board; system had no X-rays (calibration verified)
- 05/12/10 – Software problem; reloaded Wintrace software
- 08/11/10 – Replaced E/I board; intermittent 100% DT issue (calibration verified)
- 08/12/10 - PM performed, checked voltages, resolution, and stability
- 10/28/10 – Replaced X-ray tube and shielded filament cable for spectra noise (re-calibration required)
- 12/16/10 – Replaced E/I board; burnt pins on J2 cable and calibrated detector (calibration verified)

The following repairs and maintenance were performed for XRF 2:

- 03/18/10 – Replaced sample motor assembly (calibration verified)
- 10/19/10 – PM performed, checked voltages, resolution, and stability

The following repair and maintenance was performed for XRF 3:

- 01/21/10 – Replaced HVPS , tube and calibrated detector (re-calibration required)
- 07/01/10 – Replaced vacuum pump
- 10/21/10 – PM performed, checked voltages, resolution, and stability

The following repair and maintenance was performed for XRF 4:

- 02/24/10 – Replaced HVPS (calibration verified)
- 10/08/10 – PM performed, checked voltages, resolution, and stability

- 11/05/10 – Replaced X-ray tube and calibrated detector (re-calibration required)
- 12/16/10 - Replaced vacuum pump

3.5.1.2 Description of QC Checks Applied

QC activities for the analysis of elements by EDXRF for the RTI XRF Laboratory, their frequency of application and control limits, comments, and corrective actions are shown in **Table 3-35**.

Table 3-35. QC Procedures Performed in RTI XRF Elemental Analysis Laboratory

QC Check	QC Frequency	Control Limits	Comments/ Corrective Action
Calibration	as needed	—	—
Calibration verification[1]	monthly	90–110% recovery	check calibration
Instrument precision[2]	analyzed with each tray of samples (10 tray autosampler)	within 5% CV	check calibration and reanalysis of tray
Energy calibration	daily	—	—
Sample replicate precision (Relative Percent Difference [RPD])	5%	+/- 50 RPD	Reanalysis

[1] Using NIST SRM
[2] Micromatter QC

3.5.1.3 Summary of QC Results

Precision was monitored by the reproducibility of the measurements of the multi-element Micromatter QC sample. The QC sample has six selected elements and is analyzed with each tray of samples. Comparison of the element's replicate values gives the measure of reproducibility or precision. The data used to monitor precision are presented in **Tables 3-36 through 3-41**. The percent coefficient of variation (%CV) for the average of all data for each of the six elements ranged between -0.77 and 0.05% for XRF 1, between -0.29 and -0.02% for XRF 2, between -0.23 and 0.18% for XRF 3, and between -1.20 and 0.42% for XRF 4. Because of major repairs requiring re-calibration, QC Precision data for XRF 1 and XRF 4 are separated into two tables, reflecting performance before and after servicing.

Table 3-36. Summary of RTI XRF 1 Laboratory QC Precision Data, μg/cm^2, 1/1/2010 through 10/31/2010

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	538	4.98	5.09	5.04	0.020	0.39	-0.13
Ti	538	6.76	6.85	6.80	0.016	0.23	-0.05
Fe	538	6.85	6.95	6.89	0.015	0.22	-0.23
Cd	538	5.59	5.70	5.65	0.023	0.41	-0.04
Se	538	3.89	4.00	3.93	0.016	0.41	-0.03
Pb	538	9.10	9.20	9.15	0.019	0.21	-0.03

Table 3-37. Summary of RTI XRF 1 Laboratory QC Precision Data, μg/cm², 11/1/2010 through 12/31/2010

Element	N	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	53	4.98	5.05	5.01	0.015	0.29	-0.06
Ti	53	6.77	6.84	6.80	0.015	0.23	0.05
Fe	53	6.90	6.97	6.94	0.015	0.21	-0.16
Cd	53	5.47	5.58	5.54	0.023	0.42	-0.55
Se	53	3.95	4.03	4.00	0.017	0.43	-0.77
Pb	53	9.14	9.08	9.11	0.012	0.13	-0.05

Table 3-38. Summary of RTI XRF 2 Laboratory QC Precision Data, μg/cm², 1/1/2010 through 12/31/2010

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	631	5.19	5.29	5.24	0.022	0.41	-0.14
Ti	631	6.59	6.69	6.64	0.022	0.33	-0.05
Fe	631	6.86	6.95	6.90	0.015	0.22	-0.02
Cd	631	5.85	6.00	5.91	0.023	0.39	-0.20
Se	631	3.94	4.05	4.00	0.019	0.47	-0.29
Pb	631	9.39	9.23	9.30	0.020	0.21	-0.07

Table 3-39. Summary of RTI XRF 3 Laboratory QC Precision Data, μg/cm², 11/1/2010 through 12/31/2010

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	96	5.19	5.28	5.22	0.017	0.33	-0.23
Ti	96	7.46	7.55	7.51	0.018	0.24	0.18
Fe	96	6.99	7.06	7.03	0.016	0.23	0.06
Cd	96	4.26	4.35	4.30	0.025	0.58	0.01
Se	96	2.90	2.98	2.94	0.018	0.60	-0.13
Pb	96	7.96	8.04	8.00	0.017	0.21	0.11

Table 3-40. Summary of RTI XRF 4 Laboratory QC Precision Data, $\mu g/cm^2$, 1/1/2010 through 10/31/2010

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	547	4.44	4.56	4.50	0.022	0.50	-0.34
Ti	547	5.95	6.05	6.00	0.019	0.32	-0.21
Fe	547	6.40	6.49	6.43	0.016	0.25	0.09
Cd	547	5.59	5.70	5.64	0.022	0.40	-0.01
Se	547	3.76	3.84	3.80	0.014	0.36	-0.09
Pb	547	8.98	9.07	9.03	0.016	0.17	-0.02

Table 3-41. Summary of RTI XRF 4 Laboratory QC Precision Data, $\mu g/cm^2$, 11/1/2010 through 12/31/2010

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	53	4.49	4.58	4.53	0.019	0.43	0.42
Ti	53	5.96	6.04	6.00	0.019	0.32	-0.45
Fe	53	6.52	6.59	6.55	0.016	0.25	-0.47
Cd	53	5.46	5.58	5.51	0.024	0.44	-0.74
Se	53	3.80	3.93	3.85	0.024	0.62	-1.20
Pb	53	8.92	8.99	8.94	0.015	0.17	-0.22

n = number of observations
Min = minimum value observed
Max = maximum value observed
Std Dev = standard deviation
%CV = percent coefficient variation ((Std Dev/Average)*100)

Recovery or system accuracy was determined by the analysis of a NIST Standard Reference Material (SRM) filter. Recovery is calculated by comparisons of measured and expected values. **Tables 3-42 through 3-45** show recovery for 7 elements of the 33 elements normally measured. The recovery values for all the elements ranged between 95 and 106% for XRF 1; between 93 and 105% for XRF 2; between 94 and 104% for XRF 3; and between 95 to 105% for XRF 4. Note that every month, 33 elements of the Micromatter calibration standards are analyzed as unknowns to verify calibration.

Table 3-42. Recovery Determined from Analysis of NIST SRM 1832 for RTI XRF 1, 1/1/2010 through 12/31/2010

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Al	95	103	99	0.382	2.55	-0.744
Si	95	99	97	0.324	0.94	0.068
Ca	95	99	97	0.220	1.12	-0.080
V	98	102	100	0.052	1.08	-0.074
Mn	102	106	104	0.047	0.99	-0.029
Co	97	101	99	0.013	1.21	-0.006
Cu	96	102	97	0.037	1.57	0.107

Table 3-43. Recovery Determined from Analysis of NIST SRM 1832 for RTI XRF 2, 1/1/2010 through 12/31/2010

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Al	94	98	96	0.162	1.12	-0.048
Si	96	100	98	0.497	1.44	-0.660
Ca	93	96	95	0.187	0.98	-0.088
V	101	105	103	0.038	0.76	0.006
Mn	97	100	99	0.035	0.77	0.012
Co	97	101	99	0.008	0.78	0.001
Cu	94	97	95	0.020	0.85	0.008

Table 3-44. Recovery Determined from Analysis of NIST SRM 1832 for RTI XRF 3, 11/1/2010 through 12/31/2010

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Al	96	97	97	0.097	0.66	-0.021
Si	95	97	96	0.267	0.79	-0.255
Ca	94	97	95	0.234	1.23	-0.328
V	103	104	103	0.034	0.68	-0.036
Mn	98	101	99	0.051	1.10	-0.039
Co	99	101	99	0.008	0.75	0.000
Cu	95	95	95	0.007	0.30	0.023

Table 3-45. Recovery Determined from Analysis of NIST SRM 1832 for RTI XRF 4, 1/1/2010 through 12/31/2010

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Al	98	102	100	0.163	1.08	-0.181
Si	95	98	97	0.209	0.61	-0.295
Ca	96	99	98	0.296	1.51	-0.212
V	101	104	102	0.045	0.92	0.012
Mn	100	104	101	0.069	1.47	0.018
Co	99	105	102	0.021	1.92	0.007
Cu	97	102	99	0.043	1.79	0.015

Replicates were analyzed at a frequency of at least 5% of the number of filters analyzed in the RTI XRF Laboratory. Six elements were selected for comparison through regression analysis. **Table 3-46** shows the correlation coefficients and average RPDs for the replicate analysis. The correlation coefficients for XRF 1 range from 0.9985 to 0.9999, the correlation coefficients for XRF 2 range from 0.9998 to 0.9999, the correlation coefficients for XRF 3 range from 0.9975 to 0.9999, and the correlation coefficients for XRF 4 range from 0.9997 to 0.9999 indicating acceptable replication with all four instruments. Also, for the six elements, the average RPD on XRF 1 was less than 2%, the average RPD for the six elements on XRF 2 was less than 3%, the average RPD for the six elements on XRF 3 was less than 5%, and the average RPD for the six elements on XRF 4 was less than 1%.

Table 3-46. Summary of Replicate Results for XRF 1, XRF 2, XRF 3, and XRF 4

XRF 1				XRF 2			
Element	n	Correlation Coefficient	Average RPD	Element	n	Correlation Coefficient	Average RPD
Si	302	0.9987	1.12	Si	327	0.9999	-0.59
S	302	0.9999	-0.04	S	327	0.9999	-0.52
K	302	0.9999	-1.73	K	327	0.9999	1.24
Ca	302	0.9998	-1.40	Ca	327	0.9999	-2.16
Fe	302	0.9999	-0.60	Fe	327	0.9999	-0.54
Zn	302	0.9985	1.65	Zn	327	0.9998	-0.72

XRF 3				XRF 4			
Element	n	Correlation Coefficient	Average RPD	Element	n	Correlation Coefficient	Average RPD
Si	58	0.9994	4.15	Si	318	0.9999	-0.99
S	58	0.9996	0.06	S	318	0.9999	0.47
K	58	0.9992	-0.16	K	318	0.9999	0.83
Ca	58	0.9999	-2.82	Ca	318	0.9999	-0.01
Fe	58	0.9999	-1.08	Fe	318	0.9999	-0.19
Zn	58	0.9975	-0.49	Zn	318	0.9997	1.00

Assessment of Between-Instrument Comparability

Overview of Round-Robin Samples Run During 2010

In addition to passing internal QC samples as described in the sections above, the RTI laboratories and CLN participated in a “round-robin” filter program coordinated by the RTI XRF Laboratory. It should be emphasized that the round-robin program is only used to collect descriptive statistics about network performance; the results are not currently being used for QC purposes. The lag time between successive analyses and the potential for filter contamination and damage in transit make it impractical to use these filters for laboratory QC.

In the round-robin program, previously analyzed CSN filters are recycled through all the instruments in the two laboratories. **Table 3-47** summarizes the number of round-robin filters analyzed during 2010.

Table 3-47. Numbers of Round-Robin Filter Analyses Performed during 2010

Laboratory	Instrument	Filters Analyzed
CLN	Kevex 770	24
CLN	Kevex 772*	24
RTI	XRF 1	24
RTI	XRF 2	24
RTI	XRF 3	24
RTI	XRF 4	24

* - CLN 772 is not an approved instrument in the CSN PM2.5 Program, but CLN analyzed all 2010 round robin filters on the 772 and provided the data.

The majority of elements on the Round-Robin filters are present in quantities at or below the detection capabilities of the XRF instruments; therefore, it was necessary to restrict the statistical analysis of the round-robin results to 9 elements that were found in sufficient quantity on a majority of the filters. The statistics to follow in this section are restricted to only filters analyzed in 2010.

Assessment of Bias and Precision

The primary purpose of the round-robin program is to assess bias between instruments for the various elements. Interlaboratory precision, a component of overall network error, can also be estimated based on these statistics.

One simple way to assess potential differences in performance of the different instruments is to perform linear regression in which the individual observations for each instrument are regressed against a reference value. **Tables 3-48 through 3-50** show linear regression results for which the data for the filters are regressed versus the median for the six instruments for each filter. The median value is used as the reference value, since the “true” value is unknown for these filters. Each instrument in the program reported zeros or low-level detections in some of the elements. This was especially

Table 3-48. Regression Results for 9 Elements
RTI XRF Instrument XRF 1 and XRF 2

Element	RTI 1				RTI 2			
	n	Correlation Coefficient	Slope	Intercept	n	Correlation Coefficient	Slope	Intercept
Si	24	0.9933	0.9613	0.0485	24	0.9891	1.0033	0.0460
S	24	0.9998	1.0073	-0.1261	24	0.9998	1.0047	-0.0193
K	24	0.9998	0.9793	0.0350	24	0.9998	1.0563	0.0222
Ca	24	0.9991	0.9790	0.0070	24	0.9986	1.0001	-0.0196
Fe	24	0.9989	1.0126	0.0275	24	0.9991	1.0081	-0.0257
Ni	24	0.9981	1.0039	0.0004	24	0.9981	0.9708	-0.0003
Cu	24	0.9406	0.9820	0.0047	24	0.9731	1.0861	0.0019
Zn	24	0.9868	1.0188	-0.0107	24	0.9975	1.0610	-0.0072
Pb	24	0.96871	0.9612	0.0029	24	0.9715	1.0409	-0.0103

Note: Units for intercept are µg/filter; correlation coefficient and slope are dimensionless.

Table 3-49. Regression Results for 9 Elements
RTI XRF Instrument 3 and XRF 4

Element	RTI 3				RTI 4			
	n	Correlation Coefficient	Slope	Intercept	N	Correlation Coefficient	Slope	Intercept
Si	24	0.9947	1.0295	-0.0619	24	0.9850	1.0356	0.0110
S	24	0.9998	1.0063	0.0277	24	0.9996	1.0129	-0.1045
K	24	0.9999	0.9999	-0.0251	24	0.9999	0.9861	0.0064
Ca	24	0.9992	1.0001	0.0042	24	0.9993	0.9822	0.0104
Fe	24	0.9988	1.0081	0.0083	24	0.9991	0.9884	0.0286
Ni	24	0.9967	0.9704	0.0031	24	0.9952	0.9161	0.0036
Cu	24	0.9247	0.9498	0.0043	24	0.9910	1.0364	0.0017
Zn	24	0.9852	1.0113	-0.0090	24	0.9888	0.9578	0.0186
Pb	24	0.9464	0.9128	0.0036	24	0.9637	1.0468	-0.0021

Note: Units for intercept are µg/filter; correlation coefficient and slope are dimensionless.

Table 3-50. Regression Results for 9 Elements
CLN XRF Instrument 770 and 772

Element	770				772			
	n	Correlation Coefficient	Slope	Intercept	N	Correlation Coefficient	Slope	Intercept
Si	24	0.9629	1.0020	-0.1009	24	0.9878	1.0733	-0.0080
S	24	0.9949	0.9727	0.3279	24	0.9992	0.9791	-0.0233
K	24	0.9995	1.0053	-0.0842	24	0.9988	0.9993	0.0204
Ca	24	0.9959	1.1373	-0.0433	24	0.9930	1.0284	-0.0003
Fe	24	0.9953	0.9803	-0.0718	24	0.9974	0.9326	0.0066
Ni	24	0.9934	1.1888	0.0038	24	0.9872	1.0321	-0.0070
Cu	24	0.9727	0.9400	-0.0197	24	0.9747	0.9667	0.0003
Zn	24	0.9903	1.0805	-0.0329	24	0.9966	0.9502	0.0116
Pb	24	0.9744	0.9365	-0.0004	24	0.9601	1.0034	0.0146

Note: Units for intercept are µg/filter; correlation coefficient and slope are dimensionless.

noticeable for Ni, Cu, and Pb, which affected the calculation for slope and correlation coefficient for these elements. Note that the calculated uncertainty of these results for each instrument was not taken into account when doing the regression (i.e., no weighting factors were used).

Note: Four instruments from RTI and two from CLN were used in the calculations for the regression results.

3.5.1.4 Determination of Uncertainties and MDLs

MDLs are determined periodically by obtaining data from the analysis of 10 laboratory blanks. The MDLs are calculated as three times the average counting uncertainty for each element. This is equivalent to a “3-sigma” MDL; data users should be careful to know what multiple has been used in establishing the MDL when comparing values reported by different environmental laboratories, since some laboratories may use 1-sigma, 2-sigma, or 2.5-sigma. The calculated MDLs based on XRF uncertainty from XRF 1, XRF 2, XRF 3, and XRF 4 is presented in **Table 3-51**.

Counting uncertainties for each analytical result are automatically calculated by the ThermoNoran software, except when the concentration value is zero; the software cannot calculate an uncertainty. Total uncertainty is calculated using a combination of the counting uncertainty, attenuation uncertainty (if applicable), laboratory calibration uncertainty (5%), and field sampling and handling uncertainty (5%). The ThermoNoran software returns a zero counting uncertainty whenever the calculated mass for an element is calculated to be zero or negative. To obtain an uncertainty value for when the concentration is zero, the following formula is used:

Uncertainty = slope * A * sqrt (3 * sqrt (B * t) + B * t) / t

Where

A = scaling factor
B = background counts (cps) is incorporated during the importing of the data into the RTI XRF database
t = livetime.

