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Annual Data Summary Report for the Chemical Speciation of $PM_{2.5}$ Filter Samples Project

January 1 through December 31, 2011

Prepared for:
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TABLE OF CONTENTS

Section **Page**

TABLE OF CONTENTS (Contd.)

Section **Page**

LIST OF APPENDICES

LIST OF TABLES

Table **Page**

LIST OF TABLES (Contd.)

Table **Page**

LIST OF TABLES (Contd.)

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, 2011.

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 analyzed performance evaluation (PE) audit materials provided by EPA during late 2010 and early 2011, but no on-site audit was conducted by EPA during 2011. 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 2010, and the results were reported in 2011. 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 found to be satisfactory during 2011. Issues included problems with the weighing chamber environmental controls. 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.

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 2011 (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. During 2011, one or two sites continued sampling quartz with a MetOne sampler with analysis by the CSN TOT method.

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 2011. 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 2011 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 2011 (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 no Corrective Action Requests (CARs) issued during 2011. There were some 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
None	SHAL	Power Outage/ Surge	When power was restored, a power surge damaged the walk-in cooler. Cooler was repaired in 18 hours.	Little affect on the results of the filters.
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 179 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, 2011. 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, 2011. 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 performed by RTI, 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. While primary site selection and field-sampling operations are out of RTI's control, the RTI laboratories follow appropriate extraction and sample preparation procedures to guard against nonrepresentative sampling of the filters.
- 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 with 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 was 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 most of the minor species.[3]

2.2 Summary of Data Completeness

Data completeness network-wide exceeded 95% for 2011. 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.

[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.

Appendix B of this report includes more details of the sampling events and completeness for the Reporting Batches delivered in 2011. 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 results were impacted negatively. The following subsections describe any significant corrective actions undertaken in each laboratory area during 2011.

2.3.1 Gravimetric Mass

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

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 2011 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 2011.

2.3.5 Sample Handling and Archiving Laboratory (SHAL)

There was one major quality issue in the SHAL during 2011. On Wednesday June 8, 2011, there was a power outage at RTI’s Sample Handling Laboratory. When power was restored, a power surge damaged the walk-in cooler where newly received packages from the field sites are stored prior to unpacking. The walk-in cooler was repaired within 18 hours, but packages inside the cooler reached a maximum temperature of 20°C (68°F) during this time. Although a deviation from RTI's normal procedures, there is likely to be little affect on the analytical results of the filters inside the cold room during the outage. This is due to the short duration of the temperature rise (relative to the sample collection/retrieval and normal assembly/disassembly periods) as well as the relatively low temperatures experienced (i.e., room temperature storage). All filters that were stored in the cooler at the time of the outage were assigned a new data qualifying flag of "RTS - Refrigeration Lost Prior to Analysis". This flag does not invalidate the data and the results were posted to AQS without any qualifier, unless a monitoring agency instructed RTI to add a flag as part of their regular data review process. A total of 127 events from sampling date of June 2, 2011 and 62 events from sampling date of June 5, 2011 were assigned the RTS data qualifying flag.

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.

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 19,004 Teflon filters for the $PM_{2.5}$ speciation program between January 1 and December 31, 2011. During the same time period, the laboratory performed final (post-sampling) weighings of 17,106 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 2011. 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 2011 in either this enhanced inspection or in the routine visual inspection in the chamber. Lot stability tests indicated the seven Teflon filter lots used for the program in 2011 did not have issues with debris or outgassing.

The laboratory's environmental chambers experienced little downtime due to system failure in 2011. The gear drive actuators for both the dehumidifier and chilled water were replaced for Chambers 1 and 2. The chilled water valve was replaced for both chambers, and both chambers had a fan motor replaced. RTI's Facilities and Maintenance HVAC team was able to complete much of this work within a timeframe that it either only caused a single day of downtime or none at all. There were no prolonged instances of chamber malfunction. When necessary, weighing was suspended pending repair and stabilization of the chamber environment.

During the course of 2011, 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 set points when the building conditions became unstable after the chilled water to the entire building was lost twice and a fuse was blown on the building's air compressor one time. RTI's Facilities and Maintenance HVAC team quickly responded to fix these issues. In all cases, weighing was suspended pending repair and stabilization of the chamber environment.

The gravimetric laboratory continues to monitor any instance of static electricity effects in the laboratory. The laboratory utilizes 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.

Working mass standards were removed from use during the year when due for re-verification date by the North Carolina Department of Agriculture and Consumer Services (NCDA&CS) Standards Laboratory. The laboratory maintains several sets of working mass standards and substituted verified standards when standards 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 2012 and August 2012.

3.1.2 Description of QC Checks Applied

Internal QC checks applied in the Gravimetric Laboratory are described in **Table 3-1**, 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 3-1**; however, a small number of outliers were noted. Three of the outlier laboratory blank weighings for two 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 reweigh 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 2011. 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 3-1. 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 04/27/11 Verification: 99.99891 mg ± 0.00094 Laboratory Tolerance Interval: 99.996 – 100.002 mg	Average = 99.997 mg Std Dev = 0.0009 for 734 weighings	Laboratory average falls within tolerance interval. Two individual weighings of 99.995 mg fell a µg below lower limit.
		100-mg S/N 58096 04/23/10 Verification: 100.00012 mg ± 0.00078 Laboratory Tolerance Interval: 99.997–100.003 mg	Average = 99.999 mg Std Dev = 0.0007 for 484 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval
		04/27/11 Verification: 99.99877 mg ± 0.00094 Laboratory Tolerance Interval: 99.997–100.003 mg	Average = 99.999 mg Std Dev = 0.0006 for 776 weighings	Laboratory average falls within tolerance interval. One individual weighings of 99.996 mg fell 1 µg below lower limit.
		100-mg S/N 41144 08/10/10 Verification: 99.9979 mg± 0.00078 Laboratory Tolerance Interval: 99.995–100.001 mg	Average = 99.998 mg Std Dev = 0.0006 for 515 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval
		100-mg S/N 14059 08/10/10 Verification: 99.98877 mg ± 0.00078 Laboratory Tolerance Interval: 99.986–99.992 mg	Average = 99.989 mg Std Dev = 0.0011 for 469 weighings	Laboratory average falls within tolerance interval. One individual weighings of 99.994 mg fell 2 µg above upper limit.
		200-mg S/N 41147 04/27/11 Verification: 200.00396 mg ± 0.00095 Laboratory Tolerance Interval: 200.001–200.07 mg	Average = 200.003 mg Std Dev = 0.0007 for 736 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		200-mg S/N 58098 04/23/10 Verification: 200.00291 mg ± 0.0008 Laboratory Tolerance Interval: 200.000-200.006 mg	Mean = 200.002 mg Std Dev = 0.0006 for 484 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
		04/27/11 Verification: 200.00287 mg ± 0.00095 Laboratory Tolerance Interval: 200.000-200.006 mg	Mean = 200.002 mg Std Dev = 0.0008 for 776 weighings	Laboratory average falls within tolerance interval. One individual weighing of 200.007 mg fell 1 µg above upper limit. One individual weighing of 200.008 mg fell 2 µg above upper limit.
		200-mg S/N 41148 08/10/10 Verification: 199.99919 mg ± 0.0008 Laboratory Tolerance Interval: 199.996-200.002 mg	Average = 200.000 mg Std Dev = 0.0007 for 634 weighings	Laboratory average falls within tolerance interval. One individual weighing of 200.005 mg fell 3 µg above upper limit.
		200-mg S/N 14056 08/10/10 Verification: 199.98948 mg ± 0.0008 Laboratory Tolerance Interval: 199.986-199.992 mg	Average = 199.989 mg Std Dev = 0.0015 for 300 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		Chamber 2 100-mg S/N 58097 04/23/10 Verification: 100.0001 mg ± 0.00078 Laboratory Tolerance Interval: 99.997–100.003 mg	Average = 99.999 mg Std Dev = 0.0008 for 346 weighings	Laboratory average falls within tolerance interval. One individual weighing of 99.996 mg fell 1 µg below lower limit.
		04/27/11 Verification: 99.99886 mg ± 0.00094 Laboratory Tolerance Interval: 99.996–100.002 mg	Average = 99.999 mg Std Dev = 0.0011 for 207 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		100-mg S/N RTI01 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 933 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		100-mg S/N 41143 04/27/11 Verification: 99.98791 mg ± 0.00094 Laboratory Tolerance Interval: 99.985 – 99.991 mg	Mean = 99.987 mg Std Dev = 0.0008 for 521 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		200-mg S/N 58099 04/23/10 Verification: 200.00314 mg ± 0.0008 Laboratory Tolerance	Mean = 200.003 mg Std Dev = 0.0010 for 344 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
		Interval: 199.999 – 200.006 mg		
		04/27/11 Verification: 200.00396 mg ± 0.00095 Laboratory Tolerance Interval: 200.000 – 200.006 mg	Mean = 200.003 mg Std Dev = 0.0013 for 207 weighings	Laboratory average falls within tolerance interval. One individual weighing of 199.999 mg fell 1 μg below lower limit. Two individual weighings of 199.998 mg fell 2 μg below lower limit.
		200-mg S/N 41146 04/27/11 Verification: 200.00146 mg ± 0.00095 Laboratory Tolerance Interval: 199.998 – 200.004 mg	Mean = 200.000 mg Std Dev = 0.0008 for 521 weighings	Laboratory average falls within tolerance interval. No weighing exceeded tolerance interval.
		200-mg S/N 18659 08/10/10 Verification: 199.97531mg ± 0.0008 Laboratory Tolerance Interval: 199.972 – 199.978 mg	Mean = 199.973 mg Std Dev = 0.0014 for 936 weighings	Laboratory average falls within tolerance interval. Four individual weighings of 199.971 mg fell 1 μg below lower limit.
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 July 31, 2011, using NIST-traceable weight	N/A	Next inspection and external calibration scheduled for July 2012
Balance audits	Annually	Audits of all balances performed by RTI Quality Systems Program personnel on November 16, 2011, 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 Bahnson Environmental Specialties on January 12, 2011 Chamber data loggers calibrated by Veriteq Data Logger Test and Calibration Services on August 12, 2011	N/A N/A	Chamber sensors, controllers, and process boards are calibrated on-site annually by Environmental Specialties Next calibration due August 2012
Laboratory (Filter) blanks	Initial weight ± 15 µg	2,034 total replicate weighings of 300 individual laboratory blanks	Average difference between final and initial weight = 1.2 µg Std Dev = 3.8 Min wt change = -19 µg Max wt change = 14 µg	3 total replicate weighings of 2 individual laboratory blank filters (0.1% of the replicate weighings; 0.7% of the individual laboratory blanks) exceeded the 15 µg criterion.
Replicates	Initial weight ± 15 µg	6,646 individual filters were weighed as pre-sampling (tared) replicates 2,164 individual filters were weighed as post-sampling replicates	Average = 0.3 µg Average = 0.18 µg	0 replicate weighings (0.0% of the weighings) exceeded the 15 µg criterion on the first pass. Outliers would be reweighed in order to confirm a mass value with two weights within 5 µg of each other. 0 replicate weighings (0.0% of the weighings) exceeded the 15 µg criterion. These outliers would be reweighed to confirm value with two weights within 5 µg of each other.

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 21271 (rec'd 8/6/2010)	24 hours = +1 µg 48 hours = -2 µg 72 hours = +1 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = -2 µg 72 hours = 0 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = -1 µg 72 hours = 0 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = +3 µg 72 hours = -1 µg	Weight changes fall within required range
			24 hours = +5 µg 48 hours = -1 µg 72 hours = -1 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = +1 µg 72 hours = 0 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +2 µg 72 hours = -2 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = +1 µg 72 hours = 0 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = +2 µg 72 hours = +2 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = 0 µg 72 hours = 0 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +1 µg 72 hours = +1 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = -2 µg 72 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 26595 (rec'd 9/3/2010)	24 hours = -3 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 = -1 µg 72 hours = +2 µg 96 hours = -2 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = -2 µg 72 hours = 0 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = 0 µg 72 hours = +1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = 0 µg 72 hours = +1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = 0 µg 72 hours = -1 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = 0 µg 72 hours = 0 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = -7 µg 48 hours = +1 µg 72 hours = +2 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = -4 µg 48 hours = +3 µg 72 hours = +3 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = 0 µg 72 hours = 0 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = -1 µg 72 hours = +2 µg 96 hours = -4 µg	Weight changes fall within required range
			24 hours = -3 µg 48 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 31523 (rec'd 8/6/2010)	72 hours = +3 µg 96 hours = -3 µg 24 hours = +1 µg 48 hours = -2 µg 72 hours = 0 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = 0 µg 72 hours = 0 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = -1 µg 72 hours = +1 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = +1 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 = -3 µg 72 hours = 0 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = 0 µg 72 hours = 0 µg 96 hours = +1 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 = +2 µg 48 hours = -1 µg 72 hours = 0 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 = 0 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = -4 µg 72 hours = +2 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 = +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 32779 (rec'd 8/6/2010)	24 hours = 0 µg 48 hours = 0 µg 72 hours = -3 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = 0 µg 72 hours = +2 µg 96 hours = -2 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 = +2 µg 72 hours = 0 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 = -1 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = +2 µg 72 hours = +3 µg 96 hours = -3 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = +1 µg 72 hours = +1 µg 96 hours = -2 µg	Weight changes fall within required range
			24 hours = +3 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 = -1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = -1 µg 72 hours = +1 µg 96 hours = 0 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 = +1 µg 48 hours = +2 µg 72 hours = 0 µg	Weight changes fall within required range

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
			96 hours = -1 µg	
			24 hours = -3 µg 48 hours = +1 µg 72 hours = 0 µg 96 hours = +1 µg	Weight changes fall within required range
Lot blanks (Lot stability filters) (cont'd)	The filters are weighed until a 24-hour weight change < ± 5 µg is demonstrated.	Whatman Lot 36986 (rec'd 9/28/2010)	24 hours = -1 µg 48 hours = 0 µg 72 hours = +3 µg 96 hours = -4 µg	Weight changes fall within required range
			24 hours = -4 µg 48 hours = -1 µg 72 hours = 0 µg 96 hours = +5 µg	Weight changes fall within required range
			24 hours = -6 µg 48 hours = -1 µg 72 hours = +1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = -4 µg 48 hours = +4 µg 72 hours = -4 µg 96 hours = +6 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +3 µg 72 hours = 0 µg 96 hours = -1 µg	Weight changes fall within required range
			24 hours = -1 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 = +2 µg 72 hours = -5 µg 96 hours = +3 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = -1 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 = -7 µg 96 hours = +1 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 = 0 µg	Weight changes fall