Table 3-51. RTI Method Detection Limits – Interference-Free, 3-sigma, μg/filter

Element	RTI 1	RTI 2	RTI 3	RTI 4
Na	0.397	0.303	0.319	0.370
Mg	0.114	0.114	0.108	0.104
Al	0.266	0.129	0.247	0.254
Si	0.130	0.093	0.124	0.124
P	0.104	0.155	0.104	0.096
S	0.066	0.095	0.072	0.064
Cl	0.052	0.075	0.054	0.048
K	0.044	0.070	0.040	0.040
Ca	0.050	0.073	0.047	0.047
Ti	0.039	0.051	0.044	0.039
V	0.030	0.037	0.029	0.030
Cr	0.020	0.025	0.024	0.021
Mn	0.017	0.018	0.018	0.017
Fe	0.014	0.016	0.018	0.014
Co	0.013	0.013	0.013	0.012
Ni	0.012	0.012	0.012	0.010
Cu	0.027	0.016	0.049	0.015
Zn	0.013	0.017	0.016	0.016
As	0.018	0.009	0.021	0.020
Se	0.020	0.013	0.025	0.020
Br	0.019	0.013	0.024	0.019
Rb	0.019	0.019	0.023	0.019
Sr	0.022	0.023	0.033	0.019
Zr	0.309	0.032	0.270	0.202
Ag	0.221	0.126	0.249	0.197
Cd	0.295	0.166	0.344	0.215
In	0.279	0.154	0.312	0.317
Sn	0.447	0.196	0.673	0.353
Sb	0.595	0.377	0.612	0.500
Cs	0.092	0.110	0.114	0.107
Ba	0.083	0.105	0.110	0.101
Ce	0.066	0.094	0.070	0.075
Pb	0.041	0.045	0.045	0.045

3.5.1.5 Audits, PEs, Training, and Accreditations

The RTI XRF laboratory participated in a NAREL sponsored inter-laboratory comparison study. The study included the analysis of 47mm Teflon filters from samples analyzed in the 2009 inter-laboratory study and were re-analyzed a second time once they returned from the participating laboratories. The results of the NAREL study are included in the final report posted on the EPA website:

http://www.epa.gov/ttn/amtic/files/ambient/pm25/spec/RTI_TSA_2009.pdf

Also during 2010, the RTI XRF laboratory served as the reference laboratory for the next inter-laboratory study being conducted in 2011. As the reference lab, RTI analyzed all of the 47mm filters used in the study before they were distributed to the other participating laboratories in January 2011.

3.5.2 Chester LabNet X-Ray Fluorescence Laboratory

During the period covered by this report, Chester Labnet (CLN) operated one Kevex 770 XRF instrument analyzing 1350 samples for 33 elements.

3.5.2.1 Quality Issues and Instrument Repair and Maintenance

The following repairs and maintenance were performed for XRF-770:

- 3/16/10 – Adjusted pre-filter bar.
- 7/26/10 – Moved pre-filter collimator (re-calibration required)

3.5.2.2 Description of QC Checks Applied

QC activities for the analysis of elements by EDXRF for the CLN XRF laboratory, their frequency of application and control limits, comments and corrective actions are shown in **Table 3-52A.**

Table 3-52A. QC Procedures Performed in CLN XRF Elemental Analysis Laboratory

QC Check	QC Frequency	Control Limits	Comments/Corrective Action
Calibration	As needed	± 5%	Calibration
Calibration verification[1]	Once per week	± 2 sigma	Recalibrate
Instrument precision[2]	Per 10 to 15 samples	± 10%	Re-analyze
Excitation condition check	Per 10 to 15 samples	± 10%	Re-analyze
Sample replicate precision	Per 10 samples	RPD < 2x uncertainty	Re-analyze if necessary

1 - Using NIST SRMs
2 – Micromatter QC

3.5.2.3 Summary of QC Results

Precision was monitored by the reproducibility of the multi-element Micromatter QC sample. The QC sample has six selected elements and is analyzed with each tray of samples. The comparison of the element’s values gives the measure of reproducibility or precision. The data used to monitor precision are presented in **Table 3-52B**. The percent coefficient of variation (%CV) for the average of all data for each of the six elements ranged between 2.10 and 3.13%.

Table 3-52B. Summary of CLN XRF 770 Laboratory QC Precision Data, Percent Recovery, 1/1/2010 through 12/31/2010

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	114	92	105	98	3.06	3.13	-2.74
Ti	114	92	103	98	2.16	2.21	2.32
Fe	114	91	103	98	2.06	2.10	1.83
Cd	114	94	105	100	2.32	2.32	4.06
Se	114	92	104	98	2.46	2.51	1.66
Pb	114	92	105	98	2.44	2.49	1.06

Accuracy

Accuracy determinations are performed with three NIST thin film SRMs, four vapor deposited Micromatter standards, and one NIST particle size standard. Recovery is calculated by dividing the measured result by the expected value. Table 3-21A show recovery for 12 elements spanning the atomic mass range of the 33 elements normally measured. The min and max recovery values for all the elements ranged between 90 and 113%. Analysis of NIST Particle Standard SRM 2783 yielded recoveries of 100.0% for Ca and 105% for Zn. Averages over the reporting period were within the recovery goal of twice the standard deviation; however individual measurements were sometimes outside this criterion. Corrective actions were taken whenever a recovery was outside specifications as follows:

- If one of the elements in **Table 3-53** fell outside of the 2-sigma limit, a single re-analysis of the standard was performed in that excitation condition. If re-analysis resulted in failure, then recalibration of that excitation condition was necessary.

- If recalibration demonstrated that the log of the inverse of the new calibration factor (log sensitivity) –vs- atomic number (Z) for the “failed element” did not conform to a smoothly varying curve defined by the log of the sensitivity factors –vs- atomic numbers for the remaining elements, then the calibration factor was “forced” to fit the curve, with the resulting calibration factor yielding “less than optimum” recovery values.

Table 3-53. Recovery Determined from Analysis of NIST SRMs 1832, 1833, 2708 and 2783 for CLN XRF 770 -- 1/1/2010 through 12/31/2010

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Al	96	107	100	2.02	2.02	-2.76
Si	96	106	99	2.00	2.02	-1.31
Si	92	101	98	1.59	1.62	2.05
S	90	107	101	3.87	3.83	5.64
K	98	110	104	2.30	2.23	0.12
Ca	92	107	100	3.82	3.84	-8.50
Ti	90	101	96	2.08	2.16	-0.26
V	91	106	98	2.71	2.76	-2.60
Mn	101	112	106	2.26	2.14	-2.23
Fe	94	103	98	2.26	2.30	-0.59
Cu	94	112	103	4.23	4.10	-2.54
Zn	98	113	105	3.04	2.90	-6.28
Pb	100	111	106	2.33	2.21	1.71

Replicate analysis of field samples are used to assess reproducibility of the analytical system. Replicates were analyzed at a frequency of 10% of the filters analyzed. Six elements were selected for comparison through regression analysis. **Table 3-54** shows the correlation coefficient and average RPDs for the replicate analysis. The correlation coefficients range from 0.9927 to 0.9998.

Table 3-54. Summary of Replicate Results for CLN XRF 770

Kevex 770			
Element	n	Correlation Coefficient	Average RPD
Al	83	.9982	-0.67
Si	131	.9992	-5.21
S	132	.9983	-0.90
K	132	.9927	-0.23
Ca	132	.9980	0.11
Fe	132	.9994	-1.87
Zn	113	.9998	-2.06

There are times when the distribution of a certain species across the filter is not uniform, and will not produce tight precision. This is important information for those who intend to use the data. It is CLN's position that re-analysis of particle deposits on filters received from the field represents the degree of confidence the client may expect more accurately than precision calculated from the uniformly distributed deposits from the Micromatter QC standard.

Failure of individual replicate analysis results to fall with 2x uncertainty can fall into several categories:

- The wrong sample can be re-analyzed, which is easily deduced and easily corrected by re-analyzing the correct sample.

- If one element in a sample lies outside the 2-sigma range, especially a volatile species such as Cl which can be an order of magnitude lower on subsequent analysis due to the low pressure atmosphere in the analysis chamber, no action is taken. However, if several elements in one excitation condition lie outside action levels, while other species in different excitation conditions demonstrate good precision, then the spectra for the excitation condition in question are examined for anomalies, and re-analysis of that excitation condition is performed.

3.5.2.4 Assessment of Between-instrument Comparability

For XRF, inter-instrument comparability is assessed by a round-robin filter exchange program coordinated by the RTI XRF laboratory. See Section 3.4.2.4 for comparative performance of both laboratories.

Since the inception of the PM2.5 Speciation project, Chester has performed numerous comparisons between instruments via replicate analysis of a number of clients, but much of this data is proprietary and cannot be shared in this report.

3.5.2.5 Uncertainties and MDLs

The methods for determining uncertainties and MDLs are described in SOPs XR-002.02 and XR-006.01. MDLs were determined for the 770 instrument on 12/26/05. The calculated MDLs are presented in presented in **Table 3-55**.

3.5.2.6 Audits, PEs, Training, and Accreditations

CLN has not received any audit visits from EPA on the CSN program since the beginning of the speciation project, and would welcome any PE samples or other oversight, which the EPA might deem appropriate.

Another CLN client provides quarterly PE samples in the form of Micromatter vapor deposited standards for elements: Cr, Cu, Zn, Ga, As, Se, Cd, Te, and Pb. However, these PE samples were analyzed using instrument XRF 772, which is not currently approved for use on the CSN program.

Table 3-55. CLN Method Detection Limits – Interference-Free, 3-sigma, μg/filter

Element	CLN 770
Na	0.849
Mg	0.314
Al	0.160
Si	0.110
P	0.059
S	0.056
Cl	0.106
K	0.058
Ca	0.046
Ti	0.022
V	0.019
Cr	0.024
Mn	0.030
Fe	0.049
Co	0.036
Ni	0.029
Cu	0.022
Zn	0.022
As	0.042
Se	0.021
Br	0.020
Rb	0.022
Sr	0.026
Zr	0.042
Ag	0.149
Cd	0.160
In	0.179
Sn	0.212
Sb	0.254
Cs	0.052
Ba	0.082
Ce	0.043
Pb	0.064

3.6 Denuder Refurbishment Laboratory

The Denuder Refurbishment Laboratory is located in RTI Building No. 3, Laboratory 219. The purpose of the laboratory is to clean and refurbish the coatings on acid-gas-removing denuders used in samplers of CSNs operated by EPA and various State, local, and tribal agencies, which utilize the RTI/EPA contract. The laboratory also prepares denuders for capture of either acidic or basic gases from the atmosphere and subsequent extraction and analysis to quantify the concentrations of these gases. The laboratory follows these SOPs, which are kept on file in the laboratory:

- Standard Operating Procedures for Coating [MetOne] Aluminum Honeycomb Denuders with Magnesium Oxide
- Standard Operating Procedure for Coating and Extracting Annular Denuders with Sodium Carbonate
- Standard Operating Procedure for Coating and Extracting Denuders for Capture of Ammonia and Its Analysis [specific for use with glass honeycomb denuder].
- Standard Operating Procedure for Coating and Extracting Compact Parallel-Plate Denuders for Capture of Ammonia [specific for use with the parallel plate denuder for the MetOne SASS sampler]

3.6.1 Quality Issues and Corrective Actions

Ms. Constance Wall coordinates the Denuder Refurbishment Laboratory. She reviews the denuder refurbishment SOPs to ensure procedures are clearly stated and all processes are up to date. All SOPs were reviewed and signed by responsible personnel in early 2010.

Personnel have been cross-trained to be able to process denuders. At present, there are three persons trained to refurbish and coat denuders. RTI is also capable of coating denuders in a glove cabinet so that exposure of denuders to ambient air is minimized and the denuders can later be extracted to quantify the mass of acidic (e.g., HNO_3) or basic (e.g., NH_3) gases collected.

3.6.2 Operational Discussion

3.6.2.1 Numbers of Denuder Serviced

Table 3-56 lists the denuders refurbished and the number of refurbishments completed in 2010.

Table 3-56. Denuder Refurbishments, January 1, 2010 through December 31, 2010

Denuder Type	Total Refurbished
Aluminum Honeycomb	672

3.6.2.2 Scheduling of Replacements

MetOne speciation sampler aluminum honeycomb denuders are coated with magnesium oxide. Because the MetOne denuders are part of the sampling module and six sets of modules are in circulation to each site, these denuders are refurbished at 18-month intervals. RTI is able to remove MgO from denuders using a dilute hydrochloric acid solution. As needed, RTI orders uncoated aluminum honeycomb denuder substrates from MetOne, cleans them with solvent and deionized water, and then coats them with magnesium oxide. The change-out occurs whenever the MetOne denuder assembly has been in use for 18 months.

3.6.3 Description of QC Checks Applied and Results

QC checks for coating weight are no longer done. Work in earlier years of the project(s) showed that coating weights on the same types of MgO-coated denuders were usually within 10% of one another and that the amount (number of moles) of MgO applied far exceeded the expected mass (number of moles) of acidic gases that would be drawn through the denuder during the cumulative sampling period. Now the newly-coated denuder surfaces are examined by holding the denuder up to a light and sighting along the interior to determine the coating is thoroughly applied and the annuli are not blocked.

3.7 Sample Handling and Archiving Laboratory

3.7.1 Quality Issues and Corrective Actions

There were no major quality issues in the SHAL during 2010.

3.7.2 Description of QC Checks Applied

The SHAL uses a customized database program written specifically for RTI's SHAL operation. This database has been refined over 10 years to incorporate many built-in QC checks. For example, RTI has assigned an inventory number to all

Figure 3-2. SHAL Technician Loading the URG 3000N Cassette.

filter modules in the network. The database will only accept allowable inventory numbers for filter modules. This avoids errors in data input for any filter module used for a sampling event. Another example is the unique number of the Teflon filters used by RTI. RTI purchases Teflon filters with a check sum digit in the numbering sequence. The database will only accept those filter numbers with the correct check sum. This prevents inadvertent entry of incorrect filter identification numbers.

- Bar-code readers are used to input identification numbers from modules, containers, and data forms to eliminate data transcription errors.
- A SHAL technician other than the one who prepared an outgoing shipment checks the package of outgoing filters. A checklist is used by the technician to verify that the package contents are correct before it is shipped from RTI. This check is performed on all outgoing shipments from the SHAL.
- Blank filters are taken from the SHAL refrigerator and sent unopened to the analytical laboratories for analysis. The results of the analysis of these QC filters are used to improve the overall quality of the program.
- The field site operators are provided contact information for the SHAL laboratory so they may communicate directly with personnel at RTI if any problems are discovered upon receipt of the filter modules. RTI personnel will attempt to resolve issues promptly. For example, a Field Data Form may be faxed from RTI to the site operator if necessary.

3.7.3 Summary of QC Results

During calendar year 2010, the SHAL shipped out and received back more than 31,000 packages of filters. By employing the QC checks described in Section 3.7.2, the majority of the coolers shipped and received at RTI contained the correct filter modules and the required paperwork for completing the sampling event at the field site. The high number of correctly packaged shipments sent from RTI helped the field-sampling locations meet their completion goals.

3.7.4 Summary of Scheduling Problems

RTI prepares shipping schedules for the CSN and distributes these to all field sampling locations through the EPA DOPO's. The schedules indicate when each cooler will be sent from RTI, the scheduled sampling date for the filters, and the return ship date from the site back to RTI. The schedules are designed to allow RTI to send the sampling site clean filters, allowing time for field site operators to set up and retrieve filters from the samplers. A 48 hour window for sample retrieval by the site operator is built into the schedule. **Table 3-57** lists those sites with less than 95% of their filters run on the intended sampling date.

Table 3-57. Sites with Less than 95% of Filters Run on Intended Sampling Date

AQS Site Code	POC	Location	Events[(1)]	On Date	Percent
471570024	5	Alabama (TN)	242	208	86.0
540390011	5	WV-Guthrie Agricultural Center	202	185	91.6
490353006	5	Hawthorne	244	224	91.8
171190024	5	Granite City	124	116	93.5
080010006	5	Commerce City	202	190	94.1
060290014	5	Bakersfield – California Ave	202	192	95.0

(1) For sites with both SASS and URG 3000 N, each sampler was counted separately.

3.7.5 Support Activities for Site Operators and Data Users

SHAL staff provided support to site operators and data users throughout 2010. A summary of email and phone communications with site operators and data users is presented in **Table 3-58**.

Table 3-58. Summary of SHAL Communications with Site Operators and Data Users

Description	Number of Communications
Site will send cooler late	142
Site needs schedule	30
Site did not receive cooler	61
Change of operator/site information	97
Sampler problems/questions	56
Field Blank/Trip Blank ran as routine sample	0
Request change of ship date from RTI	23
Site is stopping	13
Miscellaneous QA Issues	207
Data questions/reporting	68
Other	187

3.7.6 Audits, PEs, Training, and Accreditations

- All new SHAL technicians must undergo a formal training process before they handle any filters. This process includes a Safety and Occupational Health Orientation, a review of the SOP and instruction by senior staff in filter handling. A record of this training is kept on file.
- SHAL staff periodically review the SOP and a record of this review is added to their training file.
- All SHAL staff are trained in the handling of the 25mm quartz filters used in the URG 3000N sampler and the proper installation and removal of the quartz filter using the URG 3000N cassette.

- Throughout the year, senior SHAL staff will periodically observe the SHAL technicians processing filter modules. A checklist has been prepared listing each step in the module processing task. The checklist is used during the observation of the technician. The SHAL supervisor keeps the completed checklists. Technicians are briefed following the review of any findings. A summary of the reviews for calendar year 2010 is shown in **Table 3-59**.

Table 3-59. Review of SHAL Technician Processing Filter Modules

Module Type	Number Observed	Findings	Findings Reviewed with Technician
MET ONE	80	3	3
URG 3000N	80	0	0

3.7.7 Collocated Carbon Measurements

Beginning in 2009, with the Phase 1 introduction of the URG 3000N carbon sampler into the Chemical Speciation Network, eleven field sampling locations were selected by EPA to collect collocated carbon samples. These sites would collect a carbon sample using both the MET ONE sampler and the URG 3000N sampler on each sampling date for a period of one year. **Table 3-60** lists the eleven sites selected for this study and the timeframe of collection at each location.

Table 3-60 Sampling Sites Collecting Collocated Carbon Samples

Site Name	AQS #	Phase 1	Phase 2	Phase 3
Queens College	360810124		X	
IS 52	360050110	X		
South DeKalb	130890002		X	
North Birmingham	010730023	X		
Allen Park	261630001		X	
GT Craig	390350060			X
Com Ed	170310076	X		
Commerce City	080010006	X		
Riverside Rubidoux	060658001	X		
Sacramento Del Paso Manor	060670010		X	
Beacon Hill	530330080	X		

Phase 1 Collocation: May 1, 2009 – April 30, 2010
Phase 2 Collocation: April 1, 2009 – March 31, 2010
Phase 3 Collocation: October 1, 2009 – September 30, 2010

3.7.8 Chemical Speciation Site Changes December 2010

In December of 2010, the SHAL implemented a number of changes as directed by EPA. These changes involved starting new sites and changing the sampling collection frequency for a number of existing speciation sites. These changes were to be effective with the first sampling date in January 2011.