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
			48 hours = +4 µg 72 hours = -2 µg 96 hours = +2 µg	within required range
			24 hours = 0 µg 48 hours = -1 µg 72 hours = +3 µg 96 hours = +1 µg	Weight changes fall within required range
Lot blanks (Lot stability filters) (cont'd)	The filters are weighed until a 24-hour weight change < ± 5 µg is demonstrated.	Whatman Lot 37321 (rec'd 9/28/2010)	24 hours = +2 µg 48 hours = 0 µg 72 hours = +1 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = +4 µg 48 hours = +1 µg 72 hours = -2 µg 96 hours = +4 µg	Weight changes fall within required range
			24 hours = 0 µg 48 hours = +2 µg 72 hours = +2 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = +4 µg 48 hours = +1 µg 72 hours = 0 µg 96 hours = +1 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 = -1 µg 48 hours = 1 µg 72 hours = -1 µg 96 hours = +3 µg	Weight changes fall within required range
			24 hours = -1 µg 48 hours = +1 µg 72 hours = +1 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = +1 µg 48 hours = 0 µg 72 hours = +2 µg 96 hours = 0 µg	Weight changes fall within required range
			24 hours = +4 µg 48 hours = -2 µg 72 hours = -1 µg 96 hours = +3 µg	Weight changes fall within required range
			24 hours = +4 µg 48 hours = -2 µg 72 hours = +2 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
			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 = +1 µg 72 hours = +1 µg 96 hours = 0 µg	Weight changes fall within required range
Lot blanks (Lot stability filters) (cont'd)	The filters are weighed until a 24-hour weight change < ± 5 µg is demonstrated.	Whatman Lot 65098 (rec'd 10/20/2011)	24 hours = -3 µg 48 hours = +3 µg 72 hours = -2 µg 96 hours = +1 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = -4 µg 72 hours = +3 µg 96 hours = -3 µg	Weight changes fall within required range
			24 hours = -5 µg 48 hours = -3 µg 72 hours = +4 µg 96 hours = -3 µg	Weight changes fall within required range
			24 hours = -7 µg 48 hours = -2 µg 72 hours = +1 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = -3 µg 48 hours = -1 µg 72 hours = -2 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = -5 µg 72 hours = +3 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 = -3 µg 48 hours = +3 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 = -2 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = +2 µg 48 hours = -3 µg	Weight changes fall within required range

QC Check	Requirements	QC Checks Applied in RTI Laboratory	Average Value Determined by Lab	Comments
			72 hours = +4 µg 96 hours = -3 µg	
			24 hours = 0 µg 48 hours = -4 µg 72 hours = 0 µg 96 hours = +2 µg	Weight changes fall within required range
			24 hours = -2 µg 48 hours = -2 µg 72 hours = +2 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 3-2 contains information regarding audits, performance evaluations (PEs), training, and accreditations for the Gravimetric Laboratory.

3.2 Ions Analysis Laboratory

The Ion Analysis Laboratory used ten ion chromatographs to analyze 21,262 filter samples for cations (sodium, potassium, and ammonium) and 21,375 filter samples for anions (nitrate and sulfate). The analyses were performed for the CSN program during the period January 1 through December 31, 2011.

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 – Environmental Chemistry Department (EISD-ECD). Ten Dionex ion chromatographic systems were used for performance of the measurements and are summarized in **Table 3-3**. Distribution of samples among these ten instruments was determined by laboratory workload and instrument availability.

Table 3-2. Description of Audits, PEs, Training, and Accreditations

Type of Evaluation	Date	Administered By	Significant Findings/Comments
Internal Audit	January 26, 2011	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)	March 16, 2011 (results finalized)	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 2010-2011. 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.
	December 2011		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 2012 and results are expected 2012.
Accreditation	Certificate issued July 1, 2011	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).

Table 3-3. 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
A8	ICS-3000	SO_4, NO_3
A9	ICS-3000	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
C6	ICS-3000	Na, NH_4, K

QA/QC checks for ion analyses are summarized in **Table 3-4**. 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.

Table 3-4. Ion Analysis of PM2.5 Quality Control/ Quality Assurance Checks

QA/QC Check	Frequency	Requirements
Calibration Regression Parameters	Daily	r $\geq$0.999
Initial QA/QC Checks:		
▪ RTI prepared QC sample at mid- to high-range concentration	Daily, immediately after calibration	Measured concentrations within 10% of known values
▪ RTI prepared QC sample at lower-end concentration	Daily, immediately after calibration	Measured concentrations within 10% of known values
▪ Commercially prepared, NIST- traceable QA sample	Daily, immediately after calibration	Measured concentrations within 10% of known values
Periodic QA/QC Checks:		
▪ Replicate sample †	Every 20 samples	RPD = 5% at 100x MDL* RPD = 10% at 10x MDL* RPD = 100% at MDL*
▪ QA/QC sample	Every 20 samples	Measured concentrations within 10% of known values
▪ Matrix spiked sample extract	Every 20 samples	Recoveries within 90 to 100% of target values
▪ Duplicates ‡	At least one per day	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.

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.

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 3-5**. The observed value for any ion being measured must be within 10% of the known value for the QA/QC samples (**Table 3-6**), 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 3-5. 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
A8	0.109	0.159	na	na	na
A9	0.086	0.343	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
C6	na	na	0.063	0.029	0.066

* In µg/filter

Table 3-6. 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 3-7 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 3-7. Average Percent Recovery for QA and QC Samples

Analyte	Sample ID	Count	Conc. µg/mL	Avg % Rec *	SD	Min	Max
Nitrate	QA-CPI_LOW	296	0.6	96.2%	3.0%	0.520	0.700
	QA-CPI_MED-HI	306	3.0	99.3%	2.4%	2.815	3.270
	RTI-QC-HIGH	307	6.0	101.2%	1.6%	5.634	6.338
	RTI-QC-LOW	476	0.6	97.5%	2.5%	0.527	0.693
	RTI-QC-MED	589	1.5	98.1%	1.9%	1.351	1.631
Sulfate	QA-CPI_LOW	296	1.2	97.6%	1.9%	1.081	1.292
	QA-CPI_MED-HI	306	6.0	100.6%	1.9%	5.752	6.494
	RTI-QC-HIGH	307	12.0	101.4%	1.3%	11.451	12.722
	RTI-QC-LOW	476	1.2	98.6%	1.8%	1.083	1.311
	RTI-QC-MED	589	3.0	99.5%	1.5%	2.820	3.290
Sodium	GFS 0.4 PPM QA	658	0.4	100.0%	1.6%	0.381	0.454
	GFS 4.0 PPM QA	615	4.0	99.7%	1.3%	3.745	4.426
	RTI 2.0 PPM QC Reg Std	421	2.0	99.7%	1.4%	1.884	2.241
	RTI 5.0 PPM QC	387	5.0	100.3%	1.3%	4.705	5.446
Ammonium	GFS 0.4 PPM QA	658	0.4	100.7%	2.7%	0.357	0.456
	GFS 4.0 PPM QA	615	4.0	99.9%	1.6%	3.666	4.326
	RTI 2.0 PPM QC Reg Std	421	2.0	99.1%	1.5%	1.858	2.171
	RTI 5.0 PPM QC	387	5.0	100.3%	1.8%	4.459	5.386
Potassium	GFS 0.4 PPM QA	658	0.4	99.1%	1.8%	0.375	0.462
	GFS 4.0 PPM QA	615	4.0	100.0%	1.3%	3.707	4.465
	RTI 2.0 PPM QC Reg Std	421	2.0	99.8%	1.4%	1.881	2.257
	RTI 5.0 PPM QC	387	5.0	100.2%	1.4%	4.659	5.467

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

Average recoveries for the QC samples ranged from 97.5 to 101.4% for the year. Average recoveries for the QA samples ranged from 96.2 to 100.7% for the year.

Table 3-8 shows percent recovery for all analyte spikes for the year. Average recoveries for the spikes ranged from 100.4 to 100.9%.

Table 3-8. Average Percent Recovery for Spikes

Analyte	Avg Recovery *	StDev	Count	Min	Max
Nitrate	100.9%	2.1%	683	83.1%	117.0%
Sulfate	100.8%	1.4%	683	96.0%	108.1%
Sodium	100.4%	1.5%	692	91.0%	109.3%
Ammonium	100.5%	1.6%	692	93.6%	107.7%
Potassium	100.5%	1.6%	692	92.2%	109.9%

* Acceptance criteria for average percent recovery is ± 10%

Table 3-9 presents filter blank (NQC BLANK) and reagent blank statistics for all analytes over the 12-month period.

Table 3-9. Filter Blank (NQC) and Reagent Blank Values (ppm) for all Analytes

Analyte	Type	Count	Avg	StDev	Min	Max
Nitrate	Reagent	707	0.006	0.009	-0.016	0.040
	NQC	419	0.007	0.009	-0.006	0.038
Sulfate	Reagent	707	0.006	0.006	-0.018	0.035
	NQC	419	0.006	0.006	0.000	0.036
Sodium	Reagent	721	0.000	0.002	0.000	0.040
	NQC	81	0.000	0.002	0.000	0.015
Ammonium	Reagent	721	0.000	0.000	0.000	0.005
	NQC	81	0.000	0.000	0.000	0.000
Potassium	Reagent	721	0.000	0.002	0.000	0.029
	NQC	81	0.001	0.004	0.000	0.031

* 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 3-10 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 3-10. Between-instrument Comparability: IC Systems A4 vs. A8 and C2 vs. C6

Analyte	QA/QC Type	Conc., ppm	Count	Average * Difference	Standard Deviation of Diff.	Minimum Diff.	Maximum Diff.
Nitrate	QA-CPI_LOW	1.2	11	-0.002	0.007	-0.009	0.013
	QA-CPI_MED-HI	6.0	22	-0.010	0.032	-0.127	0.028
	RTI-QC-HIGH	12.0	24	0.050	0.097	-0.141	0.426
	RTI-QC-LOW	1.2	47	-0.007	0.012	-0.047	0.014
	RTI-QC-MED	3.0	74	-0.013	0.021	-0.097	0.023
Sulfate	QA-CPI_LOW	1.2	11	-0.010	0.015	-0.033	0.014
	QA-CPI_MED-HI	6.0	22	0.023	0.042	-0.059	0.088
	RTI-QC-HIGH	12.0	24	0.061	0.194	-0.130	0.815
	RTI-QC-LOW	1.2	47	-0.011	0.014	-0.045	0.016
	RTI-QC-MED	3.0	74	-0.001	0.034	-0.162	0.049
Sodium	GFS 0.4 PPM QA	0.4	142	0.003	0.006	-0.022	0.016
	GFS 4.0 PPM QA	4.0	76	-0.044	0.059	-0.282	0.034
	RTI 2.0 PPM QC	2.0	55	-0.014	0.026	-0.114	0.029
	RTI 5.0 PPM QC	5.0	52	-0.059	0.067	-0.304	0.033
Ammonium	GFS 0.4 PPM QA	0.4	142	0.002	0.011	-0.032	0.023
	GFS 4.0 PPM QA	4.0	76	-0.052	0.064	-0.266	0.130
	RTI 2.0 PPM QC	2.0	55	-0.010	0.032	-0.143	0.033
	RTI 5.0 PPM QC	5.0	52	-0.068	0.055	-0.270	0.018
Potassium	GFS 0.4 PPM QA	0.4	142	0.003	0.007	-0.021	0.022
	GFS 4.0 PPM QA	4.0	76	-0.063	0.074	-0.345	0.032
	RTI 2.0 PPM QC	2.0	55	-0.018	0.029	-0.134	0.017
	RTI 5.0 PPM QC	5.0	52	-0.077	0.089	-0.372	0.032

* Differences are calculated as Concentration of A4 – Concentration of A8 for Anions and Concentration of C2 – Concentration of C6 for Cations.

3.2.5 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.

3.2.6 Audits, Performance Evaluations, Training, and Accreditations

In January 2011, the IC laboratory participated in NAREL's 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. During 2011 a small number of CSN/TOT samples were analyzed by RTI for two sites that still used the MetOne sampler instead of the URG 3000N sampler.

The RTI OC/EC Laboratory staff analyzed and reported 164 quartz filter aliquots by the STN or CSN/TOT method for the CSN contract during the period January 1, 2011 through December 31, 2011. **Table 3-11** lists the CSN sites that ran the CSN/TOT method during 2011. The balance of samples was 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 2011. The oven was changed on analyzers R and T in October of 2011. No significant modifications to analyzer F were performed during 2011.

Table 3-11. CSN Sites with Filters Analyzed by the CSN/TOT Method During 2011.

Site - POC	Last Sampling Month for CSN/TOT Method	Comment
Kingston - 5	End of 2011.	EPA Special Study - non-CSN
Newark - 5	January 2012.	URG 3000N to be installed in January 2012

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 3-12**.

Table 3-13 contains a list of all data flags assigned to carbon analysis data and the number of filter analysis results with the assigned flags in the OC/EC Laboratory during the reporting period. Only flags assigned in OC/EC Laboratory data reports submitted 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.

3.3.3 Summary of QC Results

3.3.3.1 Instrument Blanks

Table 3-14 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 2011.

For all reported data, the last instrument blank run before reported samples were analyzed 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.

Table 3-12. 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 3-13. OC/EC Laboratory-Assigned Data Flags

Flag	Description	Number of Filters
LFU	Filter inspection flag - non-uniformity (Duplicate analysis failed applicable duplicate criterion.)	1
Total Number of Analyses Flagged by OC/EC Analysts		1
Total Number of OC/EC Analyses Reported to SPIMS		164
Percent of OC/EC Analyses Flagged by Analysts		0.6%

Table 3-14. OC/EC Instrument Blank Statistics

Statistic	R	T	F
Number of Instrument Blanks	98	80	12
Mean Response (µg C/cm^2)	0.0074	-0.0228	0.0919
Standard Deviation	0.0084	0.0843	0.0394
Minimum Response (µg C/cm^2)	0.0000	-0.3731	0.0172
Maximum Response (µg C/cm^2)	0.0449	0.2964	0.1425

3.3.3.2 Calibrations

Table 3-15 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 3-15. OC/EC Three-Point Calibration Counts

Variable or Statistic	R	T	F
Number of Three-point Calibrations Passing All Criteria during 2011 (typically performed weekly)	48	36	6
Number of Full Calibrations Failing Any Criterion during 2011	0	0	0

Table 3-16 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 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)	49	32	5
Number of Cal Checks Failing Any Criterion during 2011	0	0	0

3.3.3.3 Duplicate Analyses

A duplicate analysis was run on the same analyzer on about every 10th filter. During 2011, one CSN filter failed the duplicates test on analyzer R, none on analyzer T or F. This was responsible for the single LFU flag shown in Table 3-13.

3.3.3.4 Assessment of Between-Instrument Comparability

Because of the small number of CSN filters run during 2011, 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 2011. 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 3-17 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 2010 Annual Report for more information.

Table 3-17. 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 3-18 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 3-18. 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.

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[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 3-18. Target MDLs for OC/EC Carbon Fractions

Carbon Fraction	Target MDL ($\mu gC/cm^2$)
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 2011. 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 2011. RTI's results were generally comparable to those from other laboratories receiving PE samples. A discrepancy was noted in duplicate filter analysis results between two RTI analyzers. This discrepancy was diagnosed in early 2012 by the OC/EC laboratory manager. 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 2011.

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 17,716 quartz-fiber filters in batches 115 through 138 during the period December 28, 2010 through December 31, 2011. (Batch numbers refer to sets of quartz filters sent from RTI to DRI twice per month.) However, three filter holders were empty, so a total of 17,713 filters were actually analyzed. DRI performed 21,496 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. 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 17,716 filters sent from RTI in barcoded petrislides, the ID labels for 130 samples (approximately 0.73%) could not be read by DRI's automated barcode reader. DRI was entered these ID numbers manually.

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 3-19.** It specifies the frequency and standards required for the specified checks, along with the acceptance criteria and corrective actions.

Table 3-20 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 21,496 runs, there were 1,601 runs flagged as invalid. In addition, 4,037 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 16, 2012. 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 2012, after all the 2011 data had been processed and validated.

There were 2,182 runs with replicate (or duplicate) flags. In many cases, there was more than one flag for a sample run. The flag category "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.

Table 3-19. 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.
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.	Void 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, EC, TC ≥10 µg C/cm^2 or <±1 µg/cm^2 when OC, EC, TC <10 µg C/cm^2	Investigate instrument and sample anomalies and rerun replicate when difference > ±10%.
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 with 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.	Replace the He cylinder and/or O_2 scrubber.

Table 3-20. DRI Carbon Laboratory-Assigned Data Flags

Validation Flag Category	Validation Flag Subcategory	Description	No. of Sample Runs
n		Foreign substance on sample	0
s		Suspect analysis result	12
v		Void (invalid) analysis result	1601
	v2	Replicate analysis failed acceptable limit	143
	v3	Potential contamination	19
	v5	Analytical instrument error	1369
	v6	Analyst error	34
	v7	Software malfunction	35
		Total no. of sample runs (incl. blank and replicate flags)	21496

3.4.3 Summary of QC Results

3.4.3.1 Blanks

Tables 3-21 and **3-22** contain the number of instrument laboratory 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 3-21** gives the laboratory blank values by month for all eleven analyzers and **Table 3-22** gives the system blank values for each of the eleven carbon analyzers used during this reporting period.

Laboratory 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/cm^2 of TC. However, they are also run to check instrument performance after repairs and adjustments. In addition, laboratory system blanks are assigned to the instrument and not to the project. The data in **Tables 3-21** and **3-22** include all reported laboratory 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. DRI now uses the term “system” blank for a run that is made without a filter punch in the analyzer and “laboratory system blank” for a run with a “clean” punch in the analyzer. DRI is in the process of further distinguishing laboratory system blanks from maintenance blanks.

Tables 3-23 through **3-26** 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 was only one trip blank backup filter, so there is no separate table showing the analysis results by analyzer. SHAL blanks are pre-fired filters that have never been sent to the field, and which are

Table 3-21. DRI Carbon Laboratory System Blank Statistics for All Analyzers by Month

			IMPROVE_A Parameter (units are µg C/cm^2)													
Month	No.*	Statistic*	O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
Dec/Jan	269	Mean	0.000	0.002	0.006	0.000	0.001	0.001	0.009	0.009	0.000	0.000	0.002	0.001	0.001	0.010
		StdDev	0.003	0.008	0.017	0.002	0.005	0.009	0.025	0.026	0.001	0.001	0.010	0.008	0.004	0.027
		Max	0.038	0.069	0.114	0.014	0.071	0.113	0.158	0.157	0.018	0.014	0.113	0.113	0.039	0.158
		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
Feb	142	Mean	0.000	0.001	0.002	0.000	0.000	0.001	0.003	0.004	0.000	0.000	0.002	0.003	0.002	0.006
		StdDev	0.001	0.005	0.008	0.001	0.000	0.004	0.012	0.012	0.001	0.001	0.017	0.017	0.017	0.021
		Max	0.009	0.053	0.062	0.009	0.000	0.031	0.095	0.095	0.012	0.010	0.198	0.199	0.199	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
Mar	223	Mean	0.000	0.001	0.005	0.000	0.000	0.001	0.007	0.008	0.000	0.000	0.001	0.002	0.001	0.009
		StdDev	0.001	0.004	0.016	0.002	0.001	0.013	0.018	0.022	0.001	0.004	0.010	0.013	0.006	0.022
		Max	0.012	0.025	0.153	0.021	0.014	0.188	0.153	0.189	0.014	0.062	0.126	0.174	0.084	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	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Apr	220	Mean	0.000	0.002	0.010	0.000	0.000	0.001	0.013	0.014	0.000	0.000	0.002	0.002	0.001	0.015
		StdDev	0.003	0.008	0.024	0.001	0.001	0.008	0.030	0.031	0.001	0.003	0.011	0.012	0.008	0.031
		Max	0.043	0.070	0.126	0.012	0.009	0.096	0.175	0.175	0.014	0.033	0.096	0.096	0.096	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	0.000
May	225	Mean	0.000	0.002	0.007	0.001	0.000	0.001	0.010	0.011	0.000	0.001	0.002	0.003	0.002	0.013
		StdDev	0.002	0.007	0.019	0.004	0.003	0.007	0.026	0.027	0.003	0.008	0.011	0.015	0.014	0.031
		Max	0.019	0.065	0.145	0.048	0.043	0.065	0.199	0.199	0.043	0.116	0.117	0.141	0.141	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
Jun	200	Mean	0.001	0.003	0.012	0.000	0.000	0.002	0.017	0.018	0.000	0.000	0.003	0.003	0.001	0.019
		StdDev	0.008	0.010	0.023	0.002	0.005	0.015	0.031	0.035	0.001	0.004	0.014	0.016	0.005	0.036
		Max	0.108	0.082	0.125	0.020	0.064	0.175	0.171	0.178	0.008	0.051	0.123	0.175	0.049	0.192
		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
Jul	261	Mean	0.001	0.003	0.012	0.000	0.000	0.002	0.017	0.018	0.000	0.000	0.003	0.003	0.001	0.019
		StdDev	0.008	0.010	0.023	0.002	0.005	0.015	0.031	0.035	0.001	0.004	0.014	0.016	0.005	0.036
		Max	0.108	0.082	0.125	0.020	0.064	0.175	0.171	0.178	0.008	0.051	0.123	0.175	0.049	0.192
		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
Aug	187	Mean	0.001	0.005	0.021	0.001	0.000	0.003	0.028	0.030	0.000	0.001	0.002	0.003	0.001	0.031
		StdDev	0.005	0.013	0.032	0.003	0.000	0.015	0.044	0.045	0.000	0.007	0.014	0.015	0.002	0.045
		Max	0.063	0.068	0.129	0.025	0.003	0.143	0.189	0.189	0.002	0.087	0.147	0.147	0.023	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	0.000	0.000	0.000	0.000	0.002	0.004	0.000	0.000	0.000	0.000	0.000	0.005
Sep	198	Mean	0.000	0.004	0.017	0.001	0.000	0.002	0.022	0.025	0.000	0.000	0.002	0.003	0.001	0.025
		StdDev	0.002	0.013	0.030	0.006	0.000	0.014	0.040	0.042	0.002	0.002	0.013	0.014	0.003	0.043
		Max	0.025	0.085	0.151	0.065	0.002	0.150	0.187	0.187	0.015	0.019	0.131	0.150	0.027	0.187
		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	0.002	0.000	0.000	0.000	0.000	0.000	0.002
Oct	268	Mean	0.000	0.004	0.016	0.000	0.000	0.001	0.020	0.021	0.000	0.000	0.001	0.001	0.001	0.022
		StdDev	0.002	0.010	0.023	0.002	0.002	0.004	0.030	0.031	0.000	0.001	0.007	0.007	0.005	0.031
		Max	0.023	0.070	0.190	0.017	0.035	0.044	0.194	0.194	0.002	0.008	0.085	0.085	0.070	0.194
		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	0.004	0.006	0.000	0.000	0.000	0.000	0.000	0.007
Nov	184	Mean	0.000	0.003	0.012	0.001	0.000	0.002	0.016	0.018	0.000	0.000	0.003	0.004	0.002	0.020
		StdDev	0.001	0.010	0.026	0.004	0.003	0.014	0.036	0.039	0.003	0.003	0.017	0.019	0.013	0.040
		Max	0.007	0.072	0.151	0.034	0.043	0.120	0.192	0.192	0.043	0.043	0.163	0.164	0.164	0.192
		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
Dec	69	Mean	0.000	0.004	0.018	0.000	0.000	0.000	0.022	0.023	0.000	0.000	0.003	0.003	0.003	0.026
		StdDev	0.001	0.013	0.026	0.002	0.000	0.002	0.034	0.033	0.002	0.001	0.020	0.020	0.020	0.037
		Max	0.010	0.071	0.097	0.014	0.000	0.015	0.163	0.163	0.013	0.003	0.165	0.167	0.167	0.167
		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	0.002	0.000	0.000	0.000	0.004	0.009	0.000	0.000	0.000	0.000	0.000	0.012
2011	2446	Mean	0.000	0.003	0.011	0.000	0.000	0.001	0.014	0.015	0.000	0.000	0.002	0.002	0.001	0.017
		StdDev	0.003	0.009	0.023	0.003	0.004	0.010	0.031	0.032	0.002	0.004	0.013	0.014	0.010	0.034
		Max	0.108	0.088	0.190	0.065	0.131	0.188	0.200	0.199	0.043	0.116	0.198	0.199	0.199	0.200
		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

* Excludes replicates

Table 3-22. DRI Carbon Laboratory System Blank Statistics for Each Analyzer

Analyzer No.	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
6	242	Mean	0.000	0.002	0.012	0.001	0.001	0.002	0.017	0.017	0.000	0.001	0.003	0.003	0.003	0.020
		StdDev	0.001	0.007	0.023	0.003	0.011	0.010	0.031	0.032	0.001	0.004	0.013	0.013	0.012	0.035
		Max	0.009	0.055	0.131	0.034	0.131	0.120	0.160	0.177	0.008	0.043	0.107	0.120	0.131	0.192
		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	0.003	0.000	0.000	0.000	0.000	0.000	0.005
7	192	Mean	0.002	0.005	0.014	0.001	0.000	0.001	0.021	0.022	0.000	0.001	0.003	0.003	0.002	0.024
		StdDev	0.009	0.013	0.029	0.004	0.005	0.008	0.042	0.042	0.000	0.008	0.014	0.016	0.015	0.045
		Max	0.108	0.068	0.137	0.034	0.071	0.089	0.192	0.192	0.006	0.116	0.117	0.141	0.141	0.192
		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
8	251	Mean	0.000	0.002	0.010	0.000	0.000	0.001	0.013	0.014	0.000	0.000	0.003	0.004	0.002	0.016
		StdDev	0.001	0.007	0.022	0.002	0.000	0.009	0.026	0.028	0.001	0.001	0.019	0.019	0.017	0.032
		Max	0.015	0.058	0.153	0.024	0.000	0.143	0.170	0.170	0.014	0.014	0.198	0.199	0.199	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	0.001
9	256	Mean	0.000	0.000	0.011	0.000	0.000	0.000	0.012	0.012	0.000	0.000	0.001	0.001	0.001	0.013
		StdDev	0.000	0.002	0.025	0.001	0.000	0.004	0.025	0.026	0.000	0.000	0.006	0.006	0.005	0.026
		Max	0.007	0.019	0.151	0.012	0.003	0.050	0.151	0.151	0.000	0.004	0.066	0.066	0.066	0.151
		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	251	Mean	0.000	0.002	0.008	0.000	0.000	0.002	0.011	0.012	0.000	0.001	0.002	0.003	0.001	0.013
		StdDev	0.002	0.008	0.022	0.001	0.000	0.014	0.027	0.030	0.001	0.004	0.012	0.014	0.004	0.031
		Max	0.023	0.070	0.190	0.012	0.004	0.175	0.194	0.194	0.008	0.051	0.123	0.175	0.057	0.194
		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	229	Mean	0.000	0.001	0.008	0.000	0.000	0.001	0.010	0.010	0.000	0.000	0.001	0.001	0.000	0.011
		StdDev	0.002	0.007	0.020	0.001	0.002	0.005	0.024	0.025	0.000	0.001	0.007	0.006	0.003	0.025
		Max	0.038	0.071	0.120	0.011	0.033	0.070	0.149	0.149	0.003	0.008	0.071	0.070	0.039	0.149
		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	231	Mean	0.001	0.003	0.013	0.001	0.000	0.001	0.019	0.020	0.001	0.001	0.001	0.001	0.000	0.020
		StdDev	0.004	0.009	0.025	0.004	0.003	0.006	0.035	0.035	0.004	0.003	0.003	0.005	0.002	0.036
		Max	0.034	0.054	0.145	0.048	0.043	0.065	0.199	0.199	0.043	0.033	0.036	0.044	0.014	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	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.004
13	258	Mean	0.000	0.001	0.007	0.000	0.000	0.001	0.009	0.010	0.000	0.000	0.001	0.001	0.000	0.010
		StdDev	0.001	0.007	0.018	0.001	0.000	0.007	0.023	0.024	0.001	0.001	0.007	0.007	0.001	0.024
		Max	0.010	0.065	0.095	0.014	0.003	0.075	0.163	0.163	0.008	0.010	0.075	0.075	0.011	0.163
		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
16	236	Mean	0.000	0.006	0.014	0.001	0.000	0.004	0.021	0.025	0.000	0.001	0.004	0.005	0.001	0.026
		StdDev	0.003	0.015	0.024	0.005	0.002	0.021	0.038	0.042	0.001	0.007	0.020	0.023	0.011	0.043
		Max	0.043	0.088	0.101	0.065	0.022	0.188	0.200	0.190	0.015	0.087	0.163	0.174	0.164	0.200
		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	0.002	0.000	0.000	0.000	0.000	0.000	0.003
18	62	Mean	0.000	0.003	0.007	0.001	0.001	0.001	0.013	0.013	0.001	0.001	0.001	0.001	0.001	0.014
		StdDev	0.002	0.012	0.015	0.003	0.004	0.003	0.029	0.027	0.003	0.002	0.003	0.004	0.005	0.029
		Max	0.014	0.069	0.061	0.021	0.028	0.016	0.158	0.142	0.018	0.014	0.024	0.024	0.024	0.158
		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
19	238	Mean	0.000	0.003	0.010	0.000	0.000	0.001	0.014	0.015	0.000	0.000	0.002	0.002	0.002	0.016
		StdDev	0.001	0.011	0.023	0.004	0.005	0.008	0.032	0.033	0.003	0.001	0.016	0.016	0.014	0.036
		Max	0.008	0.072	0.170	0.051	0.064	0.104	0.192	0.192	0.043	0.020	0.185	0.185	0.185	0.192
		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
All	2446	Mean	0.000	0.003	0.011	0.000	0.000	0.001	0.014	0.015	0.000	0.000	0.002	0.002	0.001	0.017
		StdDev	0.003	0.009	0.023	0.003	0.004	0.010	0.031	0.032	0.002	0.004	0.013	0.014	0.010	0.034
		Max	0.108	0.088	0.190	0.065	0.131	0.188	0.200	0.199	0.043	0.116	0.198	0.199	0.199	0.200
		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