Five entirely new speciation sites were established. These were Baxter Water Treatment Plant in PA, Blaine Anoka County Airport in MN, National Trail High School in OH, Shelby Farms in TN and Sieben Flats in MT.

The CPW site in SC was stopped and was replaced by the Parklane site.

Three existing speciation sites changed sampling frequency from 1-day-in-3 to 1-day-in-6. These were Alabama (TN), Commerce City in CO, and the Philadelphia AMS Laboratory in PA.

Thirteen existing speciation sites changed sampling frequency from 1-day-in-6 to 1-day-in-3. These were Cannons Lane in KY, Children's Park in AZ, Del Norte in NM, Denver Animal Hospital in CO, Grand Rapids in MI, Jerome Mack Middle School in NV, Kapolei in HI, MLK in DE, NLR PARR in AR, North Los Angeles in CA, Northbrook in IL, Sioux Falls School in SD and Taft in OH.

The University of Florida Ag School site was also supposed to stop and be replaced by the Broward County Highway location. However, this was delayed until at least the summer of 2011 because the new location was not ready.

4.0 Data Processing

4.1 Quality Issues and Corrective Actions

No significant quality issues arose during the period of this report that affected reportable data.

4.2 Operational Summary

Routine data-processing activities have remained largely unchanged since the beginning of the program. These include the following:

- Accepting data entered from field forms
- Accepting data from the laboratories
- Backing up and maintaining the database
- Generating data monthly for validation and review
- Posting review data monthly to the Web site for external review
- Incorporating data change requested by the States
- Uploading finalized data to AQS
- Responding to user inquiries and data requests, including support to EPA and RTI personnel.

4.3 Operational Changes and Improvements

In 2003, RTI upgraded its OC/EC analysis equipment with new improved software that enables more accurate division of OC and EC and reduced noise at low levels of carbon. Under a work assignment on another contract, RTI used the new software to reprocess all OC/EC samples posted to AQS between 2000 and July 2003. Revised data for these samples were reposted to AQS in 2010. As a result, all CSN carbon data in AQS analyzed by RTI using the CSN/TOT method should now be consistent across the entire period (2000 to 2009). After 2009, all OC/EC is being done by the IMPROVE_A method except at collocated sites until April 2010.

4.4 Monthly Data Postings to Web Site

Each month, RTI posts data for samples received on or before the 15th of the previous month. **Table 4-1** shows monthly totals for postings, and **Table 4-2** shows totals for events. Sample dates may overlap between different batches due to different shipping schedules for the 1-in-3 and 1-in-6 sampling schedules. In addition, the latest date may include samples received

Table 4-1. Events Posted to Web Site

Report		Sampling Date				Blanks			Backup Filters[3]	
Batch	Date	Earliest	Latest	Total[1]	Routine	Field	Trip	24 Hour[2]	Routine	Trip Blank
121	2/15/2010	12/3/2009	1/14/2010	1,694	1,194		14	244	241	1
122	3/13/2010	1/8/2010	2/17/2010	1,664	1,136	63	2	233	230	
123	4/15/2010	2/7/2010	3/12/2010	1,640	1,086		180	187	186	1
124	5/14/2010	3/6/2010	4/14/2010	2,058	1,279	179	1	302	297	
125	6/14/2010	4/8/2010	5/14/2010	1,697	1,166	63		234	234	
126	7/15/2010	5/8/2010	6/13/2010	1,643	1,109		63	237	234	
127	8/13/2010	6/7/2010	7/10/2010	1,792	1,143	176	5	236	231	1
128	9/15/2010	7/4/2010	8/10/2010	1,586	1,128	1	2	230	225	
129	10/18/2010	8/6/2010	9/8/2010	1,857	1,156	64	172	235	230	
130	11/12/2010	9/5/2010	10/12/2010	1,788	1,315		3	234	235	1
131	12/15/2010	10/5/2010	11/7/2010	1,641	1,000	171	2	234	234	
132	1/14/2011	11/10/2010	12/13/2010	1,848	1,314		64	235	235	
			Total	20,908	14,026	717	508	2,841	2,812	4

1) Counts for Routine Events and Total Events do not include backup filters or 24-hour blanks.

2) 24 Hour blanks are only used with the URG 3000N samplers. Only results for OC/EC analysis by the IMPROVE_A method are reported for these samples.

3) Backup filters are only used for URG 3000N samplers. Only results for OC/EC analysis by the IMPROVE_A method are reported.

Table 4-2. Records Posted to Web Site

Report		Sampling Date				Blanks			Backup Filters(3)	
Batch	Date	Earliest	Latest	Total(1)	Routine	Field	Trip	24 Hour(2)	Routine	Trip Blank
121	2/15/2010	12/3/2009	1/14/2010	127,408	117,039		1,369	5,612	3,374	14
122	3/13/2010	1/8/2010	2/17/2010	124,968	111,321	4,874	194	5,359	3,220	
123	4/15/2010	2/7/2010	3/12/2010	130,271	105,887		17,465	4,301	2,604	14
124	5/14/2010	3/6/2010	4/14/2010	149,075	124,433	13,417	121	6,946	4,158	
125	6/14/2010	4/8/2010	5/14/2010	126,191	112,859	4,674		5,382	3,276	
126	7/15/2010	5/8/2010	6/13/2010	120,989	106,187		6,075	5,451	3,276	
127	8/13/2010	6/7/2010	7/10/2010	131,761	109,655	12,948	482	5,428	3,234	14
128	9/15/2010	7/4/2010	8/10/2010	117,110	108,378	98	194	5,290	3,150	
129	10/18/2010	8/6/2010	9/8/2010	140,797	110,955	4,722	16,495	5,405	3,220	
130	11/12/2010	9/5/2010	10/12/2010	135,122	126,148		288	5,382	3,290	14
131	12/15/2010	10/5/2010	11/7/2010	117,177	95,794	12,533	192	5,382	3,276	
132	1/14/2011	11/10/2010	12/13/2010	140,877	126,036		6,146	5,405	3,290	
			Total	1,561,746	1,354,692	53,266	49,021	65,343	39,368	56

1) Counts for Routine Events and Total Events do not include backup filters or 24-hour blanks.

2) 24 Hour blanks are only used with the URG 3000N samplers. Only results for OC/EC analysis by the IMPROVE_A method are reported for these samples.

3) Backup filters are only used for URG 3000N samplers. Only results for OC/EC analysis by the IMPROVE_A method are reported.

late (i.e., after the previous report's cutoff date). Note that the number of records reported per event varies with sampler type. Thus, the number of records per event will vary depending on how many of each sampler type was operating during that period. In addition, the totals in Table 4-1 exclude backup filters (which are always run as part of another event) to prevent double counting of events.

Postings to AQS

After data have been posted to the external Web site, sites have 45 days to review data and send corrections to RTI. RTI then is required to post data to AQS within 15 days. RTI met all processing deadlines for this reporting year. **Table 4-3** contains totals of events posted to AQS. **Table 4-4** contains totals of records posted to AQS. Note that blanks involve fewer records per event, as temperature and barometric pressure for field and trip blanks are not posted to AQS. Some data, such as results for the collocated shipping study, were reported to the sites, but were not reported to AQS. In addition, the number of records posted per event varies with sampler type (with the URG posting volatile and total nitrate).

4.5 Data User Support Activities

RTI had continuing data-user support throughout the year. Most responses may be categorized into four categories; data change requests, requests for old data, support requests for the Speciation Data Validation and Analysis Tool (SDVAT), and requests from data users.

4.5.1 Data Change Requests

Sites are asked to review their data and submit any changes to RTI within 45 days. RTI then processes these changes before posting the data to AQS. Sites report changes via e-mail. Many sites do not report unless they have changes, whereas others send a report back indicating there are no changes to be made. **Table 4-5** shows a count of the number of change requests per batch. Note that many requests represent multiple sites (often an entire state).

Table 4-3. Events Posted to AQS

Report Batch	Routine[(1)]	Blanks			Backup Filters[(2)]
		24 Hour[(2)]	Field	Trip	
121	1,221	246		14	245
122	1,158	234	65	2	234
123	1,110	187	1	181	187
124	1,310	302	179	1	301
125	1,186	234	66		234
126	1,134	238		63	238
127	1,168	236	176	5	235
128	1,151	231	1	2	231
129	1,169	235	64	177	233
130	1,317	234		3	235
Total	11,924	2,377	552	448	2,373

1) A sampling event is defined as a sample taken at a single AQS site ID and Parameter Occurrence Code (POC) on a single day. This would represent two physical samplers at sites that use URG 3000N samplers for carbon sampling.

2) URG 3000 N samplers only.

Table 4-4. Records Posted to AQS

Report Batch	Routine	Blanks			Backup Filters[(1)]
		24 Hour[(1)]	Field	Trip	
121	70,848	3,198		819	3,185
122	67,217	3,042	3,002	110	3,042
123	63,467	2,431	45	10,499	2,431
124	75,547	3,926	8,153	65	3,913
125	68,555	3,042	2,991		3,042
126	65,124	3,094		3,655	3,094
127	67,267	3,068	7,948	284	3,055
128	66,246	3,003	52	110	3,003
129	67,387	3,055	2,894	10,235	3,029
130	76,054	3,042		174	3,055
Total	687,712	30,901	25,085	25,951	30,849

1) URG 3000 N only.

Table 4-5. Change Requests per Report Batch[(1)]

	Report Batch											
	119	120	121	122	123	124	125	126	127	128	129	130
Change Requests[1]	3	2	5	5	4	7	7	6	8	7	5	3

1) Number of site data contact changes. Multiple data changes by one site contact are counted as one request.

5.0 Quality Assurance and Data Validation

5.1 QA Activities

5.1.1 QAPP Updates

RTI's QAPP was revised not revised in 2010. The current revision was prepared at the start of the new CSN contract, and was submitted in February, 2009.

5.1.2 SOP Updates

RTI's SOPs were updated in preparation for the procurement of the CSN contract in July 2008. All SOPs were finalized in early 2009, after contract award. One SOP (Coating and Extracting Compact Parallel-Plate Denuders for Ammonia Determination) was updated during 2010. The current versions of all SOPs are listed in Section 7 of this report.

5.1.3 Internal Surveillance Activities

Internal surveillance activities during 2010 included walkthroughs of all the laboratories to verify compliance with the SOPs. Outstanding quality issues are discussed at monthly project meetings, and any new changes required were implemented.

SHAL technicians also crosscheck each other's coolers before they are shipped to the sites.

5.1.4 Data User Support Activities

The Project Manager, QA Manager, SHAL Supervisors, Data Processing Supervisor and other project personnel responded to a number of questions and requests for data during 2010. These originated from both network participants (state agency personnel and EPA), as well as data users who were not affiliated with the CSN program. See Sections 3.0 and 4.0 for additional information.

5.2 Data Validation and Review

5.2.1 Review of Monthly Data Reports to the CSN Web Site

Each month, RTI reviews data completed during the previous month. These reviews include the following activities:

- Verification of data attribution to the correct site, POC, and date
- Visual review of report formats
- Investigation and corrective actions when discrepancies are found

- Automated range checks (e.g., barometric pressure, temperature)
- Level 1 checks (e.g., reconstructed mass balance, anion/cation balance, and sulfur/sulfate balance).

Tables **5-1** through **5-3** summarize the data flags attached to the data primarily through the data review process, although some of these were specified by either the field operator or one of the laboratories. Examining trends in flag percentages is a useful tool in diagnosing potential problems; however, during 2010 the flag percentages were low and stable. Increases in the percentages of flags such as DST, temperature of receipt above 4 degrees C, could be explained by seasonal factors.

Table 5-1 lists the percentages of validity status flags that are defined in AIRS/AQS. Data records having a validity status flag should be used with caution because the reported value was noted as atypical, or some unusual circumstance was reported by the field operator or by the laboratory. Table 5-2 lists the percentages of null value codes defined in AIRS/AQS. These data records have been invalidated due to more serious problems and the concentration is not included in the record. Table 5-3 lists percentages of internal RTI informational flags. These flags are not defined in AIRS/AQS, but give more insight to the monitoring agencies during data review about the reasons why AIRS/AQS flags were set.

5.2.2 Review of Monthly Data Packages to AQS

Approximately 60 days after initial posting on the RTI Web site, the data are uploaded to the AQS database. Prior to uploading, the data processing staff prepares a QC summary report, which is reviewed by the QA Manager. This summary and review includes the following main areas:

- Verification that changes requested by the state agencies have been implemented. This includes checking data flags that are different between original reporting (Web site posting) and final AQS reporting.
- Verification that record counts match exactly the number of records previously reported on the CSN Web site, with allowance for all records that were added and deleted during processing. Record changes include such things as elimination of duplicates, generation of aggregated nitrate values for MASS samplers, and deletion of data for sites not reported to AQS (e.g., special studies).
- Scanning for unusual values such as start times other than midnight
- Scanning for formatting errors such as the following:
  - duplicate records
  - flags and other data in incorrect columns
  - previously delivered data (unless they are Modify records)
  - MDLs and uncertainties that do not agree between the original report and the AQS data file.

Table 5-1. Summary of Validity Status Codes by Delivery Batch Number (percent of data records reported)

Flag	Description	121	122	123	124	125	126	127	128	129	130	131	132
1	Critical criteria not met						0.3%	0.0%					
2	Operational criteria not met					0.0%							
3	Possible field contamination	0.0%	0.1%		0.0%								
5	Outlier - cause unknown	5.5%	4.0%	2.9%	4.1%	4.9%	5.6%	3.3%	3.5%	1.9%	3.4%	3.3%	1.9%
IA	African Dust							0.1%					
IC	Chem Spills and Industrial Accidents	0.2%	0.1%	0.1%	0.4%	0.2%	0.2%	0.3%	0.2%	0.3%	0.4%	0.2%	0.3%
ID	Cleanup After a Major Disaster	0.2%	0.1%	0.1%	0.4%	0.2%	0.2%	0.3%	0.2%	0.3%	0.4%	0.2%	0.3%
IF	Fire - Canadian			0.1%									
IH	Fireworks				0.1%	0.3%	0.4%	0.3%		0.1%			
II	High Pollen Count				0.4%	0.4%	0.4%	0.3%	0.1%				
IJ	High Winds	0.4%	0.5%	0.5%	0.7%	1.2%	0.4%	0.3%	0.2%	0.7%	0.2%	0.1%	0.2%
IK	Infrequent Large Gatherings					0.3%	0.4%						
IL	Other	0.2%	0.7%	0.4%	0.2%	0.4%	0.4%	0.1%	0.3%	0.2%	0.2%		0.2%
IM	Prescribed Fire	0.2%	0.1%	0.2%	0.1%	0.1%			0.1%		0.1%		0.0%
IN	Seismic Activity							0.2%					
IR	Unique Traffic Disruption					0.4%	0.3%						
IT	Wildfire - U.S.	0.1%		0.0%	0.1%	0.1%	0.2%	0.2%	0.4%	0.1%	0.0%		
IU	Wildland Fire Use Fire - U.S.				0.1%								
W	Flow Rate average out of spec		0.0%		0.0%	0.1%	0.1%	0.0%	0.1%	0.1%			0.2%
X	Filter Temp. Diff out of spec	0.9%	0.6%	0.6%	0.6%	0.5%	0.6%	0.9%	0.9%	0.7%	0.7%	0.5%	0.6%
Y	Elapsed Samp. time out of spec							0.1%					0.1%

Table 5-2. Summary of Null Value Codes by Delivery Batch Number (percent of data records reported)

Flag	Description	121	122	123	124	125	126	127	128	129	130	131	132
AB	Technician Unavailable	0.1%	0.6%	0.1%	0.2%	0.1%	0.3%	0.6%	0.2%	0.3%	0.1%	0.3%	0.3%
AC	Construction/Repairs in Area	0.0%	0.0%		0.4%	0.3%	0.3%	0.1%	0.2%		0.0%		0.0%
AD	Shelter Storm Damage							0.1%		0.1%	0.0%		
AF	Scheduled but not Collected	0.9%	1.2%	0.7%	0.8%	0.7%	0.8%	0.7%	0.6%	0.6%	0.3%	0.5%	1.5%
AG	Sample Time out of Limits	0.7%	0.5%	0.9%	0.6%	0.5%	0.7%	0.5%	1.0%	0.4%	0.7%	0.2%	0.6%
AH	Sample Flow Rate out of Limits	1.2%	0.7%	0.6%	0.5%	0.6%	0.7%	0.5%	0.4%	0.3%	0.4%	0.4%	0.6%
AI	Insufficient Data (Can't Calculate)	0.2%	0.1%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.1%	0.1%		0.1%
AJ	Filter Damage	0.1%	0.2%	0.1%	0.1%	0.2%	0.1%	0.3%	0.3%	0.2%	0.2%	0.1%	0.2%
AK	Filter Leak	0.1%	0.0%					0.0%				0.0%	0.0%
AL	Voided by Operator	0.2%	0.1%	0.3%	0.3%	0.4%	0.6%	0.4%	0.3%	0.2%	0.1%	0.0%	0.3%
AM	Miscellaneous Void	0.1%		0.0%	0.1%	0.0%	0.1%	0.1%	0.0%	0.2%			0.0%
AN	Machine Malfunction	1.7%	1.3%	0.9%	0.7%	0.7%	0.7%	0.4%	0.7%	0.7%	0.3%	0.5%	1.0%
AO	Bad Weather	0.3%	0.1%	0.3%	0.1%	0.2%		0.1%	0.1%	0.1%	0.0%		0.1%
AQ	Collection Error	0.1%	0.1%	0.0%	0.2%	0.1%	0.3%	0.2%	0.4%	0.2%	0.0%	0.4%	0.1%
AR	Lab Error	0.1%	0.3%	0.0%	0.0%	0.1%	0.3%	0.1%	0.1%	0.1%	0.2%	0.1%	0.0%
AS	Poor Quality Assurance Results				0.1%	0.1%			0.1%				
AU	Monitoring Waived	0.2%	0.0%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%	0.1%	0.1%	0.1%	0.6%
AV	Power Failure	0.4%	0.5%	0.5%	0.1%	0.5%	0.2%	0.4%	0.7%	0.3%	0.3%	0.5%	0.3%
AW	Wildlife Damage						0.0%	0.0%		0.1%			0.0%
AZ	QC Audit (AUDT)										0.0%		
BA	Maintenance/Routine Repairs	0.3%	0.3%	0.1%	0.1%	0.1%	0.1%	0.2%	0.3%	0.2%	0.5%	0.1%	0.2%
BB	Unable to Reach Site	0.3%	0.1%	0.2%	0.0%	0.1%	0.2%		0.1%	0.1%	0.0%		0.1%
BE	Building/Site Repairs									0.4%			
BI	Lost or Damaged in Transit			0.1%			0.2%			0.1%	0.1%		
BJ	Operator Error							0.1%	0.1%	0.0%			