* Excludes replicates

Table 3-23. DRI Carbon Analysis Statistics for 24-Hour Field Blanks

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	164	Mean	0.109	0.434	0.642	0.073	0.003	0.010	1.261	1.268	0.012	0.006	0.001	0.016	0.009	1.277
		StdDev	0.163	0.208	0.667	0.178	0.023	0.048	1.009	1.037	0.052	0.016	0.003	0.047	0.024	1.045
		Max	1.805	2.105	6.991	1.573	0.264	0.428	9.657	9.822	0.428	0.090	0.027	0.316	0.168	9.837
		Min	0.000	0.138	0.241	0.000	0.000	0.000	0.472	0.472	0.000	0.000	0.000	0.000	0.000	0.472
		Median	0.095	0.390	0.517	0.035	0.000	0.000	1.078	1.074	0.000	0.000	0.000	0.000	0.000	1.078
7	76	Mean	0.147	0.422	0.669	0.064	0.000	0.005	1.302	1.307	0.008	0.003	0.000	0.012	0.007	1.314
		StdDev	0.108	0.179	0.424	0.112	0.000	0.022	0.665	0.678	0.026	0.010	0.001	0.029	0.016	0.682
		Max	0.524	0.925	2.733	0.730	0.000	0.157	4.623	4.781	0.161	0.053	0.009	0.161	0.066	4.784
		Min	0.000	0.101	0.171	0.000	0.000	0.000	0.342	0.342	0.000	0.000	0.000	0.000	0.000	0.342
		Median	0.131	0.414	0.558	0.030	0.000	0.000	1.157	1.157	0.000	0.000	0.000	0.000	0.000	1.176
8	167	Mean	0.144	0.348	0.604	0.061	0.000	0.008	1.157	1.165	0.012	0.005	0.000	0.017	0.010	1.174
		StdDev	0.175	0.159	0.360	0.117	0.002	0.031	0.648	0.672	0.045	0.021	0.001	0.054	0.041	0.686
		Max	1.700	1.331	3.287	0.905	0.029	0.216	5.016	5.198	0.344	0.134	0.014	0.344	0.329	5.230
		Min	0.000	0.082	0.276	0.000	0.000	0.000	0.442	0.442	0.000	0.000	0.000	0.000	0.000	0.442
		Median	0.131	0.319	0.511	0.030	0.000	0.000	1.009	1.009	0.000	0.000	0.000	0.000	0.000	1.014
9	165	Mean	0.060	0.409	0.744	0.091	0.007	0.010	1.311	1.314	0.014	0.003	0.000	0.010	0.007	1.321
		StdDev	0.073	0.187	0.866	0.217	0.053	0.072	1.224	1.243	0.076	0.011	0.001	0.034	0.022	1.251
		Max	0.278	1.082	9.308	1.772	0.551	0.728	12.543	12.664	0.728	0.096	0.009	0.241	0.202	12.714
		Min	0.000	0.075	0.148	0.000	0.000	0.000	0.223	0.223	0.000	0.000	0.000	0.000	0.000	0.223
		Median	0.025	0.373	0.599	0.051	0.000	0.000	1.145	1.145	0.000	0.000	0.000	0.000	0.000	1.147
10	147	Mean	0.103	0.365	0.574	0.064	0.004	0.014	1.110	1.120	0.013	0.004	0.000	0.013	0.003	1.123
		StdDev	0.077	0.154	0.422	0.133	0.031	0.051	0.695	0.714	0.041	0.014	0.002	0.035	0.016	0.717
		Max	0.330	0.827	3.336	1.005	0.306	0.426	5.270	5.355	0.322	0.103	0.013	0.169	0.169	5.355
		Min	0.000	0.007	0.099	0.000	0.000	0.000	0.178	0.178	0.000	0.000	0.000	0.000	0.000	0.178
		Median	0.101	0.348	0.488	0.024	0.000	0.000	0.964	0.964	0.000	0.000	0.000	0.000	0.000	0.964
11	120	Mean	0.046	0.360	0.565	0.068	0.009	0.017	1.048	1.056	0.020	0.004	0.000	0.015	0.007	1.063
		StdDev	0.068	0.208	0.481	0.152	0.071	0.112	0.827	0.849	0.131	0.028	0.000	0.087	0.047	0.882
		Max	0.483	1.422	4.547	1.066	0.756	1.193	6.673	6.663	1.374	0.277	0.003	0.895	0.458	6.862
		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	0.013	0.331	0.465	0.015	0.000	0.000	0.864	0.864	0.000	0.000	0.000	0.000	0.000	0.864
12	148	Mean	0.136	0.432	0.683	0.089	0.003	0.018	1.344	1.359	0.016	0.006	0.000	0.019	0.005	1.363
		StdDev	0.108	0.237	0.435	0.143	0.016	0.047	0.746	0.770	0.041	0.018	0.002	0.046	0.021	0.773
		Max	0.433	2.042	3.519	1.033	0.133	0.307	5.277	5.292	0.302	0.107	0.017	0.307	0.246	5.299
		Min	0.000	0.000	0.177	0.000	0.000	0.000	0.187	0.189	0.000	0.000	0.000	0.000	0.000	0.189
		Median	0.126	0.380	0.570	0.045	0.000	0.000	1.171	1.172	0.000	0.000	0.000	0.000	0.000	1.172
13	177	Mean	0.081	0.383	0.733	0.077	0.005	0.022	1.278	1.296	0.018	0.004	0.000	0.018	0.001	1.296
		StdDev	0.108	0.168	0.531	0.160	0.029	0.086	0.804	0.838	0.067	0.030	0.001	0.076	0.007	0.838
		Max	0.671	1.287	3.918	1.174	0.287	0.745	5.845	6.221	0.447	0.365	0.009	0.745	0.083	6.221
		Min	0.000	0.062	0.219	0.000	0.000	0.000	0.413	0.413	0.000	0.000	0.000	0.000	0.000	0.413
		Median	0.026	0.350	0.605	0.025	0.000	0.000	1.101	1.101	0.000	0.000	0.000	0.000	0.000	1.101
16	158	Mean	0.121	0.427	0.632	0.085	0.002	0.021	1.267	1.286	0.021	0.007	0.000	0.026	0.007	1.294
		StdDev	0.100	0.176	0.511	0.139	0.022	0.059	0.782	0.804	0.058	0.019	0.002	0.060	0.026	0.811
		Max	0.382	1.120	5.913	1.271	0.273	0.396	8.356	8.479	0.396	0.116	0.014	0.386	0.234	8.479
		Min	0.000	0.139	0.222	0.000	0.000	0.000	0.362	0.362	0.000	0.000	0.000	0.000	0.000	0.362
		Median	0.109	0.401	0.512	0.051	0.000	0.000	1.126	1.126	0.000	0.000	0.000	0.000	0.000	1.126
18	34	Mean	0.181	0.311	0.651	0.080	0.001	0.027	1.225	1.251	0.026	0.004	0.000	0.029	0.003	1.255
		StdDev	0.100	0.140	0.457	0.158	0.007	0.061	0.750	0.789	0.067	0.011	0.001	0.070	0.016	0.792
		Max	0.428	0.813	2.265	0.662	0.042	0.243	4.008	4.075	0.336	0.042	0.006	0.336	0.093	4.075
		Min	0.000	0.124	0.232	0.000	0.000	0.000	0.385	0.385	0.000	0.000	0.000	0.000	0.000	0.385
		Median	0.182	0.283	0.504	0.023	0.000	0.000	1.064	1.073	0.000	0.000	0.000	0.000	0.000	1.073
19	146	Mean	0.064	0.381	0.728	0.109	0.014	0.023	1.296	1.304	0.030	0.006	0.000	0.022	0.014	1.318
		StdDev	0.081	0.168	0.847	0.281	0.089	0.108	1.190	1.210	0.129	0.041	0.004	0.106	0.113	1.232
		Max	0.345	0.921	8.279	2.567	0.952	1.086	11.499	11.633	1.086	0.475	0.046	1.199	1.345	11.633
		Min	0.000	0.054	0.083	0.000	0.000	0.000	0.137	0.137	0.000	0.000	0.000	0.000	0.000	0.137
		Median	0.022	0.346	0.574	0.042	0.000	0.000	1.109	1.114	0.000	0.000	0.000	0.000	0.000	1.124
All	1502	Mean	0.102	0.393	0.660	0.079	0.005	0.015	1.239	1.249	0.017	0.005	0.000	0.017	0.007	1.256
		StdDev	0.118	0.187	0.588	0.172	0.043	0.070	0.892	0.915	0.074	0.023	0.002	0.063	0.043	0.924
		Max	1.805	2.105	9.308	2.567	0.952	1.193	12.543	12.664	1.374	0.475	0.046	1.199	1.345	12.714
		Min	0.000	0.000	0.083	0.000	0.000	0.000	0.132	0.132	0.000	0.000	0.000	0.000	0.000	0.132
		Median	0.088	0.358	0.539	0.036	0.000	0.000	1.062	1.069	0.000	0.000	0.000	0.000	0.000	1.071

* Excludes replicates

Table 3-24. 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	157	Mean	0.245	1.000	1.254	0.375	0.026	0.072	2.900	2.946	0.074	0.037	0.001	0.086	0.040	2.986
		StdDev	0.386	0.468	0.747	0.293	0.076	0.117	1.429	1.479	0.107	0.053	0.003	0.126	0.096	1.508
		Max	3.130	2.795	6.303	1.595	0.365	0.656	9.758	9.902	0.571	0.311	0.040	0.765	0.889	9.973
		Min	0.000	0.038	0.130	0.000	0.000	0.000	0.191	0.191	0.000	0.000	0.000	0.000	0.000	0.191
		Median	0.111	0.920	1.121	0.302	0.000	0.000	2.759	2.763	0.012	0.010	0.000	0.021	0.002	2.788
7	128	Mean	0.440	0.927	1.289	0.372	0.021	0.079	3.049	3.107	0.097	0.026	0.001	0.102	0.044	3.151
		StdDev	0.465	0.481	0.823	0.520	0.109	0.222	1.771	1.896	0.250	0.054	0.006	0.225	0.120	1.943
		Max	3.363	3.261	5.498	4.421	0.868	1.097	10.786	11.884	1.801	0.363	0.066	1.556	1.116	12.072
		Min	0.000	0.171	0.275	0.000	0.000	0.000	0.481	0.481	0.000	0.000	0.000	0.000	0.000	0.481
		Median	0.316	0.778	1.060	0.212	0.000	0.000	2.626	2.650	0.004	0.000	0.000	0.008	0.000	2.671
8	151	Mean	0.393	0.870	1.233	0.340	0.004	0.065	2.840	2.901	0.052	0.032	0.000	0.081	0.020	2.921
		StdDev	0.332	0.346	0.588	0.255	0.020	0.105	1.214	1.292	0.089	0.043	0.003	0.122	0.050	1.308
		Max	2.281	1.866	3.995	1.391	0.160	0.631	6.914	7.511	0.530	0.193	0.035	0.665	0.378	7.511
		Min	0.000	0.021	0.264	0.000	0.000	0.000	0.350	0.350	0.000	0.000	0.000	0.000	0.000	0.350
		Median	0.316	0.840	1.102	0.261	0.000	0.006	2.656	2.689	0.011	0.009	0.000	0.021	0.000	2.704
9	153	Mean	0.216	0.973	1.241	0.326	0.026	0.056	2.782	2.812	0.044	0.034	0.000	0.052	0.022	2.835
		StdDev	0.284	0.500	0.676	0.268	0.076	0.115	1.359	1.398	0.092	0.048	0.000	0.076	0.034	1.415
		Max	1.739	2.859	5.716	1.634	0.478	0.697	8.208	8.463	0.596	0.307	0.003	0.335	0.157	8.542
		Min	0.000	0.039	0.162	0.000	0.000	0.000	0.256	0.256	0.000	0.000	0.000	0.000	0.000	0.256
		Median	0.143	0.895	1.122	0.245	0.000	0.000	2.536	2.536	0.000	0.007	0.000	0.015	0.000	2.536
10	133	Mean	0.395	0.923	1.182	0.352	0.039	0.099	2.892	2.952	0.077	0.026	0.001	0.064	0.004	2.956
		StdDev	0.322	0.457	0.617	0.273	0.092	0.150	1.422	1.479	0.111	0.052	0.005	0.099	0.015	1.480
		Max	1.511	2.405	3.860	1.407	0.626	0.869	7.326	7.377	0.624	0.375	0.051	0.603	0.132	7.377
		Min	0.000	0.174	0.176	0.000	0.000	0.000	0.451	0.451	0.000	0.000	0.000	0.000	0.000	0.451
		Median	0.332	0.866	1.084	0.288	0.000	0.029	2.694	2.736	0.034	0.000	0.000	0.018	0.000	2.768
11	124	Mean	0.217	0.868	1.177	0.361	0.023	0.076	2.647	2.699	0.072	0.011	0.000	0.059	0.007	2.706
		StdDev	0.257	0.410	0.783	0.347	0.136	0.223	1.518	1.605	0.208	0.030	0.001	0.113	0.018	1.614
		Max	1.377	3.278	5.550	2.649	1.396	2.205	13.454	14.263	2.078	0.228	0.012	0.910	0.101	14.365
		Min	0.000	0.097	0.161	0.000	0.000	0.000	0.258	0.258	0.000	0.000	0.000	0.000	0.000	0.258
		Median	0.122	0.826	0.992	0.260	0.000	0.003	2.362	2.407	0.003	0.000	0.000	0.014	0.000	2.408
12	134	Mean	0.373	0.963	1.377	0.423	0.062	0.104	3.198	3.240	0.092	0.035	0.001	0.066	0.024	3.264
		StdDev	0.493	0.449	0.759	0.340	0.141	0.161	1.651	1.677	0.135	0.059	0.011	0.094	0.065	1.696
		Max	2.992	2.495	4.660	1.781	0.766	0.773	9.230	9.313	0.669	0.305	0.116	0.558	0.545	9.365
		Min	0.000	0.326	0.408	0.000	0.000	0.000	0.780	0.780	0.000	0.000	0.000	0.000	0.000	0.780
		Median	0.230	0.826	1.158	0.327	0.000	0.034	2.724	2.808	0.044	0.003	0.000	0.028	0.000	2.821
13	171	Mean	0.267	0.839	1.347	0.345	0.018	0.080	2.816	2.878	0.060	0.022	0.000	0.064	0.002	2.880
		StdDev	0.399	0.386	0.620	0.257	0.058	0.112	1.227	1.280	0.086	0.038	0.001	0.091	0.012	1.281
		Max	2.473	2.800	3.871	1.363	0.419	0.506	7.013	7.226	0.424	0.213	0.017	0.394	0.105	7.279
		Min	0.000	0.221	0.361	0.000	0.000	0.000	0.583	0.583	0.000	0.000	0.000	0.000	0.000	0.583
		Median	0.120	0.773	1.266	0.312	0.000	0.036	2.683	2.709	0.024	0.000	0.000	0.012	0.000	2.717
16	150	Mean	0.309	1.054	1.282	0.395	0.022	0.107	3.062	3.147	0.081	0.039	0.000	0.097	0.013	3.159
		StdDev	0.260	0.452	0.601	0.262	0.094	0.148	1.338	1.402	0.105	0.064	0.001	0.109	0.040	1.409
		Max	1.612	2.439	3.882	1.616	0.954	1.180	7.409	7.696	0.632	0.547	0.012	0.464	0.342	7.709
		Min	0.000	0.202	0.396	0.000	0.000	0.000	0.752	0.752	0.000	0.000	0.000	0.000	0.000	0.752
		Median	0.280	1.013	1.108	0.346	0.000	0.062	2.817	2.908	0.055	0.009	0.000	0.063	0.000	2.916
18	55	Mean	0.736	0.782	1.029	0.247	0.012	0.091	2.807	2.885	0.064	0.030	0.001	0.082	0.004	2.889
		StdDev	0.557	0.347	0.452	0.211	0.058	0.170	1.317	1.395	0.133	0.060	0.003	0.154	0.017	1.396
		Max	2.714	1.843	2.430	0.932	0.387	0.781	6.113	6.113	0.742	0.263	0.018	0.781	0.123	6.113
		Min	0.000	0.194	0.426	0.000	0.000	0.000	0.685	0.685	0.000	0.000	0.000	0.000	0.000	0.685
		Median	0.598	0.699	0.867	0.202	0.000	0.000	2.403	2.513	0.000	0.000	0.000	0.003	0.000	2.513
19	149	Mean	0.216	0.915	1.358	0.402	0.031	0.105	2.921	2.996	0.078	0.040	0.001	0.089	0.014	3.010
		StdDev	0.369	0.449	0.700	0.310	0.078	0.147	1.464	1.540	0.108	0.063	0.006	0.130	0.041	1.549
		Max	2.361	2.491	3.886	1.494	0.384	0.598	7.926	7.982	0.457	0.261	0.051	0.606	0.258	7.982
		Min	0.000	0.065	0.301	0.000	0.000	0.000	0.366	0.366	0.000	0.000	0.000	0.000	0.000	0.366
		Median	0.052	0.840	1.169	0.348	0.000	0.018	2.635	2.682	0.021	0.000	0.000	0.017	0.000	2.704
All	1505	Mean	0.320	0.928	1.267	0.364	0.026	0.084	2.905	2.963	0.071	0.030	0.001	0.076	0.018	2.981
		StdDev	0.388	0.442	0.686	0.314	0.092	0.153	1.435	1.500	0.135	0.052	0.005	0.125	0.059	1.516
		Max	3.363	3.278	6.303	4.421	1.396	2.205	13.454	14.263	2.078	0.547	0.116	1.556	1.116	14.365
		Min	0.000	0.021	0.130	0.000	0.000	0.000	0.191	0.191	0.000	0.000	0.000	0.000	0.000	0.191
		Median	0.230	0.858	1.125	0.289	0.000	0.010	2.649	2.682	0.014	0.000	0.000	0.021	0.000	2.695

* Excludes replicates

Table 3-25. DRI Carbon Analysis Statistics for Trip Blanks

Analyzer No.	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
6	27	Mean	0.209	0.402	0.517	0.071	0.001	0.007	1.199	1.205	0.006	0.013	0.002	0.020	0.014	1.219
		StdDev	0.104	0.129	0.171	0.057	0.004	0.017	0.343	0.344	0.013	0.024	0.007	0.034	0.026	0.352
		Max	0.444	0.699	1.017	0.214	0.023	0.064	1.912	1.912	0.057	0.097	0.038	0.114	0.113	1.924
		Min	0.000	0.147	0.310	0.000	0.000	0.000	0.654	0.654	0.000	0.000	0.000	0.000	0.000	0.660
		Median	0.219	0.391	0.496	0.062	0.000	0.000	1.219	1.219	0.000	0.003	0.000	0.003	0.003	1.219
7	15	Mean	0.274	0.402	0.718	0.131	0.000	0.042	1.525	1.567	0.073	0.030	0.005	0.109	0.066	1.634
		StdDev	0.164	0.172	0.638	0.253	0.000	0.152	1.022	1.148	0.203	0.058	0.019	0.248	0.120	1.255
		Max	0.742	0.810	2.757	0.931	0.000	0.591	4.524	5.115	0.794	0.156	0.075	0.946	0.355	5.469
		Min	0.073	0.259	0.138	0.000	0.000	0.000	0.488	0.488	0.000	0.000	0.000	0.000	0.000	0.488
		Median	0.276	0.346	0.523	0.006	0.000	0.000	1.130	1.134	0.000	0.000	0.000	0.000	0.000	1.141
8	30	Mean	0.177	0.334	0.542	0.056	0.000	0.002	1.108	1.110	0.005	0.005	0.000	0.010	0.008	1.119
		StdDev	0.066	0.147	0.277	0.088	0.000	0.010	0.482	0.484	0.014	0.020	0.000	0.031	0.023	0.497
		Max	0.314	0.702	1.576	0.420	0.003	0.054	2.772	2.772	0.057	0.109	0.000	0.163	0.109	2.804
		Min	0.057	0.116	0.229	0.000	0.000	0.000	0.423	0.423	0.000	0.000	0.000	0.000	0.000	0.423
		Median	0.181	0.315	0.460	0.032	0.000	0.000	0.991	0.991	0.000	0.000	0.000	0.000	0.000	0.997
9	33	Mean	0.140	0.337	0.657	0.075	0.003	0.005	1.212	1.214	0.013	0.008	0.000	0.017	0.016	1.230
		StdDev	0.061	0.137	0.427	0.115	0.011	0.020	0.655	0.658	0.044	0.017	0.001	0.043	0.031	0.673
		Max	0.269	0.625	2.533	0.616	0.043	0.102	3.911	3.936	0.224	0.063	0.003	0.224	0.122	3.960
		Min	0.000	0.123	0.298	0.000	0.000	0.000	0.545	0.545	0.000	0.000	0.000	0.000	0.000	0.545
		Median	0.142	0.305	0.556	0.045	0.000	0.000	1.104	1.104	0.000	0.000	0.000	0.000	0.000	1.104
10	29	Mean	0.189	0.295	0.466	0.038	0.001	0.004	0.990	0.992	0.004	0.001	0.000	0.004	0.001	0.994
		StdDev	0.094	0.112	0.163	0.046	0.007	0.015	0.317	0.322	0.012	0.005	0.001	0.015	0.007	0.323
		Max	0.380	0.549	0.948	0.143	0.036	0.080	1.689	1.692	0.055	0.026	0.003	0.079	0.036	1.692
		Min	0.028	0.081	0.223	0.000	0.000	0.000	0.398	0.398	0.000	0.000	0.000	0.000	0.000	0.398
		Median	0.189	0.278	0.443	0.023	0.000	0.000	0.990	0.990	0.000	0.000	0.000	0.000	0.000	0.990
11	23	Mean	0.106	0.329	0.486	0.053	0.000	0.002	0.974	0.976	0.002	0.000	0.000	0.003	0.001	0.977
		StdDev	0.090	0.136	0.174	0.058	0.000	0.005	0.340	0.342	0.007	0.002	0.000	0.007	0.005	0.344
		Max	0.363	0.559	0.906	0.193	0.000	0.019	1.738	1.738	0.024	0.008	0.000	0.024	0.024	1.738
		Min	0.000	0.091	0.192	0.000	0.000	0.000	0.330	0.330	0.000	0.000	0.000	0.000	0.000	0.330
		Median	0.100	0.305	0.458	0.044	0.000	0.000	0.927	0.927	0.000	0.000	0.000	0.000	0.000	0.927
12	25	Mean	0.188	0.311	0.488	0.036	0.003	0.007	1.025	1.030	0.004	0.002	0.002	0.006	0.001	1.031
		StdDev	0.125	0.145	0.190	0.058	0.013	0.017	0.481	0.485	0.015	0.009	0.007	0.013	0.004	0.485
		Max	0.471	0.701	1.047	0.196	0.065	0.065	2.212	2.212	0.065	0.046	0.031	0.048	0.019	2.212
		Min	0.000	0.106	0.286	0.000	0.000	0.000	0.427	0.427	0.000	0.000	0.000	0.000	0.000	0.427
		Median	0.151	0.297	0.445	0.003	0.000	0.000	0.871	0.871	0.000	0.000	0.000	0.000	0.000	0.871
13	22	Mean	0.106	0.353	0.600	0.071	0.001	0.017	1.131	1.147	0.014	0.003	0.000	0.016	0.000	1.147
		StdDev	0.094	0.187	0.311	0.098	0.003	0.051	0.629	0.667	0.046	0.007	0.000	0.051	0.000	0.667
		Max	0.274	0.717	1.582	0.386	0.015	0.231	2.913	3.145	0.207	0.024	0.000	0.231	0.000	3.145
		Min	0.000	0.006	0.189	0.000	0.000	0.000	0.195	0.195	0.000	0.000	0.000	0.000	0.000	0.195
		Median	0.119	0.307	0.560	0.023	0.000	0.000	1.037	1.037	0.000	0.000	0.000	0.000	0.000	1.037
16	32	Mean	0.194	0.415	0.581	0.080	0.000	0.018	1.270	1.289	0.023	0.008	0.000	0.031	0.013	1.301
		StdDev	0.113	0.200	0.240	0.086	0.000	0.060	0.571	0.590	0.066	0.022	0.001	0.067	0.031	0.604
		Max	0.434	0.974	1.256	0.269	0.000	0.317	2.662	2.685	0.314	0.104	0.006	0.317	0.128	2.742
		Min	0.000	0.110	0.253	0.000	0.000	0.000	0.368	0.368	0.000	0.000	0.000	0.000	0.000	0.368
		Median	0.181	0.363	0.551	0.060	0.000	0.000	1.148	1.167	0.000	0.000	0.000	0.000	0.000	1.206
18	0	Mean														
		StdDev														
		Max														
		Min														
		Median														
19	25	Mean	0.079	0.371	0.691	0.102	0.005	0.014	1.248	1.257	0.015	0.002	0.000	0.013	0.004	1.260
		StdDev	0.080	0.193	0.729	0.238	0.025	0.049	1.132	1.172	0.056	0.011	0.000	0.061	0.018	1.189
		Max	0.220	1.107	4.017	1.169	0.127	0.217	6.292	6.509	0.253	0.053	0.000	0.306	0.089	6.598
		Min	0.000	0.177	0.298	0.000	0.000	0.000	0.498	0.498	0.000	0.000	0.000	0.000	0.000	0.498
		Median	0.076	0.310	0.496	0.026	0.000	0.000	1.035	1.035	0.000	0.000	0.000	0.000	0.000	1.035
All	261	Mean	0.164	0.353	0.569	0.069	0.001	0.010	1.157	1.166	0.013	0.007	0.001	0.019	0.010	1.176
		StdDev	0.109	0.160	0.367	0.121	0.010	0.049	0.630	0.656	0.061	0.021	0.006	0.074	0.037	0.677
		Max	0.742	1.107	4.017	1.169	0.127	0.591	6.292	6.509	0.794	0.156	0.075	0.946	0.355	6.598
		Min	0.000	0.006	0.138	0.000	0.000	0.000	0.195	0.195	0.000	0.000	0.000	0.000	0.000	0.195
		Median	0.158	0.318	0.496	0.034	0.000	0.000	1.037	1.037	0.000	0.000	0.000	0.000	0.000	1.041