Table 5-3. RTI-assigned Flags (not reported to AQS) by Delivery Batch Number (percent of data records reported)

Flag	Description	121	122	123	124	125	126	127	128	129	130	131	132
ANB	Analysis not billable	0.1%	0.4%	0.1%	0.3%	0.2%	0.2%	0.1%	0.1%	0.0%	0.2%	0.1%	0.1%
APB	Analysis partially billable	3.6%	3.0%	2.8%	2.1%	2.1%	2.7%	2.8%	3.1%	1.8%	1.5%	2.1%	2.7%
DFM	Filter missing	0.0%	0.0%		0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	
DST	Received Temperature > 4C	7.7%	10.9%	8.5%	37.5%	36.7%	58.2%	57.2%	38.3%	39.9%	17.2%	10.5%	9.7%
FCE	Corrected - operator data entry error	5.3%	2.0%	1.2%	1.1%	1.2%	1.6%	0.7%	2.1%	1.8%	2.0%	1.8%	1.0%
FES	Field Environmental Data Substituted	0.2%	0.1%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.1%	0.1%
FHT	Pickup holding time exceeded	18.1%	6.1%	19.5%	13.7%	6.7%	15.9%	14.6%	16.8%	6.3%	16.3%	14.7%	14.5%
FSL	Sample lost or damaged in shipmen				0.1%		0.1%						
LFA	Filter inspection - Filter wet	0.0%	0.1%	0.2%	0.1%	0.0%	0.0%	0.1%	0.1%		0.0%		0.1%
LFH	Filter inspection - Holes in filter			0.0%		0.0%		0.1%	0.1%	0.0%			
LFT	Filter inspection - Tear					0.0%				0.1%			0.0%
QAC	Cation/Anion Ratio out of limits	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.3%	0.1%	0.1%	0.2%	0.1%	0.2%
QL1	Invalidated by Level 1 Check	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%
QMB	Reconst. mass balance outside limits	5.2%	3.7%	2.7%	3.9%	4.7%	5.3%	2.7%	3.3%	1.7%	3.1%	3.1%	1.6%
SNB	Sample not billable	0.3%	0.5%	0.2%	0.1%		0.1%	0.1%		0.2%	0.1%	0.0%	0.3%
SPB	Sample partially billable	1.5%	1.8%	1.4%	1.5%	1.7%	1.7%	1.6%	1.9%	1.6%	1.2%	1.1%	2.2%

5.3 Analysis of Collocated Data

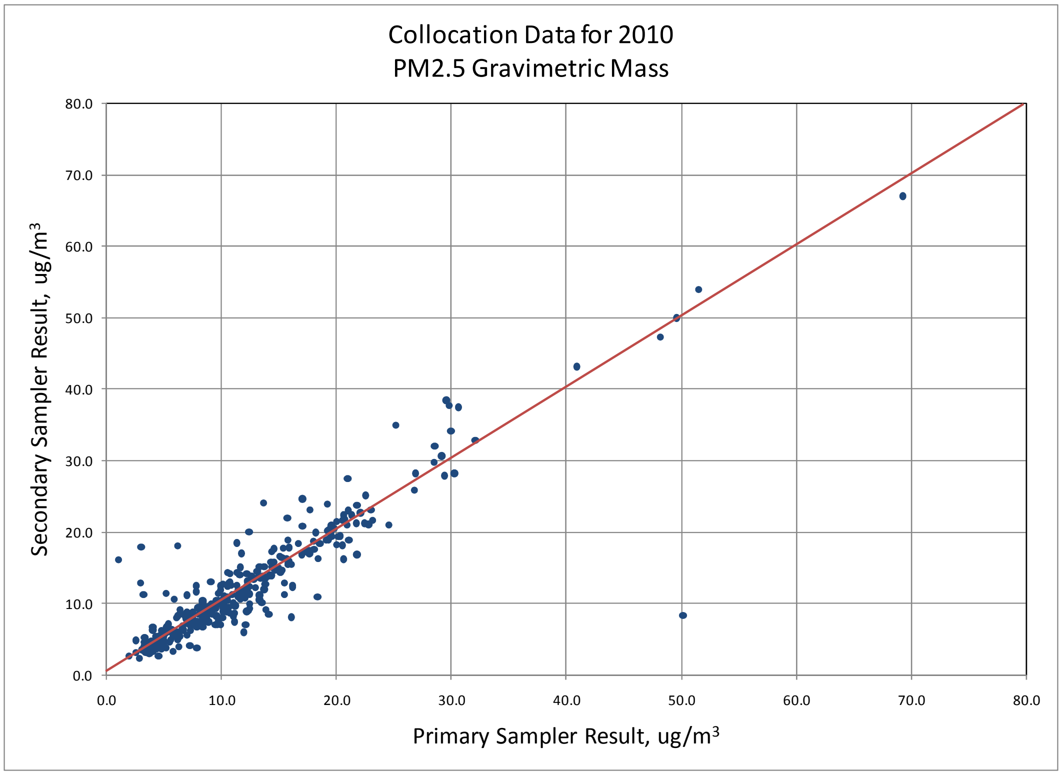
The CSN program operated six sites with collocated samplers during 2010, shown in **Table 5-4**. All six sites included collocated MetOne samplers for Teflon and nylon filters, plus the URG 3000N samplers for quartz on both the primary and collocated sampler. The primary samplers at these sites run on a 1-in-3 schedule, but the collocated (secondary) samplers typically only run on a 1-in-6 day schedule, which governs how much collocation data are available for analysis. The data from the sites with collocated samplers affords an opportunity to calculate total precision and compare the values with the uncertainty values that are currently being reported to AQS. Bias or accuracy cannot be assessed from this dataset because neither of the collocated samplers can be assumed to be more accurate than the other. Collocation data from the URG 3000N samplers may also be useful in evaluating the magnitude and uncertainty of the artifact in Organic Carbon measurement.

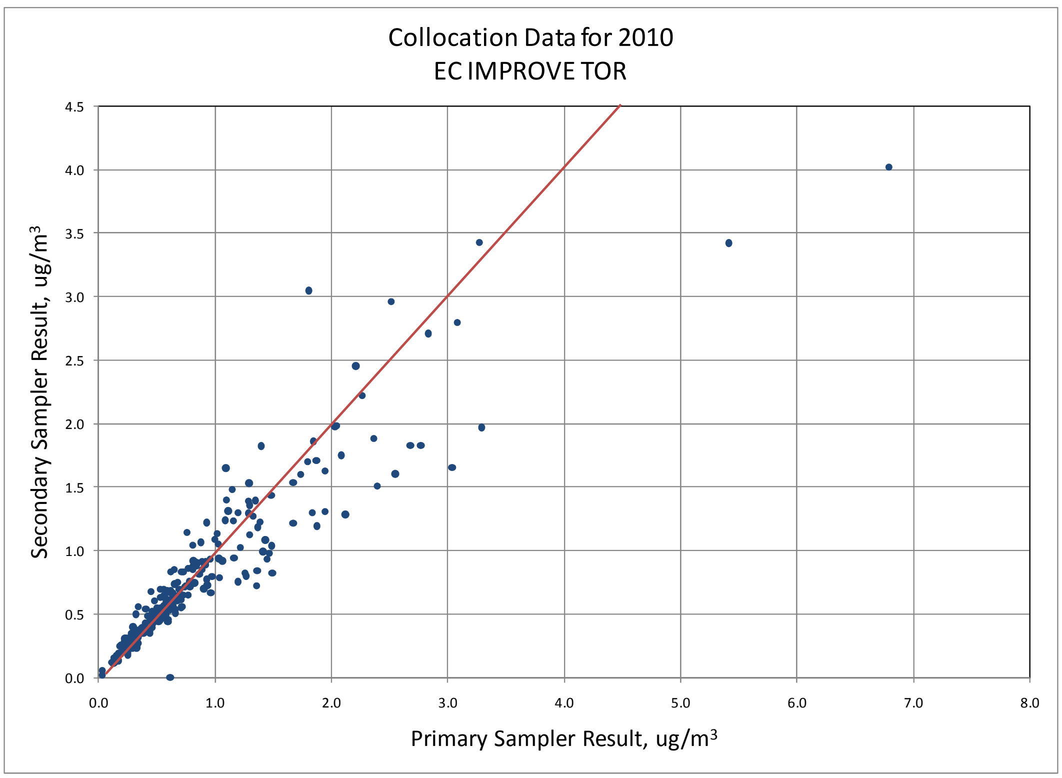
Table 5-4. Collocated Sites in the CSN During 2010.

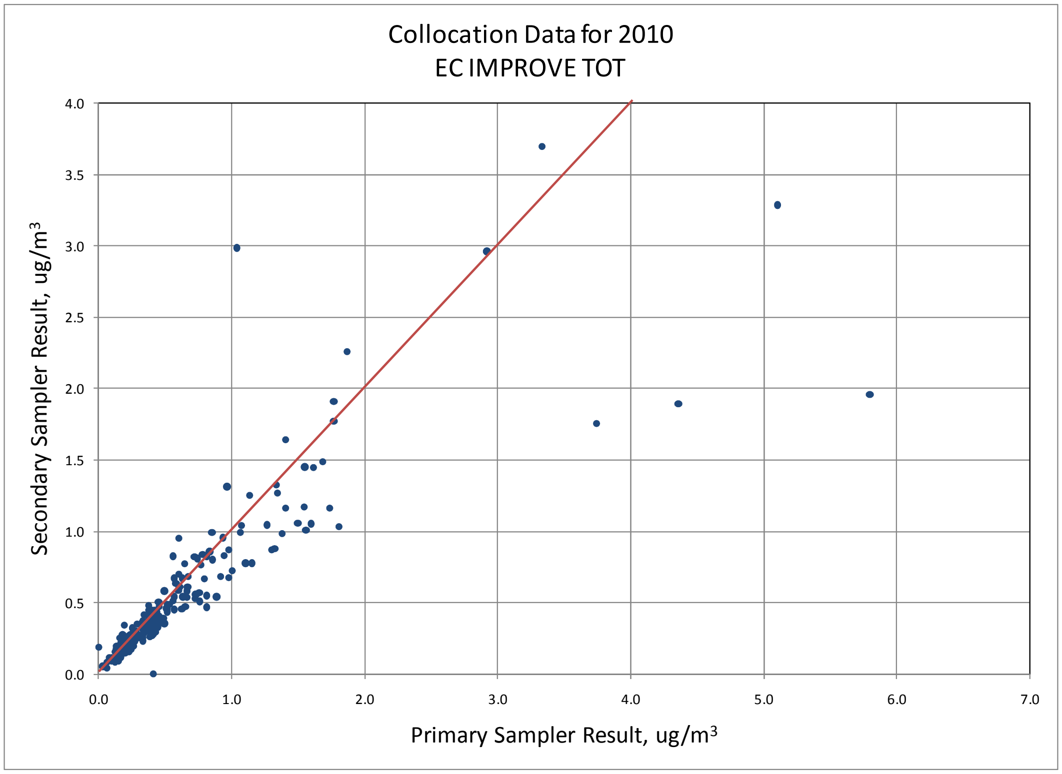
Location Name	State	AQS Code	Sampler Type
Bakersfield-California Ave	California	60290014	MetOne SASS + URG 3000N
Deer Park	Texas	482011039	MetOne SASS + URG 3000N
G.T. Craig	Ohio	390350060	MetOne SASS + URG 3000N
New Brunswick	New Jersey	340230006	MetOne SASS + URG 3000N
Riverside-Rubidoux	California	60658001	MetOne SASS + URG 3000N
Roxbury (Boston)	Massachusetts	250250042	MetOne SASS + URG 3000N

In general, the collocation data shows good or excellent agreement for the major analytes. The figures that follow (**Figure 5-1**) show examples of the comparisons for $PM_{2.5}$ mass, organic and elemental carbon (IMPROVE_A TOT and TOR methods), nitrate, sulfate, and sulfur.

Figure 5-1 Collocation data for selected species during 2010.







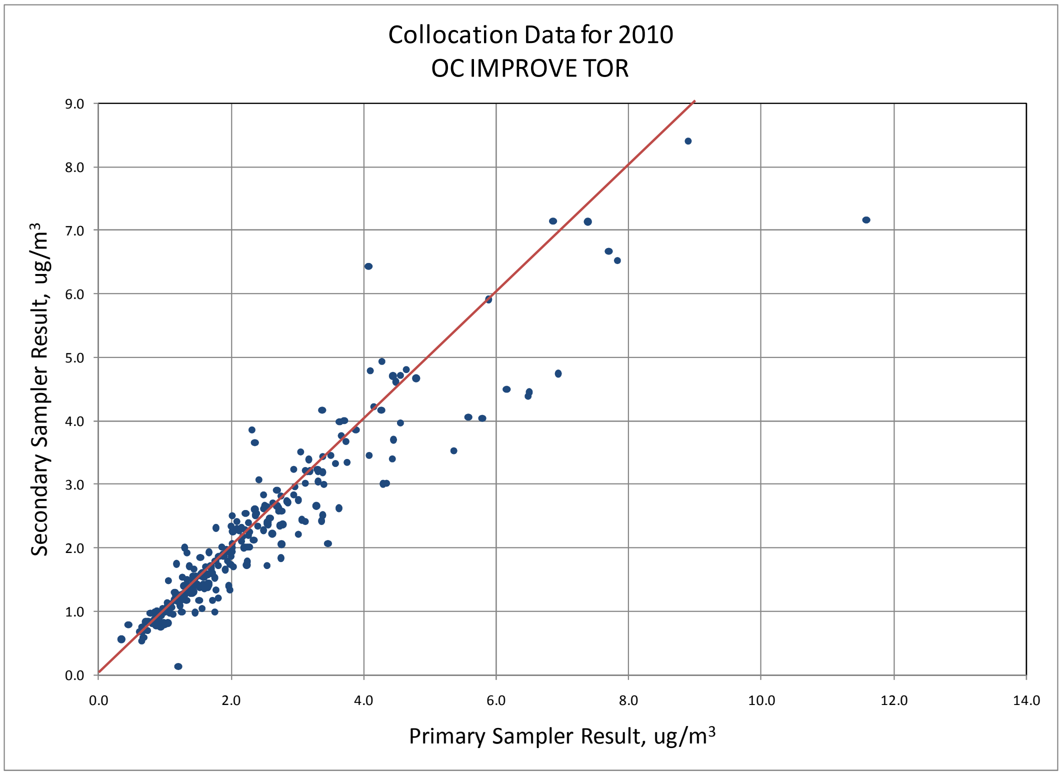
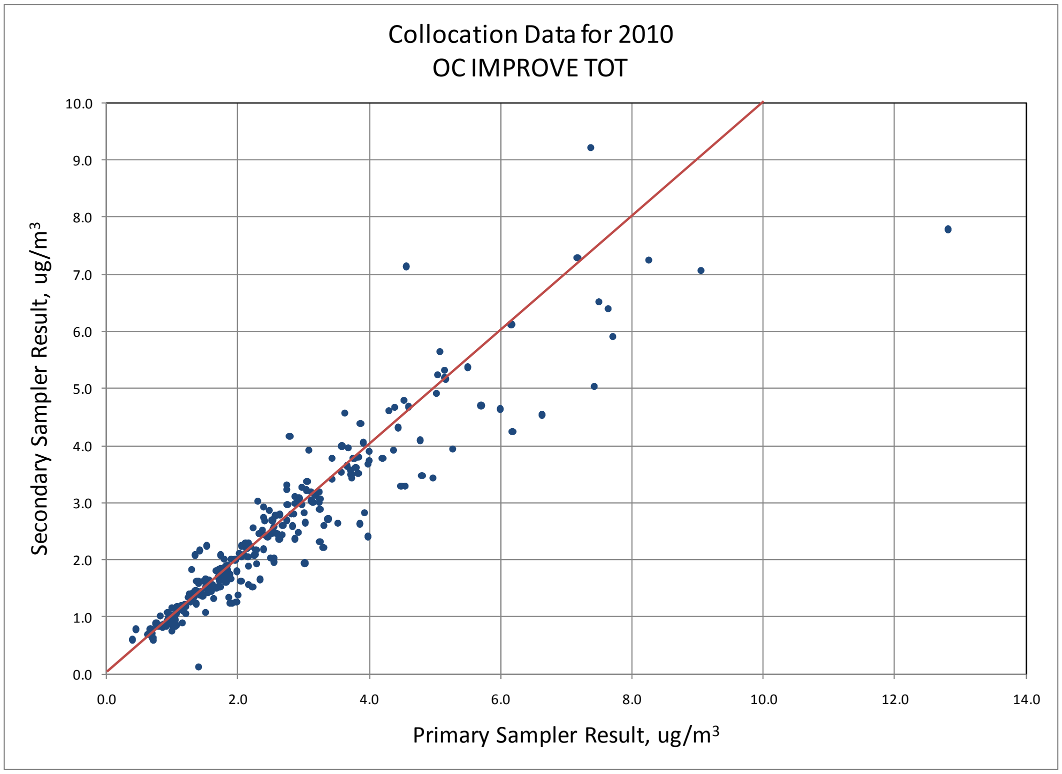


Figure 5-1. (continued).