* Excludes replicates

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

Analyzer No.	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
6	19	Mean	0.004	0.071	0.178	0.002	0.000	0.001	0.255	0.256	0.000	0.001	0.000	0.001	0.001	0.256
		StdDev	0.012	0.045	0.072	0.005	0.000	0.003	0.089	0.089	0.001	0.003	0.000	0.003	0.001	0.089
		Max	0.053	0.135	0.345	0.023	0.000	0.011	0.480	0.480	0.006	0.011	0.002	0.011	0.006	0.480
		Min	0.000	0.000	0.069	0.000	0.000	0.000	0.108	0.108	0.000	0.000	0.000	0.000	0.000	0.108
		Median	0.000	0.075	0.196	0.000	0.000	0.000	0.246	0.246	0.000	0.000	0.000	0.000	0.000	0.246
7	9	Mean	0.017	0.077	0.277	0.026	0.000	0.000	0.398	0.398	0.006	0.013	0.004	0.023	0.023	0.421
		StdDev	0.050	0.043	0.277	0.079	0.000	0.000	0.344	0.344	0.019	0.033	0.012	0.053	0.053	0.395
		Max	0.151	0.136	0.966	0.238	0.000	0.000	1.240	1.240	0.056	0.100	0.036	0.156	0.156	1.396
		Min	0.000	0.000	0.063	0.000	0.000	0.000	0.100	0.100	0.000	0.000	0.000	0.000	0.000	0.100
		Median	0.000	0.083	0.161	0.000	0.000	0.000	0.297	0.297	0.000	0.000	0.000	0.000	0.000	0.297
8	19	Mean	0.014	0.060	0.201	0.009	0.000	0.003	0.284	0.287	0.003	0.004	0.003	0.010	0.007	0.294
		StdDev	0.032	0.045	0.100	0.025	0.000	0.012	0.182	0.192	0.012	0.013	0.009	0.027	0.018	0.205
		Max	0.133	0.170	0.499	0.109	0.000	0.051	0.911	0.961	0.051	0.055	0.033	0.106	0.056	1.017
		Min	0.000	0.000	0.083	0.000	0.000	0.000	0.094	0.094	0.000	0.000	0.000	0.000	0.000	0.094
		Median	0.000	0.068	0.156	0.000	0.000	0.000	0.236	0.236	0.000	0.000	0.000	0.000	0.000	0.236
9	22	Mean	0.004	0.044	0.208	0.001	0.001	0.001	0.257	0.257	0.001	0.000	0.000	0.000	0.000	0.257
		StdDev	0.013	0.044	0.110	0.003	0.004	0.004	0.131	0.131	0.004	0.000	0.000	0.000	0.000	0.131
		Max	0.056	0.136	0.473	0.012	0.019	0.019	0.539	0.539	0.019	0.000	0.000	0.001	0.001	0.539
		Min	0.000	0.000	0.075	0.000	0.000	0.000	0.075	0.075	0.000	0.000	0.000	0.000	0.000	0.075
		Median	0.000	0.033	0.183	0.000	0.000	0.000	0.208	0.208	0.000	0.000	0.000	0.000	0.000	0.208
10	19	Mean	0.016	0.049	0.168	0.007	0.000	0.003	0.240	0.243	0.001	0.000	0.001	0.003	0.000	0.243
		StdDev	0.035	0.047	0.114	0.016	0.000	0.006	0.166	0.171	0.006	0.002	0.003	0.007	0.001	0.172
		Max	0.141	0.148	0.466	0.050	0.000	0.026	0.677	0.703	0.026	0.009	0.011	0.026	0.006	0.703
		Min	0.000	0.000	0.053	0.000	0.000	0.000	0.062	0.062	0.000	0.000	0.000	0.000	0.000	0.062
		Median	0.000	0.031	0.141	0.000	0.000	0.000	0.189	0.189	0.000	0.000	0.000	0.000	0.000	0.189
11	16	Mean	0.002	0.032	0.176	0.006	0.000	0.000	0.217	0.217	0.002	0.000	0.000	0.002	0.002	0.219
		StdDev	0.009	0.050	0.074	0.025	0.000	0.000	0.097	0.097	0.008	0.000	0.000	0.008	0.008	0.101
		Max	0.037	0.149	0.282	0.098	0.000	0.000	0.431	0.431	0.031	0.000	0.000	0.031	0.031	0.462
		Min	0.000	0.000	0.044	0.000	0.000	0.000	0.044	0.044	0.000	0.000	0.000	0.000	0.000	0.044
		Median	0.000	0.008	0.193	0.000	0.000	0.000	0.240	0.240	0.000	0.000	0.000	0.000	0.000	0.240
12	6	Mean	0.020	0.078	0.248	0.006	0.000	0.002	0.353	0.355	0.004	0.001	0.000	0.005	0.003	0.358
		StdDev	0.028	0.057	0.175	0.015	0.000	0.005	0.217	0.221	0.006	0.002	0.001	0.005	0.004	0.219
		Max	0.060	0.137	0.519	0.036	0.000	0.012	0.744	0.756	0.012	0.006	0.003	0.012	0.011	0.756
		Min	0.000	0.000	0.078	0.000	0.000	0.000	0.120	0.120	0.000	0.000	0.000	0.000	0.000	0.131
		Median	0.005	0.081	0.201	0.000	0.000	0.000	0.330	0.330	0.000	0.000	0.000	0.004	0.001	0.334
13	12	Mean	0.005	0.056	0.270	0.012	0.000	0.001	0.343	0.344	0.000	0.000	0.001	0.001	0.000	0.344
		StdDev	0.013	0.016	0.199	0.030	0.000	0.002	0.233	0.234	0.001	0.000	0.002	0.002	0.000	0.234
		Max	0.047	0.080	0.693	0.092	0.000	0.006	0.858	0.861	0.003	0.000	0.006	0.006	0.000	0.861
		Min	0.000	0.021	0.086	0.000	0.000	0.000	0.136	0.136	0.000	0.000	0.000	0.000	0.000	0.136
		Median	0.000	0.055	0.188	0.000	0.000	0.000	0.278	0.281	0.000	0.000	0.000	0.000	0.000	0.281
16	9	Mean	0.026	0.095	0.172	0.000	0.000	0.001	0.293	0.294	0.001	0.000	0.000	0.001	0.000	0.294
		StdDev	0.047	0.058	0.055	0.000	0.000	0.003	0.125	0.125	0.003	0.000	0.000	0.003	0.000	0.125
		Max	0.143	0.189	0.269	0.000	0.000	0.008	0.545	0.545	0.008	0.000	0.000	0.008	0.000	0.545
		Min	0.000	0.000	0.074	0.000	0.000	0.000	0.074	0.074	0.000	0.000	0.000	0.000	0.000	0.074
		Median	0.003	0.095	0.168	0.000	0.000	0.000	0.291	0.291	0.000	0.000	0.000	0.000	0.000	0.291
18	3	Mean	0.000	0.036	0.238	0.000	0.000	0.004	0.274	0.278	0.004	0.000	0.000	0.004	0.000	0.278
		StdDev	0.000	0.033	0.108	0.000	0.000	0.007	0.088	0.093	0.007	0.000	0.000	0.007	0.000	0.093
		Max	0.000	0.065	0.306	0.000	0.000	0.013	0.349	0.362	0.013	0.000	0.000	0.013	0.000	0.362
		Min	0.000	0.000	0.113	0.000	0.000	0.000	0.178	0.178	0.000	0.000	0.000	0.000	0.000	0.178
		Median	0.000	0.043	0.294	0.000	0.000	0.000	0.294	0.294	0.000	0.000	0.000	0.000	0.000	0.294
19	24	Mean	0.003	0.036	0.287	0.022	0.006	0.006	0.354	0.354	0.003	0.003	0.004	0.004	0.004	0.358
		StdDev	0.008	0.040	0.380	0.084	0.028	0.028	0.483	0.483	0.015	0.013	0.019	0.019	0.019	0.483
		Max	0.034	0.108	1.932	0.412	0.136	0.136	2.480	2.480	0.071	0.065	0.092	0.092	0.092	2.480
		Min	0.000	0.000	0.056	0.000	0.000	0.000	0.066	0.066	0.000	0.000	0.000	0.000	-0.002	0.066
		Median	0.000	0.015	0.195	0.000	0.000	0.000	0.260	0.260	0.000	0.000	0.000	0.000	0.000	0.264
All	158	Mean	0.009	0.054	0.216	0.009	0.001	0.002	0.289	0.290	0.002	0.002	0.001	0.004	0.003	0.294
		StdDev	0.025	0.046	0.191	0.041	0.011	0.012	0.246	0.247	0.009	0.011	0.008	0.018	0.016	0.253
		Max	0.151	0.189	1.932	0.412	0.136	0.136	2.480	2.480	0.071	0.100	0.092	0.156	0.156	2.480
		Min	0.000	0.000	0.044	0.000	0.000	0.000	0.044	0.044	0.000	0.000	0.000	0.000	-0.002	0.044
		Median	0.000	0.050	0.180	0.000	0.000	0.000	0.247	0.247	0.000	0.000	0.000	0.000	0.000	0.247

* Excludes replicates

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 minimal 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 3-27 summarizes the results for each type of blank, including trip blank backup filters, combined over all analyzers. Average TC concentration for the 1,502 field blanks was 1.3 ± 0.9 µg/cm^2, while it was 3.0 ± 1.5 µg/cm^2 for the 1,505 backup filters, 1.2 ± 0.7 µg/cm^2 for the 261 trip blanks, 0.5 ± 0.0 µg/cm^2 for the one trip blank backup filter, and 0.3 ± 0.3 µg/cm^2 for the 158 SHAL lab blanks.

Table 3-27. DRI Carbon Analysis Annual Statistics for CSN Blank Categories

Type of			IMPROVE_A Parameter (units are µg C/cm^2)													
Blank	No.*	Statistic*	O1TC	O2TC	O3TC	O4TC	OPTRC	OPTTC	OCTRC	OCTTC	E1TC	E2TC	E3TC	ECTRC	ECTTC	TCTC
SHAL	158	Mean	0.009	0.054	0.216	0.009	0.001	0.002	0.289	0.290	0.002	0.002	0.001	0.004	0.003	0.294
		StdDev	0.025	0.046	0.191	0.041	0.011	0.012	0.246	0.247	0.009	0.011	0.008	0.018	0.016	0.253
		Max	0.151	0.189	1.932	0.412	0.136	0.136	2.480	2.480	0.071	0.100	0.092	0.156	0.156	2.480
		Min	0.000	0.000	0.044	0.000	0.000	0.000	0.044	0.044	0.000	0.000	0.000	0.000	-0.002	0.044
		Median	0.000	0.050	0.180	0.000	0.000	0.000	0.247	0.247	0.000	0.000	0.000	0.000	0.000	0.247
		MDL	0.076	0.139	0.574	0.122	0.033	0.036	0.737	0.741	0.027	0.032	0.025	0.054	0.049	0.758
Trip	261	Mean	0.164	0.353	0.569	0.069	0.001	0.010	1.157	1.166	0.013	0.007	0.001	0.019	0.010	1.176
		StdDev	0.109	0.160	0.367	0.121	0.010	0.049	0.630	0.656	0.061	0.021	0.006	0.074	0.037	0.677
		Max	0.742	1.107	4.017	1.169	0.127	0.591	6.292	6.509	0.794	0.156	0.075	0.946	0.355	6.598
		Min	0.000	0.006	0.138	0.000	0.000	0.000	0.195	0.195	0.000	0.000	0.000	0.000	0.000	0.195
		Median	0.158	0.318	0.496	0.034	0.000	0.000	1.037	1.037	0.000	0.000	0.000	0.000	0.000	1.041
		LQL	0.327	0.479	1.102	0.362	0.030	0.146	1.890	1.968	0.184	0.064	0.017	0.222	0.112	2.031
Trip Backup	1	Mean	0.158	0.132	0.238	0.000	0.000	0.000	0.528	0.528	0.000	0.000	0.000	0.000	0.000	0.528
		StdDev														
		Max	0.158	0.132	0.238	0.000	0.000	0.000	0.528	0.528	0.000	0.000	0.000	0.000	0.000	0.528
		Min	0.158	0.132	0.238	0.000	0.000	0.000	0.528	0.528	0.000	0.000	0.000	0.000	0.000	0.528
		Median	0.158	0.132	0.238	0.000	0.000	0.000	0.528	0.528	0.000	0.000	0.000	0.000	0.000	0.528
		LQL	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
24-Hour Field	1502	Mean	0.102	0.393	0.660	0.079	0.005	0.015	1.239	1.249	0.017	0.005	0.000	0.017	0.007	1.256
		StdDev	0.118	0.187	0.588	0.172	0.043	0.070	0.892	0.915	0.074	0.023	0.002	0.063	0.043	0.924
		Max	1.805	2.105	9.308	2.567	0.952	1.193	12.543	12.664	1.374	0.475	0.046	1.199	1.345	12.714
		Min	0.000	0.000	0.083	0.000	0.000	0.000	0.132	0.132	0.000	0.000	0.000	0.000	0.000	0.132
		Median	0.088	0.358	0.539	0.036	0.000	0.000	1.062	1.069	0.000	0.000	0.000	0.000	0.000	1.071
		LQL	0.355	0.561	1.764	0.517	0.128	0.210	2.675	2.744	0.222	0.068	0.006	0.188	0.130	2.773
Backup	1505	Mean	0.320	0.928	1.267	0.364	0.026	0.084	2.905	2.963	0.071	0.030	0.001	0.076	0.018	2.981
		StdDev	0.388	0.442	0.686	0.314	0.092	0.153	1.435	1.500	0.135	0.052	0.005	0.125	0.059	1.516
		Max	3.363	3.278	6.303	4.421	1.396	2.205	13.454	14.263	2.078	0.547	0.116	1.556	1.116	14.365
		Min	0.000	0.021	0.130	0.000	0.000	0.000	0.191	0.191	0.000	0.000	0.000	0.000	0.000	0.191
		Median	0.230	0.858	1.125	0.289	0.000	0.010	2.649	2.682	0.014	0.000	0.000	0.021	0.000	2.695
		LQL	1.165	1.326	2.059	0.943	0.276	0.459	4.304	4.501	0.406	0.157	0.014	0.375	0.177	4.549

* Excludes replicates

3.4.3.2 Calibrations

Table 3-28 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. Note that analyzer 18 was removed from routine operation at the end of March 2011, modified, and subsequently used for experimental studies.

Table 3-29 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 3-19**.

Table 3-30 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. The scheduled February 2012 tests were underway at the time this report was prepared.

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 3-31**.

Table 3-28. DRI Multi-Point Calibration Statistics

Analyzer No.	Date	Slope	Scatter	Correlation
6	12/08/10	21.57	0.25	0.9904
	06/21/11	21.25	0.34	0.9845
	12/21/11	21.21	0.18	0.9943
7	08/01/10	21.53	0.27	0.9873
	02/10/11	21.42	0.20	0.9932
	09/24/11	21.55	0.29	0.9874
	11/17/11	22.20	0.24	0.9903
	01/04/12	21.55	0.20	0.9936
8	09/16/10	21.27	0.19	0.9943
	02/14/11	21.89	0.35	0.9800
	08/27/11	21.22	0.33	0.9807
9	11/07/10	21.03	0.20	0.9934
	01/28/11	20.62	0.17	0.9884
	06/21/11	20.11	0.29	0.9836
	12/21/11	19.85	0.28	0.9844
10	08/31/10	21.97	0.25	0.9934
	02/10/11	22.11	0.26	0.9884
	08/16/11	21.48	0.16	0.9836
11	10/04/10	21.65	0.22	0.9924
	10/01/11	19.34	0.27	0.9858
	10/18/11	20.58	0.32	0.9806
	12/20/11	20.43	0.23	0.9895
12	10/05/10	21.87	0.24	0.9905
	06/23/11	22.01	0.30	0.9872
	08/16/11	21.49	0.15	0.9960
	09/20/11	21.44	0.28	0.9867
	01/06/12	22.15	0.20	0.9935
13	11/07/10	21.96	0.23	0.9948
	05/20/11	21.64	0.27	0.9880
	11/17/11	21.61	0.26	0.9888
16	12/07/10	21.89	0.23	0.9922
	06/21/11	20.54	0.27	0.9865
	07/19/11	21.25	0.22	0.9915
	12/23/11	22.21	0.17	0.9950
18*	10/01/10	22.41	0.20	0.9915
19	11/07/10	20.49	0.24	0.9908
	06/23/11	20.47	0.36	0.9882
	11/17/11	20.79	0.24	0.9893

* Not used for standard analysis after March 2011

Table 3-29. DRI Temperature Calibration Statistics

Cal No.	Param.	Units	Analyzer No. 6	7	8	9	10	11	12	13	16	18	19
1	Slope		1.016	1.023	1.031	1.014	1.036	1.050	1.016	1.016	1.010	1.000	1.016
	Intercept	° C	3.506	0.592	4.887	2.456	8.378	0.721	2.916	3.976	4.815	5.470	9.361
	r^2		0.9997	0.9996	0.9993	0.9995	0.9994	0.9997	0.9995	0.9996	0.9960	0.9994	0.9996
	Date		Dec-10	Jul-10	Jul-10	Dec-10	Jul-10	Sep-10	Sep-10	Nov-10	Dec-10	Sep-10	Nov-10
2	Slope		1.021	1.013	1.037	1.014	1.046	1.014	1.020	1.029	1.013	1.000	1.032
	Intercept	° C	9.130	2.273	1.690	0.774	6.643	7.877	9.162	5.315	9.016	4.158	11.284
	r^2		0.9994	0.9998	0.9988	0.9994	0.9990	0.9996	0.9983	0.9994	0.9995	0.9995	0.9993
	Date		Jun-11	Feb-11	Feb-11	Jun-11	Feb-11	Apr-11	Feb-11	May-11	Jun-11	Apr-11	May-11
3	Slope		1.030	1.013	1.048	1.016	1.110	1.023	1.031	1.080	1.017		1.0267
	Intercept	° C	4.203	3.349	1.351	2.392	4.816	13.989	0.056	1.912	19.250		12.35
	r^2		0.9970	0.9997	0.9988	0.9998	0.9976	0.9980	0.9989	0.9956	0.9988		0.9972
	Date		Dec-11	Apr-11	Aug-11	Dec-11	Aug-11	Oct-11	Aug-11	Nov-11	Dec-11		Nov-11
4	Slope			1.011			1.036		1.005				
	Intercept	° C		6.762			10.267		10.168				
	r^2			0.9995			0.9984		0.9991				
	Date			May-11			Feb-12		Feb-12				
5	Slope			1.014									
	Intercept	° C		6.259									
	r^2			0.9982									
	Date			Sep-11									
6	Slope			1.060									
	Intercept	° C		1.959									
	r^2			0.9981									
	Date			Nov-11									

Table 3-30. DRI Oxygen Test Statistics

	Date		December 2010		August 2011	
Analyzer No.	Temp	(°C)	140	580	140	580
6	Mean O_2	(ppm)	22.9	23.2	10.5	12.0
	Std Dev	(ppm)	1.0	0.6	0.1	0.2
7	Mean O_2	(ppm)	25.3	29.6	49.7	25.6
	Std Dev	(ppm)	1.6	1.4	3.9	0.6
8	Mean O_2	(ppm)	39.1	2.2	7.1	1.1
	Std Dev	(ppm)	26.9	2.1	0.5	0.1
9	Mean O_2	(ppm)	23.3	21.0	4.3	4.9
	Std Dev	(ppm)	0.9	0.8	0.4	0.3
10	Mean O_2	(ppm)	17.6	18.0	5.5	10.3
	Std Dev	(ppm)	2.1	1.1	0.4	0.2
11	Mean O_2	(ppm)	9.2	8.0	14.5	11.5
	Std Dev	(ppm)	2.1	2.1	1.4	1.1
12	Mean O_2	(ppm)	27.7	8.9	12.4	2.3
	Std Dev	(ppm)	2.1	1.5	0.8	0.2
13	Mean O_2	(ppm)	21.6	16.4	29.2	37.7
	Std Dev	(ppm)	1.8	1.1	2.4	3.7
16	Mean O_2	(ppm)	46.4	46.0	4.0	2.8
	Std Dev	(ppm)	1.5	1.2	0.3	0.3
18	Mean O_2	(ppm)	12.8	15.2	6.3	7.7
	Std Dev	(ppm)	0.4	1.2	0.2	0.2
19	Mean O_2	(ppm)	16.3	17.4	2.3	3.4
	Std Dev	(ppm)	0.8	0.4	0.2	0.3

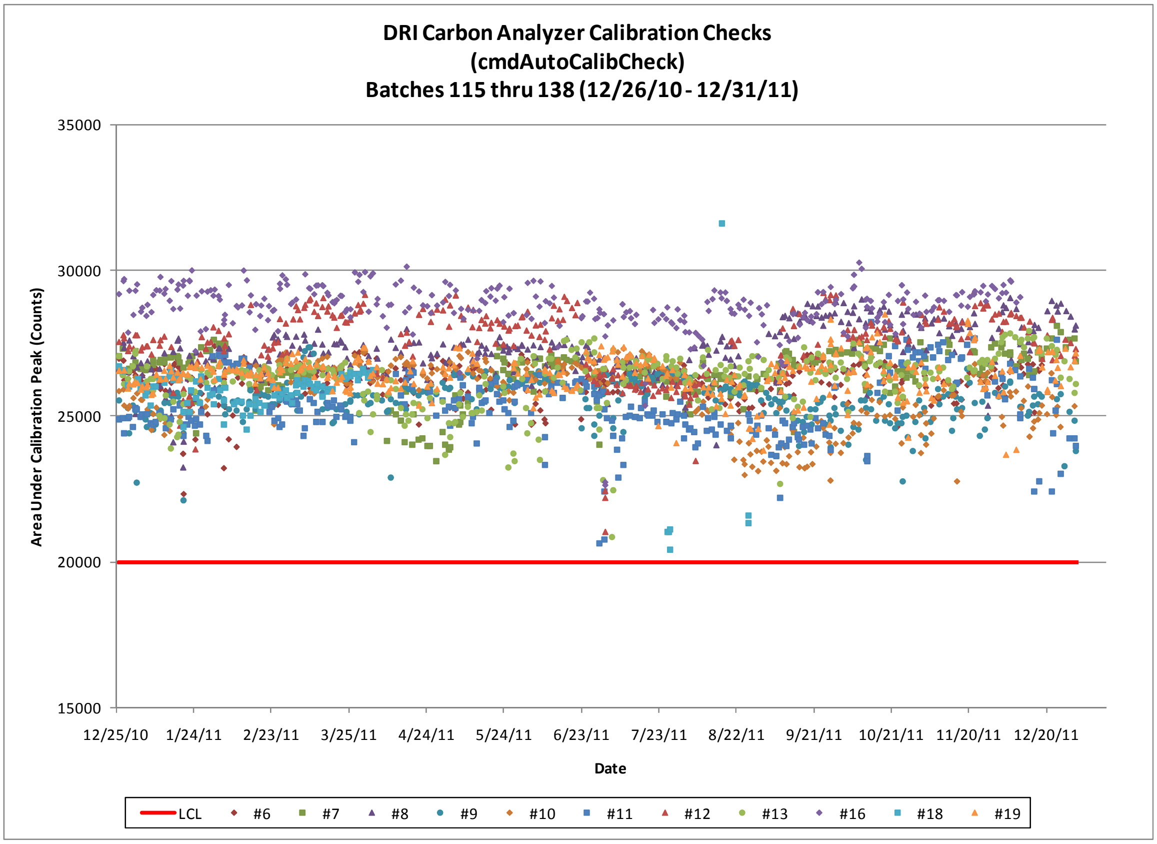


Figure 3-1. DRI Carbon Analyzer Daily AutoCalibration Response for 12/26/10 – 12/31/11

Table 3-31. Summary of Instrument Maintenance Performed as a Result of Autocalibration Peak Response

Analyzer No.	Date	Resolution
6	07/02/11	Cal peak way down – changed cal gas tank
	07/22/11	Drop in cal peak – replaced bottom quartz rod
	12/14/11	Cal peak low – replaced reducing ferrule
7	08/01/11	Cal peak low – replaced top quartz rod
8	02/23/11	Cal peak very low – repaired leak
	08/02/11	Cal peak dropping – adjusted flow
	09/23/11	Cal peak low – adjusted hydrogen flow
	11/23/11	Cal peak low – balanced flows
	12/10/11	Cal peak low – adjusted and balanced flows
9	12/28/10	Cal peak dropped – adjusted and balanced flows
	12/07/11	Cal peak low – adjusted and balanced flows
	12/10/11	Cal peak low – adjusted and balanced flows
	12/27/11	Cal peak low – adjusted and balanced flows
	12/30/11	Cal peak low – adjusted and balanced flows
10	10/24/11	Cal peak low – adjusted and balanced flows
	11/01/11	Cal peak low – adjusted and balanced flows
	11/15/11	Cal peak low – adjusted and balanced flows
11	07/08/11	Cal peak dropping – fixed leak
	10/12/11	Cal peak low – fixed oxygenator outlet ferrule leak
	12/15/11	Cal peak low – adjusted and balanced flows
	12/22/11	Cal peak low – adjusted and balanced flows
	12/23/11	Cal peak low & laser drift – replaced Teflon ferrule for reactor
	12/25/11	Cal peak low – fixed Teflon ferrule leak downstream of oxygenator
	12/28/11	Cal peak low – balanced flows
12	01/19/11	
	07/02/11	Cal peak low – changed cal gas tank
13	05/31/11	No cal peak – balanced flows
	07/02/11	Cal peak low – adjusted and balanced flows
	10/04/11	Cal peak low – adjusted and balanced flows
16	07/08/11	Cal peak dropping – balanced flows
	08/02/11	Cal peak dropped – balanced flows
	08/09/11	Cal peak dropped – balanced flows
	10/05/11	Cal peak dropped – balanced flows
18	02/31411	Cal peak dropped – tightened breech nut
19	10/11/11	Cal peak low – fixed leak
	12/20/11	Cal peak low – balanced flows

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 3-32** 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 2,182 replicate or duplicate analyses were analyzed during the reporting period. Of the 2,182 replicates or duplicates, 25 contained f, g, h, i, or n analysis flags for filter damaged or ripped, filter deposit damaged, filter holder assembly problem, inhomogeneous sample deposit, or foreign substance on sample, respectively. These were not included in the replicate and duplicate statistical summary. Of the 2,157 remaining, 35 were duplicate analyses and 2,122 were replicate analyses.

Table 3-32. DRI Replicate Analysis Criteria and Statistics

			Replicates				Duplicates				
Range	Criteria	Statistic	No.	TC	OC	EC	No.	TC	OC	EC	Units
All		Count	2122				35				
TC, OC, & EC < 10 µg C/cm^2	< ±1.0 µg C/cm^2	Count		397	543	1804		4	6	29	
		No. Fail		4	15	91		0	0	0	
		%Fail		1.0	2.8	5.0		0.0	0.0	0.0	%
		Mean		0.261	0.295	0.326		0.289	0.349	0.176	µg C/cm^2
		StdDev		0.253	0.278	0.333		0.186	0.187	0.149	µg C/cm^2
		Max		1.445	1.439	1.895		0.445	0.569	0.588	µg C/cm^2
		Min		0.001	0.000	0.000		0.037	0.033	0.003	µg C/cm^2
		Median		0.178	0.206	0.230		0.337	0.365	0.116	µg C/cm^2
TC, OC, & EC ≥ 10 µg C/cm^2	TC, OC %RPD < 10% EC %RPD < 20%	Count		1725	1604	318		31	29	6	
		No. Fail		28	89	0		0	0	0	
		%Fail		1.6	5.5	0.0		0.0	0.0	0.0	%
		Mean		3.70	4.59	5.19		2.10	2.35	4.04	%RPD
		StdDev		2.67	3.14	3.50		1.85	2.00	2.04	%RPD
		Max		16.64	18.98	18.98		6.79	7.66	7.17	%RPD
		Min		0.01	0.02	0.05		0.16	0.07	1.76	%RPD
		Median		3.25	4.13	4.61		1.53	2.02	4.08	%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 ≥ 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 3-33 gives estimated minimum detection limits (MDLs) for IMPROVE_A parameters for batches 115 through 138 (~2011). The MDLs are determined as three times the standard deviation of DRI laboratory acceptance and RTI SHAL blanks. **Table 3-33** 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.