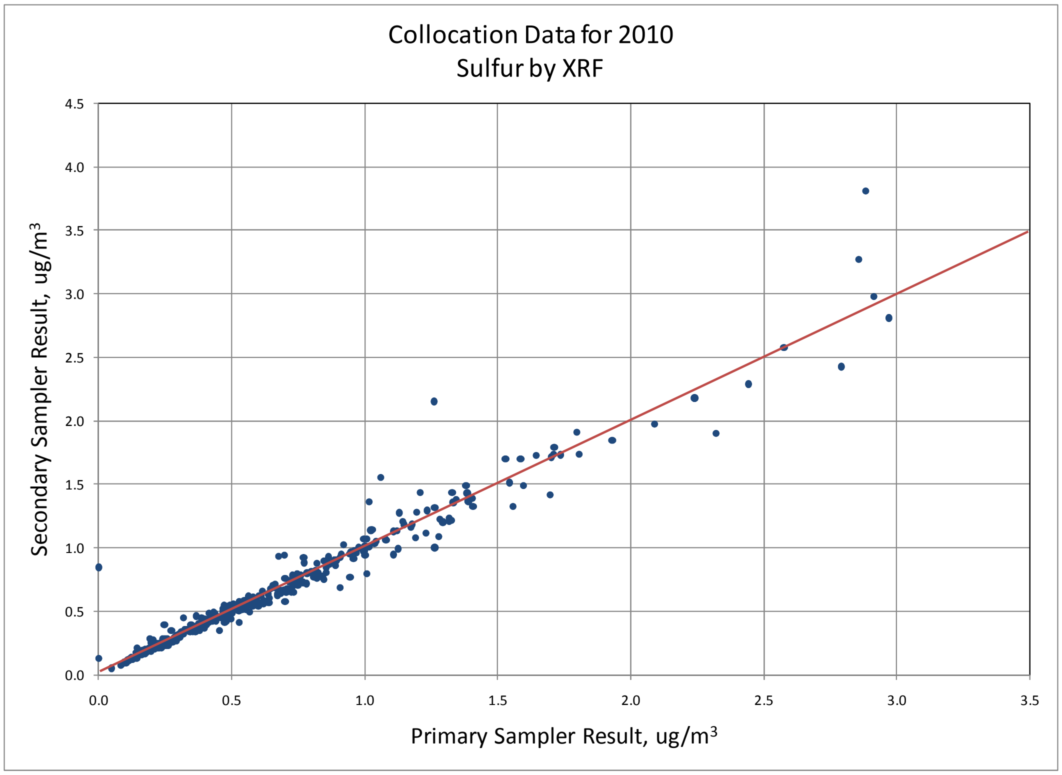
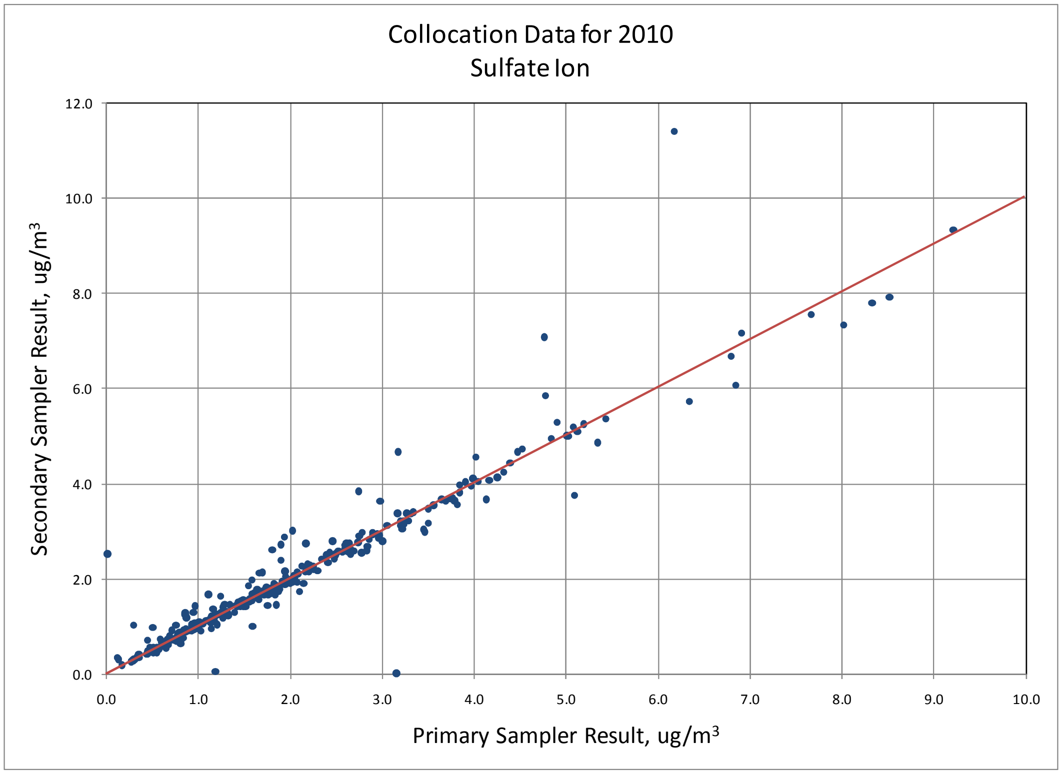


Figure 5-1. (continued).



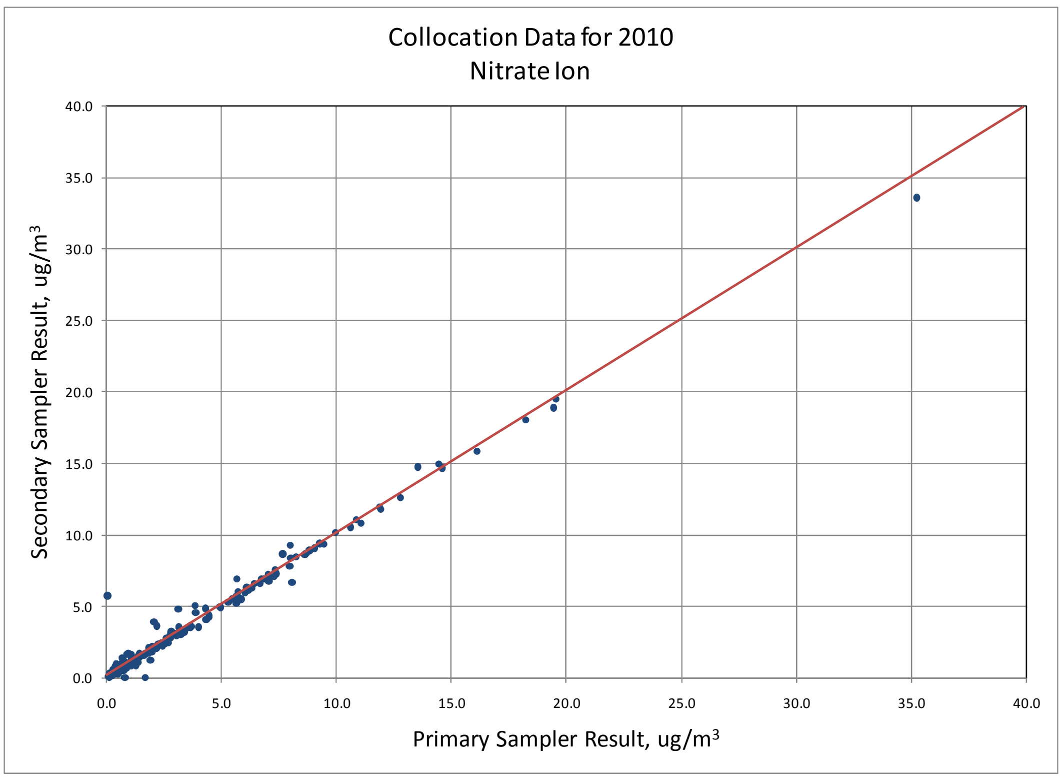


Figure 5-1. (continued).

Table 5-5 shows the results of collocated sampling and provides a comparison with the uncertainties reported to AQS. The first column indicates the name of the chemical analyte. Column 2 shows the average value from the primary sampler. Note that the standard deviations reflect environmental variability of the concentration and are not determined by the laboratory uncertainties. The column titled "Average Relative Diff" is the average of the unsigned differences between the two samplers, which is calculated using the following formula:

$$ARD = \frac{1}{\sqrt{2}} \sum \frac{|C_1 - C_2|}{(C_1 + C_2)/2}$$

Where

- C_1 and C_2 are the concentrations from the primary and collocated samplers, respectively
- The factor of $1/\sqrt{2}$ is used to convert the difference to a single-sampler basis
- The summation is over all valid concentration values where the concentration (C1 or C2) is greater than twice the uncertainty reported to AQS.

The column titled "Average AQS Uncert." is simply the grand average of all the relative uncertainties associated with the C_1 and C_2 values and is calculated as follows:

$$AvAQS = \sum_i \sum_j U_{ij} / C_{ij}$$

Where

- U_{ij} and C_{ij} refer to the uncertainty and concentration for the i^{th} exposure with the j^{th} sampler (j=1 or 2).

The criteria for inclusion in the average (index i) is the same as in the previous equation.

The next column provides the ratio of AvAQS to ARD defined above. This is essentially the average under- or over-estimate of the uncertainty for each chemical species reported during 2009. Finally, the last column provides the number of sampling events included in the averages defined above. Only events where both concentrations were greater than twice their respective uncertainties were included.

Ratios greater than 200% or less than 50% indicate situations in which the uncertainties reported to AQS were different from the uncertainty estimated from collocation data by a factor of 2 or more. The following species disagreed by a factor of 2 or more; ratios are shown in parentheses:

- Aluminum (46%), Calcium (28%), Iron (30%), Magnesia (39%), Gravimetric Mass (45%), and Potassium Ion (36%), were less than 50%.

Table 5-5. Precision of Collocated Samplers

Analyte	Sampler 1		Sampler 2		Ave Rel Diff[2]	Avg Rel AQS Unc[3]	Ratio AQS/ARD percent[4]	Counts[5]
	Avg Conc	Std Dev[1]	Avg Conc	Std Dev				
PARTICULATE MATTER (GRAVIMETRY)								
Particulate matter 2.5u	12.405	8.356	12.843	8.974	14%	6%	**45%**	258
ANIONS AND CATIONS BY IC								
Potassium	0.091	0.053	0.092	0.055	27%	10%	**37%**	124
Sodium	0.157	0.173	0.178	0.200	29%	52%	179%	206
Ammonium	1.166	1.298	1.196	1.313	12%	7%	61%	253
Nitrate	2.182	3.675	2.232	3.637	12%	8%	62%	253
Sulfate	2.108	1.637	2.132	1.627	6%	7%	124%	234
TRACE ELEMENTS BY XRF								
Aluminum	0.098	0.167	0.099	0.133	43%	20%	**46%**	122
Calcium	0.059	0.060	0.088	0.166	36%	10%	**28%**	248
Iron	0.119	0.138	0.137	0.188	26%	8%	**30%**	274
Potassium	0.068	0.057	0.070	0.060	16%	9%	60%	271
Magnesium	0.042	0.035	0.048	0.035	42%	18%	**43%**	46
Sodium	0.182	0.180	0.179	0.159	27%	15%	57%	135
Lead	0.010	0.006	0.010	0.007	32%	36%	110%	37
Sulfur	0.713	0.544	0.718	0.540	7%	7%	107%	252
Silicon	0.164	0.310	0.178	0.267	33%	13%	**39%**	240
Zinc	0.017	0.022	0.017	0.024	24%	17%	73%	222
ORGANIC AND ELEMENTAL CARBON BY IMPROVE_A METHOD (Sampled by URG 3000N)								
EC IMPROVE TOR	0.850	0.797	0.778	0.621	11.6%	N/A	N/A	250
EC IMPROVE TOT	0.569	0.711	0.502	0.518	13.2%	N/A	N/A	250
OC IMPROVE TOR	2.337	1.567	2.212	1.353	9.2%	N/A	N/A	250
OC IMPROVE TOT	2.619	1.706	2.489	1.492	9.1%	N/A	N/A	250

1 The standard deviations are a function of the natural variability of the environmental levels and are not indicative of the analytical precision.

2 Calculated as the average of the absolute value of the relative difference between the two samplers' values, divided by the square root of 2.

3 Average value of the relative uncertainties as reported to AQS.

4 AQS/ARD is the ratio of reported uncertainties divided by the uncertainty determined by average relative difference of the collocated samples. Values greater than 200% or less than 50% are shown in bold.

5 Counts are the number of individual observations included in the statistics. Only observations where both concentration values were above twice the uncertainty are included in the statistics.

5.4 Analysis of Trip and Field Blanks

In the CSN program, field blanks are run at a frequency of 10% or more, whereas trip blanks are run at approximately 3%. Historical data has shown little difference between the two types of blanks, perhaps because the field SOPs for running them are very similar, the only difference being that the Field Blanks are mounted on the sampler for a few minutes, whereas the Trip Blanks are kept closed. Data from these blanks allow evaluation of contamination, which may come from a number of different sources. In addition, the Trip and Field Blank data can sometimes provide clues to problems in the analytical laboratories or with filters received from the manufacturers. **Table 5-6** shows the distributions (percentiles) for trip and field blanks during 2009.

Trip and Field Blanks. For XRF analysis, the average and 95th percentiles were acceptably low for all elements. Of the ions, nitrate and ammonium were somewhat higher than other chemical species. The high values for organic carbon and total carbon by the CSN TOT method were not unexpected because of the well-known adsorption artifact. The corresponding levels for the IMPROVE_A method were much lower, when expressed in $\mu g/m^3$, because of sample volume and filter area differences.

Trends and Offsets in Blank Data. Other than the isolated outliers identified in the previous section, no significant trends or offsets have been observed in the trip and field data for any of the CSN analytes.

5.5 Analysis of Trip and Field Blanks for the URG 3000N

URG 3000N modules began acquiring quartz filter samples at 57 CSN sites in May, 2007. The remaining sites received URG 3000N samplers during 2009. One important feature is the acquisition of a new type of blank, called “backup filters,” which are intended to help assess the organic carbon artifact. **Table 5-7** shows the percentile points of the backup filters acquired during 2010. The median value shown in the table might be considered to be the artifact correction, similar to what is done in the IMPROVE program; however, RTI has not received a directive to implement such a correction.

Table 5-6. Concentration Percentiles for Trip, Field, and 24-hour Blanks (Reporting Batches 121 through 132).

Species	Mean (ug/m³)	Percentiles of Concentration (ug/m³)						
		5	10	25	Median	75	90	95
Cations and Anions by Ion Chromatography								
Ammonium	0.006	0.000	0.000	0.000	0.000	0.000	0.008	0.015
Potassium	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sodium	0.015	0.000	0.000	0.000	0.000	0.018	0.037	0.052
Nitrate	0.038	0.000	0.000	0.014	0.032	0.049	0.068	0.088
Sulfate	0.034	0.000	0.000	0.000	0.019	0.033	0.050	0.076
Mass by gravimetry								
Particulate matter 2.5u	0.659	-0.208	0.000	0.208	0.521	0.938	1.458	1.875
Organic and elemental carbon by IMPROVE A Method (TOT and TOR)								
E1 IMPROVE	0.003	0.000	0.000	0.000	0.000	0.000	0.006	0.012
E2 IMPROVE	0.001	0.000	0.000	0.000	0.000	0.000	0.002	0.005
E3 IMPROVE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EC IMPROVE TOR	0.003	0.000	0.000	0.000	0.000	0.001	0.008	0.015
EC IMPROVE TOT	0.002	0.000	0.000	0.000	0.000	0.000	0.003	0.008
O1 IMPROVE	0.018	0.000	0.000	0.007	0.015	0.025	0.036	0.046
O2 IMPROVE	0.040	0.017	0.020	0.027	0.036	0.049	0.065	0.077
O3 IMPROVE	0.066	0.026	0.030	0.039	0.052	0.074	0.106	0.144
O4 IMPROVE	0.008	0.000	0.000	0.000	0.002	0.009	0.020	0.032
OC IMPROVE TOR	0.133	0.056	0.065	0.083	0.112	0.152	0.209	0.270
OC IMPROVE TOT	0.135	0.056	0.065	0.083	0.112	0.153	0.212	0.276
OP IMPROVE TOR	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OP IMPROVE TOT	0.002	0.000	0.000	0.000	0.000	0.000	0.002	0.009
TC IMPROVE	0.136	0.056	0.065	0.083	0.113	0.154	0.214	0.284
Trace elements by XRF (33 Elements)								
Aluminum	0.001	0.000	0.000	0.000	0.000	0.001	0.002	0.003
Antimony	0.002	0.000	0.000	0.000	0.000	0.002	0.006	0.010
Arsenic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Barium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002
Bromine	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001
Cadmium	0.002	0.000	0.000	0.000	0.000	0.001	0.007	0.009
Calcium	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.002
Cerium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Cesium	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.005
Chlorine	0.002	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Chromium	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.002
Cobalt	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Copper	0.001	0.000	0.000	0.000	0.000	0.001	0.002	0.003
Indium	0.001	0.000	0.000	0.000	0.000	0.000	0.006	0.009
Iron	0.002	0.000	0.000	0.000	0.000	0.001	0.004	0.007
Lead	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002
Magnesium	0.001	0.000	0.000	0.000	0.000	0.000	0.002	0.002
Manganese	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Nickel	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Phosphorus	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Potassium	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.002

Species	Mean (ug/m^3)	Percentiles of Concentration (ug/m^3)						
		5	10	25	Median	75	90	95
Rubidium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Selenium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Silicon	0.001	0.000	0.000	0.000	0.000	0.001	0.002	0.003
Silver	0.001	0.000	0.000	0.000	0.000	0.000	0.005	0.009
Sodium	0.001	0.000	0.000	0.000	0.000	0.000	0.002	0.002
Strontium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002
Sulfur	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Tin	0.001	0.000	0.000	0.000	0.000	0.001	0.006	0.008
Titanium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Vanadium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Zinc	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002
Zirconium	0.001	0.000	0.000	0.000	0.000	0.000	0.002	0.004

Table 5-7. Concentration Percentiles for 3000N Backup Filters

ANALYTE	MEAN	PERCENTILES OF CONCENTRATION (as μg/m^3)						
		5	10	25	MEDIAN	75	90	95
EC IMPROVE TOR	0.0094	0.0000	0.0000	0.0000	0.0029	0.0127	0.0263	0.0369
EC IMPROVE TOT	0.0035	0.0000	0.0000	0.0000	0.0000	0.0032	0.0106	0.0176
OC IMPROVE TOR	0.3269	0.1256	0.1620	0.2241	0.3022	0.4030	0.5067	0.5965
OC IMPROVE TOT	0.3327	0.1256	0.1622	0.2253	0.3060	0.4121	0.5228	0.6169
TC IMPROVE	0.3363	0.1256	0.1627	0.2261	0.3087	0.4156	0.5294	0.6232
E1 IMPROVE	0.0093	0.0000	0.0000	0.0000	0.0023	0.0099	0.0211	0.0324
E2 IMPROVE	0.0034	0.0000	0.0000	0.0000	0.0000	0.0045	0.0101	0.0144
E3 IMPROVE	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003
O1 IMPROVE	0.0559	0.0000	0.0041	0.0216	0.0418	0.0748	0.1206	0.1577
O2 IMPROVE	0.1021	0.0392	0.0488	0.0695	0.0954	0.1256	0.1620	0.1885
O3 IMPROVE	0.1299	0.0500	0.0613	0.0844	0.1156	0.1613	0.2104	0.2555
O4 IMPROVE	0.0354	0.0038	0.0079	0.0158	0.0287	0.0486	0.0713	0.0861
OP IMPROVE TOR	0.0036	0.0000	0.0000	0.0000	0.0000	0.0000	0.0023	0.0115
OP IMPROVE TOT	0.0094	0.0000	0.0000	0.0000	0.0000	0.0094	0.0230	0.0360

6.0 External Audits

6.1 Performance Evaluation Audit Results

As part of a multi-laboratory study, PE samples were received and analyzed during late 2009. The PE study was conducted as part of EPA's QA oversight for the CSN and the Interagency Monitoring of Protected Visual Environments (IMPROVE) Program. This study was similar to one carried out annually since 2007. The final report can be found at the following URL:

http://www.epa.gov/ttn/amtic/files/ambient/pm25/spec/RTI_TSA_2009.pdf

Also during 2010, the RTI XRF laboratory served as the reference lab for the next inter-laboratory study being conducted in 2011. As the reference lab, RTI analyzed all of the 47mm filters used in the study before they were distributed to the other participating laboratories in January 2011. All the RTI speciation labs analyzed PE samples in early 2011.

The PE samples for these studies are prepared at the National Air and Radiation Environmental Laboratory (NAREL) located in Montgomery, AL. The samples are prepared by multiple collocation of samplers at the NAREL facility. Since the samples (except for metallic weights included in the gravimetry evaluation) are of unknown mass or concentration, agreement among the participating laboratories was the primary metric of performance.

The multi-lab study requires each participating laboratory to analyze a set of blind PE samples, and each lab received detailed instructions for analyzing the samples and reporting the results to NAREL. PE samples are provided for the following PM2.5 speciation analyses:

- Gravimetric Mass Analysis
    - Teflon® filters
    - Metallic transfer weights
- Ion Chromatography (IC) Analysis – Nylon filters
- Carbon by Thermal Optical Analysis (TOA) – quartz filters
    - IMPROVE_A Method (by TOR)
    - CSN Method (by TOT)
- Elemental analysis by X-Ray Fluorescence (XRF) – Teflon® filters
    - 25 mm filters
    - 47 mm filters

RTI's performance on gravimetric mass, IC, and XRF has been uniformly within the range of the other laboratories and in good agreement with the designated reference labs. However, significant variations have been noted within and among laboratories for the various OC/EC methods.

6.2 Technical Systems Audit (TSA) Results

EPA did not perform a TSA during 2010. The 2009 TSA was conducted at RTI by as part of the U.S. Environmental Protection Agency's (EPA's) quality assurance oversight for the PM2.5 Chemical Speciation Network (CSN). The results of the TSA were provided in a Technical Memorandum dated November 24, 2009, which can be found at the following URL:

http://www.epa.gov/ttn/amtic/files/ambient/pm25/spec/RTI_TSA_2009.pdf

7.0 List of Controlled Documents

Type	Title	Date Revised	Author	Document No.
SOP	Standard Operating Procedure for Sample Handling and Archiving Laboratory (SHAL)	2/18/2009	O'Rourke	
SOP	Standard Operating Procedure for Shipping Filters to and from an Off-Site Laboratory	2/18/2009	Peterson	
SOP	Standard Operating Procedure for Long-Term Archiving of PM Filters and Extracts	8/24/2009	C. Haas	
SOP	Standard Operating Procedure for Procurement and Acceptance Testing of Teflon, Nylon, and Quartz Filters	2/16/2009	E. Hardison	
SOP	Standard Operating Procedure for Cleaning Nylon Filters Used for the Collection of $PM_{2.5}$ Material	8/25/2009	E. Hardison	
SOP	Standard Operating Procedure for Particulate Matter (PM) Gravimetric Analysis	7/10/2008	Greene	
SOP	Analysis of Elements in Air Particulates by X-Ray Fluorescence (Kevex 770 & 772)	1/30/2009	Chester	
SOP	Kevex XRF Spectrometer Calibration (CHESTER LabNet Proprietary Method)	1/8/2008	Chester	
SOP	Kevex Spectrometer Data Generation, Interpretation and Reporting (CHESTER LabNet Proprietary Method)	1/30/2009	Chester	
SOP	Sample Receipt and Log In Chester LabNet Proprietary Method	6/20/2008	Chester	
SOP	Standard Operating Procedure for the X-Ray Fluorescence Analysis of Particulate Matter Deposits on Teflon Filters	8/27/2009	McWilliams	
SOP	Standard Operating Procedure for $PM_{2.5}$ Anion Analysis	8/26/2009	E. Hardison	
SOP	Standard Operating Procedure for $PM_{2.5}$ Cation Analysis	8/26/2009	E. Hardison	
SOP	DRI Model 2001 Thermal/Optical Carbon Analysis (TOR/TOT) of Aerosol Filter Samples – Method IMPROVE_A	7/24/2008	DRI	
SOP	Standard Operating Procedure for the Determination of Carbon Fractions in Particulate Matter Using the IMPROVE_A Heating Protocol on a DRI Model 2001 Analyzer	2/17/2009	Peterson	

Type	Title	Date Revised	Author	Document No.
SOP	Standard Operating Procedures for Temperature Calibration of the Sample Thermocouple in a Sunset Laboratory or a DRI Model 2001 Carbon Aerosol Analyzer	2/17/2009	Peterson	
SOP	Standard Operating Procedure for the Determination of Organic, Elemental, and Total Carbon in Particulate Matter Using a Thermal/Optical-Transmittance Carbon Analyzer	2/17/2009	Peterson	
SOP	Standard Operating Procedure for the Determination of Carbon Fractions in Particulate Matter Using the IMPROVE_A Heating Protocol on a Sunset Laboratory Dual-Mode Analyzer	2/17/2009	Peterson	
SOP	DRI Standard Operating Procedure: Analysis of Semi-Volatile Organic Compound by GC/MS	9/24/2008	DRI	
SOP	Standard Operating Procedure for Sample Preparation and Analysis of PM_{10} and $PM_{2.5}$ Samples by Scanning Electron Microscopy	7/10/2009	Crankshaw	
SOP	Standard Operating Procedure for Coating and Extracting Annular Denuders with Sodium Carbonate	2/17/2009	Eaton	
SOP	Standard Operating Procedures for Coating Aluminum Honeycomb Denuders With Magnesium Oxide	2/17/2009	Eaton	
SOP	Standard Operating Procedure for Coating Annular Denuders with XAD-4 Resin	2/17/2009	Eaton	
SOP	Standard Operating Procedures for Coating R&P Speciation Sampler Chemcomb™ Denuders with Sodium Carbonate	2/17/2009	Eaton	
SOP	Standard Operating Procedure for Coating and Extracting Denuders for Capture of Ammonia and Its Measurement	2/17/2009	Eaton	
SOP	Standard Operating Procedure for Coating and Extracting Compact Parallel-Plate Denuders for Determining Ammonia Determination	3/1/2010	Eaton	
SOP	Standard Operating Procedure for Database Operations	7/8/2008	Rickman	
SOP	Standard Operating Procedure for Assigning Data Validation Flags for the Chemical Speciation Network	5/28/2008	Wall	
SOP	Standard Operating Procedure—Speciation Data Processing Disaster Recovery Plan	7/8/2008	Rickman	
SOP	Standard Operating Procedure for the X-Series ICP-MS for the Analysis of Particulate Deposits on Teflon Filters	2/18/2009	Weber	

Type	Title	Date Revised	Author	Document No.
SOP	DRI Standard Operating Procedure: Procedure for Light Transmission Analysis	7/14/2008	DRI	
SOP	Standard Operating Procedure for Document Control and Storage for the $PM_{2.5}$ Chemical Speciation Program	2/19/2009	D. Haas	
SOP	Standard Operating Procedure for Corrective Action for the $PM_{2.5}$ Chemical Speciation Program	5/27/2008	Flanagan/Haas	
SOP	Standard Operating Procedure for Training for Staff Working on the $PM_{2.5}$ Chemical Speciation Program	5/27/2008	Haas	
QAPP	QAPP for PM2.5 of Chemical Speciation Samples	5/21/2009	RTI	RTI/0212053/01QA
Report	Tests of Acceptance of X-Ray Fluorescence Instrument #4 Operated by RTI International	11/4/2009	McWilliams/Flanagan	0212053.001.T06/01D

Appendix A

Method Detection Limits

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Appendix A
Method Detection Limits (Network-wide Maximum)

Analysis	Species	Mass_MDL (ug/filter)	Concentration (ug/m^3) by sampler type	
			SASS	URG 3000N
Gravimetry	Particulate matter 2.5u	7.5	0.82	
Anions and Cations	Ammonium	0.24	0.027	
	Nitrate	0.21	0.023	
	Potassium	0.23	0.025	
	Sodium	0.35	0.036	
	Sulfate	0.17	0.018	
Organic and elemental carbon IMPROVE_A Method	E1 IMPROVE	3		0.096
	E2 IMPROVE	2		0.064
	E3 IMPROVE	2		0.064
	EC IMPROVE TOR	2		0.064
	EC IMPROVE TOT	2		0.064
	O1 IMPROVE	2		0.064
	O2 IMPROVE	2		0.064
	O3 IMPROVE	3		0.096
	O4 IMPROVE	3		0.096
	OC IMPROVE TOR	2		0.064
	OC IMPROVE TOT	2		0.064
	OP IMPROVE TOR	3		0.096
	OP IMPROVE TOT	2		0.064
Organic and elemental carbon Original CSN Method	Elemental carbon	2.4	0.26	
	Organic carbon	2.4	0.26	
	Pk1_OC	2.4	0.26	
	Pk2_OC	2.4	0.26	
	Pk3_OC	2.4	0.26	
	Pk4_OC	2.4	0.26	
	PyrolC	2.4	0.26	
	TC IMPROVE	3		0.096
	Total carbon	2.4	0.26	
Trace Elements (XRF)	Aluminum	0.24	0.027	
	Antimony	0.5	0.056	
	Arsenic	0.026	0.0028	
	Barium	0.57	0.06	
	Bromine	0.022	0.0024	
	Cadmium	0.22	0.024	
	Calcium	0.073	0.0084	
	Cerium	0.84	0.088	
	Cesium	0.44	0.047	
	Chlorine	0.11	0.011	
	Chromium	0.025	0.0028	
	Cobalt	0.019	0.002	
	Copper	0.024	0.0027	
	Indium	0.32	0.035	

Analysis	Species	Mass_MDL (ug/filter)	Concentration (ug/m^3) by sampler type	
			SASS	URG 3000N
	Iron	0.032	0.0034	
	Lead	0.061	0.0064	
	Magnesium	0.18	0.019	
	Manganese	0.028	0.0029	
	Nickel	0.018	0.0019	
	Phosphorus	0.15	0.018	
	Potassium	0.11	0.012	
	Rubidium	0.025	0.0028	
	Selenium	0.025	0.0028	
	Silicon	0.18	0.02	
	Silver	0.36	0.04	
	Sodium	0.53	0.058	
	Strontium	0.034	0.0038	
	Sulfur	0.095	0.011	
	Tin	0.35	0.039	
	Titanium	0.051	0.0058	
	Vanadium	0.037	0.0042	
	Zinc	0.034	0.0037	
	Zirconium	0.22	0.024	

Appendix B

Data Completeness Summary

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Table B-1. Percentage of Routine Exposure Records – STN Sites
Monthly Percent Data Completeness by Site

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Alabama (TN)	TN	471570024	5	SASS with URG 3000N	90	91	40	66	100	100	100	100	100	92	100	100
Alabama (TN)	TN	471570024	5	URG 3000N	86	88	94	100	100	100	100	100	100	100	100	100
Allen Park	MI	261630001	5	SASS	100	100	100	100	100	100						
Allen Park	MI	261630001	5	SASS with URG 3000N						100	100	100	91	100	100	93
Allen Park	MI	261630001	5	URG 3000N	100	100	100	100	100	100	100	75	100	100	100	100
Bakersfield-California Ave	CA	060290014	5	SASS with URG 3000N	89	88	100	56	86	50	78	75	78	100	80	57
Bakersfield-California Ave	CA	060290014	5	URG 3000N	93	75	100	58	92	62	93	58	83	100	69	75
Bakersfield-California Ave (Collocated)	CA	060290014	6	SASS with URG 3000N	80	100	100	71	100	83	100	100	83	100	80	0
Bakersfield-California Ave (Collocated)	CA	060290014	6	URG 3000N	38	88	100	65	67	100	75	38	25	0	0	0
Beacon Hill - Met One	WA	530330080	6	SASS	88	100	100	100	100	100	100					
Beacon Hill - Met One	WA	530330080	6	SASS with URG 3000N							100	88	100	100	100	100
Beacon Hill - Met One	WA	530330080	6	URG 3000N	100	100	100	100	100	100	75	100	92	100	100	93
Blair Street	MO	295100085	6	SASS with URG 3000N	100	100	100	100	100	82	100	91	100	100	90	100
Blair Street	MO	295100085	6	URG 3000N	100	100	100	100	100	94	100	100	100	94	100	100
Burlington	VT	500070012	5	SASS with URG 3000N	100	90	100	100	100	100	100	100	100	100	100	100
Burlington	VT	500070012	5	URG 3000N	100	94	100	92	75	100	100	100	100	100	100	100
Capitol - Met One	LA	220330009	5	SASS with URG 3000N	100	100	78	100	89	100	100	100	100	90	90	91
Capitol - Met One	LA	220330009	5	URG 3000N	100	93	86	94	68	89	100	100	100	100	94	94
Chamizal - Met One	TX	481410044	5	SASS with URG 3000N	100	100	91	100	100	100	90	90	89	100	100	90
Chamizal - Met One	TX	481410044	5	URG 3000N	100	100	94	100	75	94	94	94	93	100	100	100
Chicopee	MA	250130008	5	SASS with URG 3000N	100	100	100	89	100	100	90	100	80	100	100	99
Chicopee	MA	250130008	5	URG 3000N	68	94	39	86	83	94	38	81	94	81	94	83
Com Ed - Met One	IL	170310076	5	SASS	100	100	98	93	100	89	100					
Com Ed - Met One	IL	170310076	5	SASS with URG 3000N							100	100	80	100	99	100
Com Ed - Met One	IL	170310076	5	URG 3000N	90	69	30	93	90	100	100	100	100	100	100	93
Commerce City	CO	080010006	5	SASS	99	99	88	89	83	100	100					
Commerce City	CO	080010006	5	SASS with URG 3000N							100	100	100	100	89	100
Commerce City	CO	080010006	5	URG 3000N	100	32	92	61	30	93	68	38	100	100	93	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
CPW	SC	450190049	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	72	100	100
CPW	SC	450190049	5	URG 3000N	100	93	94	86	100	100	100	100	100	100	100	100
Criscuolo Park	CT	090090027	5	SASS with URG 3000N	88	100	99	100	75	89	100	100	89	100	89	100
Criscuolo Park	CT	090090027	5	URG 3000N	67	100	92	92	58	100	93	100	75	100	86	100
Deer Park - Met One	TX	482011039	6	SASS with URG 3000N	91	100	91	92	100	100	100	100	100	92	100	100
Deer Park - Met One	TX	482011039	6	URG 3000N	83	68	83	100	100	100	100	100	100	100	100	78
Deer Park Collocated - Met One	TX	482011039	7	SASS with URG 3000N	100	100	100	100	98	100	100	100	100	100	100	100
Deer Park Collocated - Met One	TX	482011039	7	URG 3000N	100	100	38	100	100	100	100	100	88	100	100	100
Dover	DE	100010003	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	80	100	100
Dover	DE	100010003	5	URG 3000N	100	100	100	100	100	100	100	100	100	88	100	100
East Providence	RI	440071010	5	SASS with URG 3000N												100
East Providence	RI	440071010	5	URG 3000N												90
El Cajon	CA	060730003	5	SASS with URG 3000N	100	99	70	97	100	89	78	100	100	100	100	100
El Cajon	CA	060730003	5	URG 3000N	100	100	8	100	90	93	79	100	100	100	100	100
Elizabeth Lab	NJ	340390004	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Elizabeth Lab	NJ	340390004	5	URG 3000N	100	100	100	92	100	100	100	100	100	100	100	100
Essex - Met One	MD	240053001	5	SASS with URG 3000N	100	89	100	88	100	100	100	71	100	100	78	89
Essex - Met One	MD	240053001	5	URG 3000N	100	75	100	100	100	100	100	65	100	100	43	93
Fargo NW	ND	380171004	5	SASS with URG 3000N	99	100	100	100	100	100	100	100	100	100	100	100
Fargo NW	ND	380171004	5	URG 3000N	100	100	100	100	100	83	100	94	100	94	100	100
Fresno - First Street	CA	060190008	5	SASS with URG 3000N	100	100	91	100	89	100	100	100	89	99	100	100
Fresno - First Street	CA	060190008	5	URG 3000N	100	100	100	100	100	100	100	100	93	100	100	94
G.T. Craig	OH	390350060	5	SASS	100	100	100	100	100	88	99	100	90	100	99	100
G.T. Craig	OH	390350060	5	SASS with URG 3000N												100
G.T. Craig	OH	390350060	5	URG 3000N	92	100	100	58	83	93	69	75	93	100	100	93
G.T. Craig - Collocated	OH	390350060	6	SASS	94											
G.T. Craig - Collocated	OH	390350060	6	SASS with URG 3000N	70	97	100	100	100	100	80	74	60	95	75	93
G.T. Craig - Collocated	OH	390350060	6	URG 3000N	88	100	100	88	88	90	75	33	100	100	100	100
Garinger High School	NC	371190041	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	90	100	92	100
Garinger High School	NC	371190041	5	URG 3000N	88	94	83	93	89	94	94	81	93	83	94	89
Hawthorne	UT	490353006	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	86	100	30	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Hawthorne	UT	490353006	5	URG 3000N	75	100	100	100	100	100	100	100	100	100	38	94
Henrico Co.	VA	510870014	5	SASS with URG 3000N	100	100	100	100	100	77	100	100	100	100	100	100
Henrico Co.	VA	510870014	5	URG 3000N	100	100	65	88	100	50	100	100	100	100	100	100
Hinton - Met One	TX	481130069	5	SASS with URG 3000N	100	100	86	79	100	100	100	100	92	100	100	100
Hinton - Met One	TX	481130069	5	URG 3000N	92	93	83	83	100	100	92	75	100	100	100	100
Jackson UMC	MS	280490019	5	SASS with URG 3000N	49	100	88	100	88	100	100	100	100	100	100	100
Jackson UMC	MS	280490019	5	URG 3000N	90	75	100	75	75	100	100	100	100	100	100	100
JFK Center	KS	202090021	5	SASS with URG 3000N	100	100	100	100	100	100	99	67	60	0	80	100
JFK Center	KS	202090021	5	URG 3000N	100	93	100	100	100	75	94	100	88	0	50	100
Lawrenceville	PA	420030008	6	SASS with URG 3000N	100	100	81	100	89	100	100	100	100	100	100	99
Lawrenceville	PA	420030008	6	URG 3000N	90	100	100	100	92	100	100	100	100	100	100	100
Lindon	UT	490494001	5	SASS with URG 3000N	100	98	100	100	100	100	100	100	100	100	100	100
Lindon	UT	490494001	5	URG 3000N	100	100	100	100	100	100	100	100	100	75	100	100
McMillan Reservoir - Met One	DC	110010043	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
McMillan Reservoir - Met One	DC	110010043	5	URG 3000N	83	100	42	100	86	100	100	100	100	100	100	100
Missoula County Health Dept.	MT	300630031	5	SASS with URG 3000N	90	90	100									
Missoula County Health Dept.	MT	300630031	5	URG 3000N	88	94	50									
MLK	DE	100032004	5	SASS with URG 3000N	100	100	65	83	100	80	100	100	100	100	99	50
MLK	DE	100032004	5	URG 3000N	100	100	100	100	88	75	100	100	100	100	50	90
New Brunswick	NJ	340230006	5	SASS with URG 3000N	100	100	100	100	100	99	100	89	100	100	100	100
New Brunswick	NJ	340230006	5	URG 3000N	100	100	100	100	100	93	75	100	100	100	100	100
New Brunswick (Collocated)	NJ	340230006	6	SASS	100											
New Brunswick (Collocated)	NJ	340230006	6	SASS with URG 3000N	98	96	100	82	94	96	74	76	93	76	94	82
New Brunswick (Collocated)	NJ	340230006	6	URG 3000N	100	100	100	90	100	100	88	88	100	88	100	100
North Birmingham	AL	010730023	5	SASS	100	100	99	100	99	100	98					
North Birmingham	AL	010730023	5	SASS with URG 3000N							100	100	90	92	100	92
North Birmingham	AL	010730023	5	URG 3000N	56	100	100	100	94	75	100	88	94	100	100	100
Peoria Site 1127	OK	401431127	5	SASS with URG 3000N	88	100	100	78	88	100	100	100	100	88	100	100
Peoria Site 1127	OK	401431127	5	URG 3000N	67	100	100	92	75	93	100	100	100	92	100	100
PHILA - AMS Laboratory	PA	421010004	7	SASS with URG 3000N	100	91	99	100	100	99	100	90	90	90	100	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
PHILA - AMS Laboratory	PA	421010004	7	URG 3000N	75	69	100	68	69	100	100	94	75	94	100	100
Philips	MN	270530963	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	90	90	100	93
Philips	MN	270530963	5	URG 3000N	100	100	100	100	100	100	100	81	100	100	100	100
Phoenix Supersite	AZ	040139997	7	SASS with URG 3000N	100	100	92	100	100	100	100	100	89	91	100	100
Phoenix Supersite	AZ	040139997	7	URG 3000N	100	100	100	93	88	100	100	100	100	100	100	100
Portland - SE Lafayette	OR	410510080	6	SASS with URG 3000N	100	100	100	100	90	100	90	92	90	90	80	100
Portland - SE Lafayette	OR	410510080	6	URG 3000N	100	100	100	93	100	100	94	100	100	94	94	100
Reno	NV	320310016	5	SASS with URG 3000N	90	100	100	100	100	100	100	91	100	100	100	100
Reno	NV	320310016	5	URG 3000N	94	100	100	100	94	100	100	100	100	100	100	100
Riverside-Rubidoux	CA	060658001	5	SASS	90	100	100	90	100	91	100					
Riverside-Rubidoux	CA	060658001	5	SASS with URG 3000N							97	100	100	100	100	100
Riverside-Rubidoux	CA	060658001	5	URG 3000N	94	100	100	94	100	75	100	100	100	100	100	100
Riverside-Rubidoux (Collocated)	CA	060658001	6	SASS with URG 3000N	83	100	100	80	100	83	100	100	100	85	100	100
Riverside-Rubidoux (Collocated)	CA	060658001	6	URG 3000N	100	100	100	88	100	75	100	100	100	100	100	100
Roxbury (Boston)	MA	250250042	5	SASS with URG 3000N	100	100	100	100	100	91	100	100	100	100	90	100
Roxbury (Boston)	MA	250250042	5	URG 3000N	100	100	100	88	100	100	100	100	100	94	100	100
Roxbury (Boston) - collocated	MA	250250042	6	SASS	100											
Roxbury (Boston) - collocated	MA	250250042	6	SASS with URG 3000N	100	100	100	83	100	83	100	100	100	100	80	100
Roxbury (Boston) - collocated	MA	250250042	6	URG 3000N	100	50	88	40	100	100	100	100	100	100	100	100
Sacramento - Del Paso Manor	CA	060670006	5	SASS	100	100	100	100	100	100						
Sacramento - Del Paso Manor	CA	060670006	5	SASS with URG 3000N						100	90	100	100	100	100	100
Sacramento - Del Paso Manor	CA	060670006	5	URG 3000N	75	100	94	100	100	100	100	100	100	100	100	100
San Jose - Jackson Street	CA	060850005	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
San Jose - Jackson Street	CA	060850005	5	URG 3000N	100	100	93	100	100	100	100	100	100	100	75	100
SER-DNR Headquarters	WI	550790026	5	SASS with URG 3000N	97	99	100	100	80	100	100	90	100	99	100	100
SER-DNR Headquarters	WI	550790026	5	URG 3000N	94	100	100	100	88	100	100	94	100	100	100	100
Simi Valley	CA	061112002	5	SASS with URG 3000N	88	100	100	100	100	100	100	100	100	100	100	90

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Simi Valley	CA	061112002	5	URG 3000N	100	100	92	100	100	93	100	100	100	92	93	100
South DeKalb - Met One	GA	130890002	5	SASS	100	100	98	100	100	100						
South DeKalb - Met One	GA	130890002	5	SASS with URG 3000N						100	100	100	100	100	100	100
South DeKalb - Met One	GA	130890002	5	URG 3000N	100	93	100	100	100	100	100	100	100	100	100	100
Springfield Pumping Station - Met One	IL	170310057	5	SASS with URG 3000N	75	87	100	81	100	100	61	0	100	84	100	100
Springfield Pumping Station - Met One	IL	170310057	5	URG 3000N	100	100	100	80	100	75	100	100	100	100	100	100
St. Lukes Meridian (IMS)	ID	160010010	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
St. Lukes Meridian (IMS)	ID	160010010	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Sydney	FL	120573002	5	SASS with URG 3000N	90	100	83	100	100	100	100	100	90	99	100	100
Sydney	FL	120573002	5	URG 3000N	100	100	94	100	100	100	100	100	100	100	100	100
Univ. of Florida Ag School	FL	120111002	5	SASS with URG 3000N	100	66	80	54	0	100	81	80	100	100	92	100
Univ. of Florida Ag School	FL	120111002	5	URG 3000N	94	94	83	93	88	100	94	94	100	100	75	69
Urban League - Met One	RI	440070022	5	SASS with URG 3000N	100	100	91	100	100	100	100	100	100	100	100	100
Urban League - Met One	RI	440070022	5	URG 3000N	81	94	83	94	81	94	28	61	94	88	94	75
Washington Park	IN	180970078	5	SASS with URG 3000N	100	100	100	100	100	99	100	85	100	50	78	90
Washington Park	IN	180970078	5	URG 3000N	100	100	100	100	100	100	75	100	100	75	93	100
Woolworth St	NE	310550019	5	SASS with URG 3000N	96	96	96	96	96	96	96	96	96	96	96	87
Woolworth St	NE	310550019	5	URG 3000N	90	100	92	100	100	75	100	100	100	92	100	93
WV - Guthrie Agricultural Center	WV	540390011	5	SASS with URG 3000N	100	100	100	100	75	100	89	99	78	86	99	100
WV - Guthrie Agricultural Center	WV	540390011	5	URG 3000N	100	100	100	100	92	100	93	100	68	92	100	100

Table B-2. Percentage of Routine Exposure Records – Non-STN Sites
Monthly Percent Data Completeness by Site

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
5 Points	OH	391530023	5	SASS with URG 3000N	100	80	83	100	100	98	100	97	98	100	100	100
5 Points	OH	391530023	5	URG 3000N	100	88	100	100	100	100	38	100	100	100	100	90
AL - Phenix City	AL	011130001	5	SASS with URG 3000N	100	100	100	80	100	100	100	100	100	83	100	100
AL - Phenix City	AL	011130001	5	URG 3000N	100	100	100	100	100	38	63	100	100	100	50	90
Albany Co HD	NY	360010005	5	SASS with URG 3000N	89	100	81	100	100	91	100	100	82	100	92	100
Albany Co HD	NY	360010005	5	URG 3000N	29	100	89	93	88	83	75	61	83	94	69	89
Arendtsville	PA	420010001	5	SASS	100											
Arendtsville	PA	420010001	5	SASS with URG 3000N	100	99	100	100	97	86	100	100	100	100	100	87
Arendtsville	PA	420010001	5	URG 3000N	88	100	100	80	100	80	67	50	100	100	100	90
Army Reserve Center - Met One	IA	191130037	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	98	100	100
Army Reserve Center - Met One	IA	191130037	5	URG 3000N	100	100	100	88	100	100	100	100	100	100	88	90
Arnold West - Met One	MO	290990019	6	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Arnold West - Met One	MO	290990019	6	URG 3000N	100	100	100	100	100	100	100	100	94	69	100	100
Ashland Health Department	KY	210190017	5	SASS	100											
Ashland Health Department	KY	210190017	5	SASS with URG 3000N	100	80	100	100	99	100	100	100	100	100	100	83
Ashland Health Department	KY	210190017	5	URG 3000N	100	50	100	100	75	100	100	100	75	100	100	90
Athens - Met One	GA	130590001	5	SASS with URG 3000N	100	100	100	100	80	100	80	80	100	80	100	100
Athens - Met One	GA	130590001	5	URG 3000N	100	100	100	100	88	100	88	88	100	50	100	100
Augusta - Met One	GA	132450091	5	SASS with URG 3000N	100	100	100	80	100	100	80	80	100	100	100	100
Augusta - Met One	GA	132450091	5	URG 3000N	100	100	100	88	100	100	100	100	75	100	100	100
Bonne Terre - Met One	MO	291860005	5	SASS with URG 3000N	100	100	100	100	100	64	100	100	100	89	82	100
Bonne Terre - Met One	MO	291860005	5	URG 3000N	100	100	100	75	6	94	93	100	63	79	6	36
Bountiful	UT	490110004	5	SASS with URG 3000N	100	100	100	78	100	100	100	100	100	100	100	100
Bountiful	UT	490110004	5	URG 3000N	100	100	25	100	100	100	100	100	100	100	100	100
Buffalo - Met One	NY	360290005	6	SASS with URG 3000N	100	100	100	100	100	100	100	80	80	100	100	100
Buffalo - Met One	NY	360290005	6	URG 3000N	50	100	50	100	100	100	100	100	100	100	100	90
Buncombe County Board of Education	NC	370210034	5	SASS	100											
Buncombe County Board of Education	NC	370210034	5	SASS with URG 3000N	100	100	100	100	100	50	100	100	100	80	100	100
Buncombe County Board of Education	NC	370210034	5	URG 3000N	88	100	90	100	100	100	100	100	100	100	100	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Butte-Greeley School	MT	300930005	5	SASS	100											
Butte-Greeley School	MT	300930005	5	SASS with URG 3000N	100	100	100	65	100	100	100	100	100	100	100	100
Butte-Greeley School	MT	300930005	5	URG 3000N	100	88	100	88	100	100	100	100	100	100	88	100
Cannons Lane	KY	211110067	6	SASS with URG 3000N	100	100	99	100	100	100	100	80	100	100	100	100
Cannons Lane	KY	211110067	6	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Canton Fire Station	OH	391510017	5	SASS	100											
Canton Fire Station	OH	391510017	5	SASS with URG 3000N	100	100	100	98	100	100	100	100	100	80	100	100
Canton Fire Station	OH	391510017	5	URG 3000N	100	100	50	100	25	100	100	88	88	38	88	100
Chester	NJ	340273001	5	SASS with URG 3000N	100	100	88	100	98	89	100	100	100	100	100	100
Chester	NJ	340273001	5	URG 3000N	100	100	92	54	55	86	100	100	79	92	100	100
Chesterfield	SC	450250001	5	SASS	98											
Chesterfield	SC	450250001	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	97	96	100
Chesterfield	SC	450250001	5	URG 3000N	38	100	100	88	100	88	100	100	100	100	100	100
Children's Park	AZ	040191028	5	SASS	100											
Children's Park	AZ	040191028	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Children's Park	AZ	040191028	5	URG 3000N	100	100	100	100	100	100	100	100	0	0	100	100
Clarksville	TN	471251009	5	SASS	100											
Clarksville	TN	471251009	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	80	100
Clarksville	TN	471251009	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	50	100
Columbus - Met One	GA	132150011	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Columbus - Met One	GA	132150011	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Covington - University College	KY	211170007	5	SASS	100											
Covington - University College	KY	211170007	5	SASS with URG 3000N	100	100	100	100	100	100	100	100				
Covington - University College	KY	211170007	5	URG 3000N	100	100	100	100	100	100	100	100				
Craig Road	NV	320030020	5	SASS	100											
Craig Road	NV	320030020	5	SASS with URG 3000N	100	100	71	100	100	100	100					
Craig Road	NV	320030020	5	URG 3000N	100	100	100	100	100	100	100					
Dearborn	MI	261630033	5	SASS with URG 3000N	100	100	100	100	100	86	84	100	100	60	99	100
Dearborn	MI	261630033	5	URG 3000N	100	100	100	100	100	100	100	50	100	100	100	100
Del Norte - Met One	NM	350010023	5	SASS with URG 3000N	100	100	100	100	100	99	100	80	78	87	100	56
Del Norte - Met One	NM	350010023	5	URG 3000N	100	100	100	100	100	100	100	88	100	88	100	90
Denver Animal Shelter	CO	080310025	5	SASS with URG 3000N			100	100	100	100	100	100	83	100	100	100
Denver Animal Shelter	CO	080310025	5	URG 3000N			50	100	100	100	100	100	100	100	100	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Division St.	NY	360610134	5	SASS with URG 3000N	100	89	100	90	89	92	90	78	92	73	100	100
Division St.	NY	360610134	5	URG 3000N	68	94	83	88	79	10	0	0	46	72	94	89
Douglas - Met One	GA	130690002	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	85	100	100	100
Douglas - Met One	GA	130690002	5	URG 3000N	100	88	100	88	100	100	100	100	100	100	100	100
Downtown Library	OH	391130032	5	SASS	100											
Downtown Library	OH	391130032	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Downtown Library	OH	391130032	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Elkhart Prairie Street	IN	180390008	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Elkhart Prairie Street	IN	180390008	5	URG 3000N	100	100	100	100	100	100	100	100	88	100	100	100
Elmwood	PA	421010055	5	SASS with URG 3000N	99	100	99	100	100	99	100	81	100	99	97	100
Elmwood	PA	421010055	5	URG 3000N	100	75	88	100	88	100	100	100	100	100	100	100
Erie	PA	420490003	5	SASS	100											
Erie	PA	420490003	5	SASS with URG 3000N	57	100	100	100	100	100	100	80	60	100	100	98
Erie	PA	420490003	5	URG 3000N	100	100	100	100	100	100	100	50	75	100	100	100
Evansville Buena Vista Rd	IN	181630021	5	SASS with URG 3000N	100	100	99	100	99	100	100	100	100	100	100	100
Evansville Buena Vista Rd	IN	181630021	5	URG 3000N	38	75	100	100	50	63	100	88	100	100	50	90
Fairbanks State Bldg	AK	020900010	6	SASS with URG 3000N	100	100	100	100	100	100	100	90	100	100	100	91
Fairbanks State Bldg	AK	020900010	6	URG 3000N	75	100	100	100	100	100	100	100	75	100	100	94
Florence	PA	421255001	5	SASS with URG 3000N	100	100	100	100	100	100	80	59	100	78	100	86
Florence	PA	421255001	5	URG 3000N	100	100	100	100	100	100	100	100	100	88	100	100
Freemansburg	PA	420950025	5	SASS	100											
Freemansburg	PA	420950025	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Freemansburg	PA	420950025	5	URG 3000N	50	100	100	100	100	100	100	100	100	100	100	100
Gary Iitri	IN	180890022	5	SASS with URG 3000N	100	85	100	100	100	100	100	99	83	100	100	100
Gary Iitri	IN	180890022	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Grand Junction - Powell Building	CO	080770017	5	SASS with URG 3000N	100	100	100									
Grand Junction - Powell Building	CO	080770017	5	URG 3000N	100	100	100									
Grand Rapids	MI	260810020	5	SASS with URG 3000N	80	100	100	100	100	100	100	100	98	83	100	100
Grand Rapids	MI	260810020	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	90
Granite City	IL	171190024	5	SASS with URG 3000N	96	76	96	96	96	80	64	48	93	80	96	96
Granite City	IL	171190024	5	URG 3000N	88	50	100	100	100	75	80	100	50	100	100	100
Grayson	KY	210430500	5	SASS with URG 3000N	100	100	100	100	85	100	100	100	100	100	100	100
Grayson	KY	210430500	5	URG 3000N	100	100	88	100	100	100	100	100	100	0		100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Greensburg	PA	421290008	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Greensburg	PA	421290008	5	URG 3000N	88	100	100	100	88	100	100	100	100	100	100	100
Greenville ESC	SC	450450015	5	SASS	100											
Greenville ESC	SC	450450015	5	SASS with URG 3000N	100	100	98	93	95	100	100	83	100	100	100	100
Greenville ESC	SC	450450015	5	URG 3000N	100	100	40	0	100	100	100	100	100	100	88	100
Hammond Purdue	IN	180892004	5	SASS with URG 3000N		100	100	100	100	100	100	100	80	100	100	100
Hammond Purdue	IN	180892004	5	URG 3000N		100	100	100	100	100	100	100	100	100	100	100
Harrisburg	PA	420430401	5	SASS	100											
Harrisburg	PA	420430401	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	85	85	100	100
Harrisburg	PA	420430401	5	URG 3000N	88	100	100	100	100	100	100	100	100	100	50	100
Hattie Avenue	NC	370670022	5	SASS with URG 3000N	80	80	83	100	100	67	100	100	100	100	100	100
Hattie Avenue	NC	370670022	5	URG 3000N	88	100	100	100	100	75	100	88	100	100	100	100
Head Start	OH	390990014	5	SASS	100											
Head Start	OH	390990014	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Head Start	OH	390990014	5	URG 3000N	100	100	100	100	100	88	100	100	100	100	100	100
Hickory	NC	370350004	5	SASS	100											
Hickory	NC	370350004	5	SASS with URG 3000N	100	100	100	100	100	86	100	100	80	60	80	83
Hickory	NC	370350004	5	URG 3000N	50	100	100	100	100	100	100	100	100	100	88	90
Horicon Palmatory	WI	550270001	5	SASS with URG 3000N			95	99	100	100	100	92	90	92	100	91
Horicon Palmatory	WI	550270001	5	URG 3000N			93	100	100	100	100	100	100	100	94	100
Houghton Lake	MI	261130001	5	SASS with URG 3000N	85	100	43	100	100	100	100	100	100	80	100	98
Houghton Lake	MI	261130001	5	URG 3000N	100	100	75	88	100	88	100	100	100	88	100	100
HU-Beltsville Met One	MD	240330030	5	SASS with URG 3000N	80	100	80	67	100	100	100	83	100	85	100	86
HU-Beltsville Met One	MD	240330030	5	URG 3000N	88	100	88	40	100	100	75	50	88	100	100	92
Huntsville Old Airport	AL	010890014	5	SASS with URG 3000N	100	100	100	100	80	100	100	100	100	100	100	100
Huntsville Old Airport	AL	010890014	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
IS 52 - Met One	NY	360050110	5	SASS	100	100	100	100	93	100	100					
IS 52 - Met One	NY	360050110	5	SASS with URG 3000N							100	100	98			
IS 52 - Met One	NY	360050110	5	URG 3000N	68	94	78	94	13	81	75	56	100			
Jasper Post Office	IN	180372001	5	SASS with URG 3000N	100	100	100	85	99	100	100	100	100	100	100	100
Jasper Post Office	IN	180372001	5	URG 3000N	100	100	100	100	100	100	88	100	100	100	100	100
Jefferson Elementary - Met One	IA	191630015	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	90	100	100
Jefferson Elementary - Met One	IA	191630015	5	URG 3000N	100	100	100	100	100	100	100	100	100	94	100	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Jeffersonville Walnut St	IN	180190006	5	SASS with URG 3000N	100	100	100	98	100	100	100	100	100	100	100	100
Jeffersonville Walnut St	IN	180190006	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Jerome Mack Middle School	NV	320030540	5	SASS with URG 3000N							99	100	63	43	100	100
Jerome Mack Middle School	NV	320030540	5	URG 3000N							100	100	100	100	100	90
Johnstown	PA	420210011	5	SASS	100											
Johnstown	PA	420210011	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	80	100	100
Johnstown	PA	420210011	5	URG 3000N	100	88	100	100	100	100	100	100	100	50	100	100
Kapolei	HI	150030010	5	SASS	100											
Kapolei	HI	150030010	5	SASS with URG 3000N	100	100	82	100	100	100	99	100	100	80	100	100
Kapolei	HI	150030010	5	URG 3000N	100	50	100	88	100	100	100	88	100	100	100	100
Karnack - Met One	TX	482030002	5	SASS with URG 3000N	100	100	100	100	75	100	100	98	100	100	100	100
Karnack - Met One	TX	482030002	5	URG 3000N	25	100	100	100	100	100	88	100	100	100	100	100
Kingston	TN	471451001	5	SASS	100	80	100	100	100	100	100	100	80	80	100	100
Lancaster	PA	420710007	5	SASS	100											
Lancaster	PA	420710007	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Lancaster	PA	420710007	5	URG 3000N	100	100	100	100	50	100	100	100	100	100	100	100
Laurel	MS	280670002	5	SASS	100											
Laurel	MS	280670002	5	SASS with URG 3000N	100	100	100	100	99	96	100	100	83	100	100	99
Laurel	MS	280670002	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Lawrence County	TN	470990002	5	SASS	100											
Lawrence County	TN	470990002	5	SASS with URG 3000N	100	100	100	100	56	100	85	100	100	100	100	100
Lawrence County	TN	470990002	5	URG 3000N	100	100	100	100	100	100	100	88	100	100	100	100
Lexington Health Department	KY	210670012	5	SASS with URG 3000N	100	100	100	100	80	100	100	100	100	100	80	100
Lexington Health Department	KY	210670012	5	URG 3000N	100	100	100	100	100	88	100	100	100	100	100	100
(NC) - Lexington	NC	370570002	5	SASS	100											
(NC) - Lexington	NC	370570002	5	SASS with URG 3000N	100	98	100	100	100	100	100	80	100	100	100	100
(NC) - Lexington	NC	370570002	5	URG 3000N	100	100	100	50	100	100	100	100	100	100	100	100
(PA) Liberty	PA	420030064	6	SASS with URG 3000N	93	95	75	100	87	100	100	100	100	100	100	83
(PA) Liberty	PA	420030064	6	URG 3000N	0	0	33	100	100	100	100	100	100	100	100	90
Liberty - Met One	MO	290470005	5	SASS with URG 3000N	100	91	90	100	100	100	100	90	100	92	100	100
Liberty - Met One	MO	290470005	5	URG 3000N	100	94	75	100	100	100	100	94	100	100	56	89
Lockeland School - Met One	TN	470370023	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	99	100
Lockeland School - Met One	TN	470370023	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Lorain	OH	390933002	5	SASS with URG 3000N	100	99	100	100	100	100	100	98	100	100	100	100
Lorain	OH	390933002	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Luna Pier	MI	261150005	5	SASS with URG 3000N	98	85	100	100	100	100	100	80	100	100	100	100
Luna Pier	MI	261150005	5	URG 3000N	100	100	100	88	100	100	100	88	100	100	100	100
Macon - Met One	GA	130210007	5	SASS with URG 3000N	80	100	100	100	100	100	100	100	100	100	100	87
Macon - Met One	GA	130210007	5	URG 3000N	100	100	100	100	75	100	100	100	100	100	88	100
Maple Canyon	OH	390490081	6	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Maple Canyon	OH	390490081	6	URG 3000N	88	100	100	100	100	100	100	100	100	100	100	100
Marysville - 7th Ave	WA	530611007	5	SASS with URG 3000N	80	80	100	100	85	99	100	100	83	100	100	100
Marysville - 7th Ave	WA	530611007	5	URG 3000N	50	100	100	88	100	100	100	100	88	100	100	100
Mayville Hubbard Township site	WI	550270007	5	SASS with URG 3000N	100	99	100									
Mayville Hubbard Township site	WI	550270007	5	URG 3000N	100	100	100									
Middletown	OH	390171004	5	SASS	0											
Middletown	OH	390171004	5	SASS with URG 3000N	100	100	100	100	100	67						
Middletown	OH	390171004	5	URG 3000N	100	100	100	100	100	63						
Millbrook	NC	371830014	5	SASS with URG 3000N	100	89	99	100	100	90	100	70	100	91	100	91
Millbrook	NC	371830014	5	URG 3000N	69	93	78	93	89	81	69	63	94	94	100	100
Mingo Junction	OH	390811001	5	SASS with URG 3000N	76	100	80	50	75	80	100	100	100	100	99	100
Mingo Junction	OH	390811001	5	URG 3000N	88	100	100	90	83	100	100	50	100	100	100	100
MN - Rochester	MN	271095008	5	SASS	100											
MN - Rochester	MN	271095008	5	SASS with URG 3000N	67	100	100	100	100	100	100	83	100	100	100	100
MN - Rochester	MN	271095008	5	URG 3000N	50	88	100	100	100	88	100	100	100	100	100	100
MOMS	AL	011011002	5	SASS with URG 3000N	100	100	80	100	100	100	100	100	80	100	100	100
MOMS	AL	011011002	5	URG 3000N	38	88	50	30	100	0	83	100	88	100	100	100
Naperville	IL	170434002	5	SASS with URG 3000N	96	96	76	96	95	96	80	94	76	96	96	96
Naperville	IL	170434002	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
New Garden	PA	420290100	5	SASS	100											
New Garden	PA	420290100	5	SASS with URG 3000N	81	100	100	60	100	100	100	100	100	80	100	86
New Garden	PA	420290100	5	URG 3000N	100	100	100	80	25	13	13	13	63	88	100	100
Newark	NJ	340130003	5	SASS				94	86	100	77	100	99	100	100	100
Newark	NJ	340130003	5	SASS with URG 3000N				100								
Newark	NJ	340130003	5	URG 3000N				0								
NLR Parr	AR	051190007	5	SASS	100											

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
NLR Parr	AR	051190007	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	99	100	100
NLR Parr	AR	051190007	5	URG 3000N	100	88	100	100	100	100	100	100	100	100	100	100
North Los Angeles	CA	060371103	5	SASS with URG 3000N	100	100	100	100	100	69	100	100	98	100	100	100
North Los Angeles	CA	060371103	5	URG 3000N	100	100	100	100	100	90	100	100	100	100	100	100
Northbrook	IL	170314201	5	SASS with URG 3000N	96	96	96	80	96	96	96	96	96	80	96	96
Northbrook	IL	170314201	5	URG 3000N	100	100	100	100	25	75	100	100	100	100	100	100
OCUSA Campus	OK	401091037	5	SASS	100											
OCUSA Campus	OK	401091037	5	SASS with URG 3000N	100	80	100	83	100	100	100	100	85	100	98	100
OCUSA Campus	OK	401091037	5	URG 3000N	100	88	50	100	100	88	100	88	100	88	100	100
ODOT Garage	OH	390870012	5	SASS with URG 3000N	80	100	100	100	100	100	100	100	100	100	100	100
ODOT Garage	OH	390870012	5	URG 3000N	88	100	100	100	100	100	100	100	100	100	100	100
PerkinstownCASNET	WI	551198001	5	SASS	100											
PerkinstownCASNET	WI	551198001	5	SASS with URG 3000N	100	100	100	100	100	100	80	100	100	100	100	100
PerkinstownCASNET	WI	551198001	5	URG 3000N	100	100	40	0	100	100	50	100	100	100	100	100
Pinnacle State Park - Met One	NY	361010003	5	SASS with URG 3000N	100	100	91	100	82	91	100	90	89	100	100	100
Pinnacle State Park - Met One	NY	361010003	5	URG 3000N	68	94	89	100	88	83	75	88	86	94	100	78
Platteville	CO	081230008	5	SASS with URG 3000N	100	100	100	100	100	96	100	100	100	100	100	98
Platteville	CO	081230008	5	URG 3000N	88	88	10	0	83	100	100	100	100	100	100	100
Port Huron	MI	261470005	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Port Huron	MI	261470005	5	URG 3000N	100	100	100	100	50	100	100	100	100	100	100	100
Public Health Building - Met One	IA	191530030	5	SASS with URG 3000N	100	100	100	100	73	100	100	100	100	100	100	100
Public Health Building - Met One	IA	191530030	5	URG 3000N	100	100	100	100	75	100	100	100	88	100	100	100
Queens College - Met One	NY	360810124	6	SASS	99	100	100	100	90	87						
Queens College - Met One	NY	360810124	6	SASS with URG 3000N						100	90	100	100	80	100	100
Queens College - Met One	NY	360810124	6	URG 3000N	100	100	94	94	86	100	100	100	100	75	100	100
Reading Airport	PA	420110011	5	SASS	100											
Reading Airport	PA	420110011	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Reading Airport	PA	420110011	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Rochester Primary - Met One	NY	360551007	5	SASS with URG 3000N	100	80	90	50	92	100	100	100	100	91	100	90
Rochester Primary - Met One	NY	360551007	5	URG 3000N	100	94	88	69	100	100	100	100	100	94	94	94
Rockwell	NC	371590021	5	SASS	100											
Rockwell	NC	371590021	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Rockwell	NC	371590021	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Rome Elementary	GA	131150003	5	SASS	100											
Rome Elementary	GA	131150003	5	SASS with URG 3000N	100	100	85	100	100	100	100	100	100	100	100	100
Rome Elementary	GA	131150003	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Rossville - Met One	GA	132950002	5	SASS with URG 3000N	97	78	100	100	100	100	100	100	100	85	100	100
Rossville - Met One	GA	132950002	5	URG 3000N	88	100	88	100	100	100	100	88	100	100	100	100
Scranton	PA	420692006	5	SASS	100											
Scranton	PA	420692006	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Scranton	PA	420692006	5	URG 3000N	100	88	38	100	100	100	100	100	100	100	100	50
Shenandoah High School	IN	180650003	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	98	100
Shenandoah High School	IN	180650003	5	URG 3000N	100	100	100	100	100	100	100	100	50	100	100	50
Shreveport Airport - Met One	LA	220150008	5	SASS with URG 3000N	100	100	100	86	100	100	100	100	85	80	100	100
Shreveport Airport - Met One	LA	220150008	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Sioux Falls School Site	SD	460990008	5	SASS	87											
Sioux Falls School Site	SD	460990008	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	98	100	100
Sioux Falls School Site	SD	460990008	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Skyview	FL	121030026	5	SASS	100											
Skyview	FL	121030026	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Skyview	FL	121030026	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
South Charleston Library	WV	540391005	5	SASS with URG 3000N	100	100	100	100	100	100	80	100	85	100	100	100
South Charleston Library	WV	540391005	5	URG 3000N	100	100	100	100	100	100	88	100	100	100	100	100
Spring Hill Elementary School	TN	470931020	5	SASS with URG 3000N	100	100	100	100	78	100	78	100	100	85	100	86
Spring Hill Elementary School	TN	470931020	5	URG 3000N	100	75	0	75	25	45	50	100	100	100	50	100
St Theo	OH	390350038	6	SASS	100	100	100	100	75	100	100	99	79	85	100	100
St Theo	OH	390350038	6	SASS with URG 3000N												75
St Theo	OH	390350038	6	URG 3000N												83
State College	PA	420270100	5	SASS	100											
State College	PA	420270100	5	SASS with URG 3000N	100	100	100	100	100	100	100	80	100	100	100	100
State College	PA	420270100	5	URG 3000N	100	100	100	100	100	100	100	88	100	100	100	100
SW HS	MI	261630015	5	SASS with URG 3000N	100	100	100	100	100	86	100	100	100	83	100	83
SW HS	MI	261630015	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Tacoma - Met One	WA	530530029	5	SASS with URG 3000N	100	100	83	85	100	100	100	100	100	100	83	100
Tacoma - Met One	WA	530530029	5	URG 3000N	50	100	100	88	100	100	100	100	100	100	100	100
Taft	OH	390610040	5	SASS with URG 3000N	100	80	100	100	100	99	100	100	100	100	100	100

Site Name	State	AQS Code	POC	Sampler Type	Report Batch											
					119	120	121	122	123	124	125	126	127	128	129	130
Taft	OH	390610040	5	URG 3000N	100	88	100	100	100	100	100	100	100	100	100	100
Tallahassee Community College	FL	120730012	5	SASS	0											
Tallahassee Community College	FL	120730012	5	SASS with URG 3000N	75	100	100	100	100	100	100	100	100	100	100	83
Tallahassee Community College	FL	120730012	5	URG 3000N	25	100	100	100	100	100	100	100	100	100	0	
Tecumseh	MI	260910007	5	SASS with URG 3000N	100	83	79	100	100	100	100	100	100	100	78	100
Tecumseh	MI	260910007	5	URG 3000N	100	75	75	100	75	100	88	50	100	100	100	100
Toledo Airport	OH	390950026	5	SASS	0											
Toledo Airport	OH	390950026	5	SASS with URG 3000N	100	85	100	100	100	100	100	100	100	96	100	100
Toledo Airport	OH	390950026	5	URG 3000N	88	100	88	100	100	100	100	100	100	100	100	100
UTC	TN	470654002	5	SASS	0											
UTC	TN	470654002	5	SASS with URG 3000N	0	100	80	75	100	100	100	100	100	100	100	100
UTC	TN	470654002	5	URG 3000N	100	38	100	100	100	100	88	100	88	100	100	50
VAN4PLN2	WA	530110013	5	SASS with URG 3000N	100	100	85	100	100	100	100	100	80	100	100	100
VAN4PLN2	WA	530110013	5	URG 3000N	100	50	100	100	100	100	100	100	100	100	100	100
Water Treatment Plant	WV	540690010	5	SASS	100											
Water Treatment Plant	WV	540690010	5	SASS with URG 3000N	100	100	100	83	100	80	100	100	100	100	100	100
Water Treatment Plant	WV	540690010	5	URG 3000N	25	75	100	100	100	25	100	100	100	100	100	100
Waukesha, Cleveland Ave. Site	WI	551330027	5	SASS	100											
Waukesha, Cleveland Ave. Site	WI	551330027	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	80	80	100
Waukesha, Cleveland Ave. Site	WI	551330027	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Whiteface - Met One	NY	360310003	5	SASS with URG 3000N	100	100	100	100	75	100	80	100	80	80	100	100
Whiteface - Met One	NY	360310003	5	URG 3000N	100	0										
Wichita Dept. of Env. Health - Met One	KS	201730010	5	SASS	100											
Wichita Dept. of Env. Health - Met One	KS	201730010	5	SASS with URG 3000N	100	100	100	100	100	83	100	100	100	100	100	100
Wichita Dept. of Env. Health - Met One	KS	201730010	5	URG 3000N	100	100	100	100	100	88	100	100	100	100	100	50
Wylam	AL	010732003	5	SASS with URG 3000N	80	100	80	100	100	99	100	100	100	100	100	99
Wylam	AL	010732003	5	URG 3000N	88	100	88	100	100	100	100	100	100	100	100	100
Yakima Mental Health	WA	530770009	5	SASS with URG 3000N	100	100	89	100	100	100						100
Yakima Mental Health	WA	530770009	5	URG 3000N	42	25	0	20	100	100						100
York	PA	421330008	5	SASS	100											
York	PA	421330008	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	80	100	100	100
York	PA	421330008	5	URG 3000N	100	88	100	100	100	100	100	100	50	100	50	100