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, with the final report issued June 1, 2011. The report may be found at EPA's Ambient Monitoring Technical Information center (AMTIC) website at:

Table 3-33. Estimated MDLs and LQLs for IMPROVE_A Parameters for Batches 115-138

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	624	Mean	0.002	0.014	0.160	0.005	0.000	0.003	0.181	0.184	0.002	0.002	0.003	0.006	0.004	0.188
		StdDev	0.012	0.032	0.133	0.024	0.005	0.020	0.163	0.167	0.011	0.015	0.030	0.036	0.031	0.173
		Max	0.152	0.313	1.142	0.293	0.119	0.307	1.381	1.381	0.183	0.312	0.499	0.499	0.499	1.605
		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	0.119	0.000	0.000	0.000	0.133	0.133	0.000	0.000	0.000	0.000	0.000	0.134
		MDL	0.035	0.097	0.398	0.073	0.014	0.059	0.488	0.501	0.034	0.046	0.091	0.108	0.092	0.519
SHAL	158	Mean	0.009	0.054	0.216	0.009	0.001	0.002	0.289	0.290	0.002	0.002	0.001	0.004	0.003	0.294
		StdDev	0.025	0.046	0.191	0.041	0.011	0.012	0.246	0.247	0.009	0.011	0.008	0.018	0.016	0.253
		Max	0.151	0.189	1.932	0.412	0.136	0.136	2.480	2.480	0.071	0.100	0.092	0.156	0.156	2.480
		Min	0.000	0.000	0.044	0.000	0.000	0.000	0.044	0.044	0.000	0.000	0.000	0.000	-0.002	0.044
		Median	0.000	0.050	0.180	0.000	0.000	0.000	0.247	0.247	0.000	0.000	0.000	0.000	0.000	0.247
		MDL	0.076	0.139	0.574	0.122	0.033	0.036	0.737	0.741	0.027	0.032	0.025	0.054	0.049	0.758
Trip	261	Mean	0.164	0.353	0.569	0.069	0.001	0.010	1.157	1.166	0.013	0.007	0.001	0.019	0.010	1.176
		StdDev	0.109	0.160	0.367	0.121	0.010	0.049	0.630	0.656	0.061	0.021	0.006	0.074	0.037	0.677
		Max	0.742	1.107	4.017	1.169	0.127	0.591	6.292	6.509	0.794	0.156	0.075	0.946	0.355	6.598
		Min	0.000	0.006	0.138	0.000	0.000	0.000	0.195	0.195	0.000	0.000	0.000	0.000	0.000	0.195
		Median	0.158	0.318	0.496	0.034	0.000	0.000	1.037	1.037	0.000	0.000	0.000	0.000	0.000	1.041
		LQL	0.327	0.479	1.102	0.362	0.030	0.146	1.890	1.968	0.184	0.064	0.017	0.222	0.112	2.031
Trip Backup	1	Mean	0.158	0.132	0.238	0.000	0.000	0.000	0.528	0.528	0.000	0.000	0.000	0.000	0.000	0.528
		StdDev														
		Max	0.158	0.132	0.238	0.000	0.000	0.000	0.528	0.528	0.000	0.000	0.000	0.000	0.000	0.528
		Min	0.158	0.132	0.238	0.000	0.000	0.000	0.528	0.528	0.000	0.000	0.000	0.000	0.000	0.528
		Median	0.158	0.132	0.238	0.000	0.000	0.000	0.528	0.528	0.000	0.000	0.000	0.000	0.000	0.528
		LQL														
24-Hour Field	1502	Mean	0.102	0.393	0.660	0.079	0.005	0.015	1.239	1.249	0.017	0.005	0.000	0.017	0.007	1.256
		StdDev	0.118	0.187	0.588	0.172	0.043	0.070	0.892	0.915	0.074	0.023	0.002	0.063	0.043	0.924
		Max	1.805	2.105	9.308	2.567	0.952	1.193	12.543	12.664	1.374	0.475	0.046	1.199	1.345	12.714
		Min	0.000	0.000	0.083	0.000	0.000	0.000	0.132	0.132	0.000	0.000	0.000	0.000	0.000	0.132
		Median	0.088	0.358	0.539	0.036	0.000	0.000	1.062	1.069	0.000	0.000	0.000	0.000	0.000	1.071
		LQL	0.355	0.561	1.764	0.517	0.128	0.210	2.675	2.744	0.222	0.068	0.006	0.188	0.130	2.773
Backup	1505	Mean	0.320	0.928	1.267	0.364	0.026	0.084	2.905	2.963	0.071	0.030	0.001	0.076	0.018	2.981
		StdDev	0.388	0.442	0.686	0.314	0.092	0.153	1.435	1.500	0.135	0.052	0.005	0.125	0.059	1.516
		Max	3.363	3.278	6.303	4.421	1.396	2.205	13.454	14.263	2.078	0.547	0.116	1.556	1.116	14.365
		Min	0.000	0.021	0.130	0.000	0.000	0.000	0.191	0.191	0.000	0.000	0.000	0.000	0.000	0.191
		Median	0.230	0.858	1.125	0.289	0.000	0.010	2.649	2.682	0.014	0.000	0.000	0.021	0.000	2.695
		LQL	1.165	1.326	2.059	0.943	0.276	0.459	4.304	4.501	0.406	0.157	0.014	0.375	0.177	4.549

* Excludes replicates

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

The TSA report found that DRI's Carbon laboratory performed good laboratory practices, good QC practices, and good record keeping. The auditors were impressed with the new software that provided a graphical interface with all the instruments at a single workstation. No deficiencies were observed.

3.4.6.2 Performance Evaluations

Inter-laboratory comparisons and PEs, including DRI's Carbon Laboratory, have been conducted annually from 2005 through 2010. The results 2011-12 comparison is currently underway. These reports are available at EPA's Ambient Monitoring Technical Information center (AMTIC) website at:

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

3.4.6.4 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, 2011.

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:

- 05/19/11 – Replaced vacuum pump
- 10/13/11 – Preventive maintenance (PM) performed, checked voltages, resolution, and stability. Replaced power distribution and jump cord

The following repairs and maintenance were performed for XRF 2:

- 11/01/11 – PM performed, checked voltages, resolution, and stability
- 11/16/11 – Replaced E/I board; x-rays would not come on (calibration verified)

The following repair and maintenance was performed for XRF 3:

- 02/08/11 – Replaced HVPS , tube and calibrated detector (re-calibration required)
- 08/10/11 – Replaced X-ray tube and calibrated detector (re-calibration required)
- 11/18/11 – PM performed, checked voltages, resolution, and stability

The following repair and maintenance was performed for XRF 4:

- 05/19/11 – PM performed, checked voltages, resolution, and stability

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 3-34**.

Table 3-34. 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 3-35 through 3-39**. The percent coefficient of variation (%CV) for the average of all data for each of the six elements ranged between 0.19 and 0.55% for XRF 1, between 0.24 and 0.67% for XRF 2, between 0.27 and 1.86% for XRF 3, and between 0.22 and 0.57% for XRF 4. Because of a tear in the Micromatter QC for XRF 2; a replacement was required and the QC Precision data is separated into two tables, reflecting the two different Micromatter QC samples used.

Table 3-35. Summary of RTI XRF 1 Laboratory QC Precision Data, $\mu g/cm^2$, 1/1/2011 through 12/31/2011

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	686	4.94	5.20	5.00	0.026	0.52	-0.246
Ti	686	6.75	6.92	6.81	0.022	0.33	0.063
Fe	686	6.89	7.03	6.94	0.019	0.27	0.001
Cd	686	5.44	5.60	5.54	0.025	0.45	0.140
Se	686	3.93	4.05	3.99	0.022	0.55	-0.164
Pb	686	9.06	9.16	9.11	0.017	0.19	0.128

Table 3-36. Summary of RTI XRF 2 Laboratory QC Precision Data, $\mu g/cm^2$, 1/1/2011 through 3/31/2011

Element	N	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	26	5.18	5.28	5.24	0.024	0.46	-0.325
Ti	26	6.60	6.68	6.65	0.020	0.30	-0.053
Fe	26	6.88	6.94	6.91	0.019	0.28	-0.013
Cd	26	5.87	5.96	5.91	0.022	0.38	0.413
Se	26	3.95	4.04	4.00	0.024	0.59	-0.645
Pb	26	9.25	9.33	9.30	0.022	0.24	-0.273

Table 3-37. Summary of RTI XRF 2 Laboratory QC Precision Data, $\mu g/cm^2$, 4/1/2011 through 12/31/2011

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	394	5.17	5.29	5.24	0.023	0.44	0.090
Ti	394	8.52	8.69	8.63	0.022	0.26	0.036
Fe	394	7.26	7.36	7.30	0.019	0.26	-0.033
Cd	394	4.26	4.48	4.41	0.029	0.67	0.028
Se	394	2.94	3.04	3.00	0.018	0.61	-0.185
Pb	394	7.84	7.97	7.91	0.022	0.28	0.097

Table 3-38. Summary of RTI XRF 3 Laboratory QC Precision Data, $\mu g/cm^2$, 1/1/2011 through 7/31/2011

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	309	5.18	5.28	5.22	0.020	0.38	0.182
Ti	309	7.45	7.96	7.84	0.146	1.86	4.482
Fe	309	6.91	7.08	7.03	0.022	0.31	-0.011
Cd	309	4.24	4.51	4.30	0.031	0.71	-0.089
Se	309	2.90	2.99	2.94	0.020	0.68	0.166
Pb	309	7.93	8.05	8.00	0.021	0.27	-0.116

Table 3-39. Summary of RTI XRF 4 Laboratory QC Precision Data, $\mu g/cm^2$, 1/1/2011 through 12/31/2011

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	454	4.48	4.59	4.54	0.026	0.57	-0.122
Ti	454	5.93	6.06	6.00	0.025	0.41	0.251
Fe	454	6.49	6.59	6.55	0.018	0.28	-0.015
Cd	454	5.44	5.58	5.50	0.026	0.47	0.111
Se	454	3.77	3.87	3.82	0.018	0.47	0.090
Pb	454	8.83	9.00	8.93	0.020	0.22	0.010

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 3-40 through 3-43** show recovery for 8 elements of the 33 elements normally measured. The average recovery values for all the elements ranged between 94 and 105% for XRF 1; between 93 and 106% for XRF 2; between 94 and 104% for XRF 3; and between 93 to 103% for XRF 4. Note that every month, 33 elements of the Micromatter calibration standards are analyzed as unknowns to verify calibration. SRM 2783 was used in place of SRM 1832 due to a tear that developed in the standard.

Table 3-40. Recovery Determined from Analysis of NIST SRM 2783 for RTI XRF 1, 1/1/2011 through 12/31/2011

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Na	97	110	105	0.0070	3.58	-0.189
K	94	103	98	0.0136	2.61	-0.708
Ca	90	102	94	0.0326	2.64	-2.154
Mn	93	109	102	0.0014	4.43	0.038
Fe	96	103	99	0.0515	1.82	-2.809
Cu	92	109	100	0.0016	3.92	-0.011
Zn	91	107	97	0.0075	4.28	-0.699
Pb	92	106	100	0.0012	3.85	0.036

Table 3-41. Recovery Determined from Analysis of NIST SRM 2783 for RTI XRF 2, 1/1/2011 through 12/31/2011

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Na	90	110	103	0.0089	4.65	-0.476
K	95	110	106	0.0183	3.29	-1.093
Ca	90	97	93	0.0265	2.15	-0.698
Mn	93	110	103	0.0015	4.59	0.005
Fe	94	102	98	0.0591	2.11	-4.018
Cu	91	110	102	0.0016	3.86	0.062
Zn	92	110	104	0.0070	3.75	-0.912
Pb	90	109	100	0.0014	4.45	-0.020

Table 3-42. Recovery Determined from Analysis of NIST SRM 2783 for RTI XRF 3, 1/1/2011 through 7/31/2011

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Na	90	106	97	0.0074	4.06	-0.279
K	92	102	97	0.0135	2.63	-3.083
Ca	90	100	94	0.0330	2.65	-7.199
Mn	98	110	102	0.0013	4.06	0.086
Fe	93	100	97	0.0562	2.03	-1.530
Cu	90	106	98	0.0018	4.63	0.141
Zn	96	110	104	0.0080	4.26	-0.514
Pb	90	110	101	0.0016	4.91	0.196

Table 3-43. Recovery Determined from Analysis of NIST SRM 2783 for RTI XRF 4, 1/1/2011 through 12/31/2011

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Na	90	108	99	0.0092	4.97	0.342
K	93	102	98	0.0118	2.28	0.644
Ca	90	97	93	0.0306	2.49	0.596
Mn	93	109	102	0.0014	4.27	0.084
Fe	93	102	97	0.0572	2.05	-4.029
Cu	92	109	100	0.0017	4.22	-0.020
Zn	92	110	103	0.0084	4.59	-0.371
Pb	91	106	99	0.0010	3.20	0.003

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 3-44** shows the correlation coefficients and average RPDs for the replicate analysis. The correlation coefficients for XRF 1 range from 0.9994 to 0.9999, the correlation coefficients for XRF 2 range from 0.9976 to 0.9999, the correlation coefficients for XRF 3 range from 0.9998 to 0.9999, and the correlation coefficients for XRF 4 range from 0.9998 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 2%, the average RPD for the six elements on XRF 3 was less than 6%, and the average RPD for the six elements on XRF 4 was less than 1%.

Table 3-44. 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	371	0.9994	0.16	Si	225	0.9976	-1.49
S	371	0.9999	0.44	S	225	0.9999	0.17
K	371	0.9999	-0.50	K	225	0.9999	0.09
Ca	371	0.9999	0.05	Ca	225	0.9996	-0.91
Fe	371	0.9999	-0.46	Fe	225	0.9999	-0.16
Zn	371	0.9998	-1.26	Zn	225	0.9995	0.22

XRF 3				XRF 4			
Element	**n**	**Correlation Coefficient**	**Average RPD**	**Element**	**n**	**Correlation Coefficient**	**Average RPD**
Si	172	0.9999	5.23	Si	256	0.9999	0.67
S	172	0.9998	0.12	S	256	0.9998	-0.09
K	172	0.9999	0.11	K	256	0.9999	0.07
Ca	172	0.9999	-0.96	Ca	256	0.9999	-0.14
Fe	172	0.9999	-0.16	Fe	256	0.9999	0.20
Zn	172	0.9998	-2.06	Zn	256	0.9999	0.82

Assessment of Between-Instrument Comparability

Overview of Round-Robin Samples Run During 2011

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 3-45** summarizes the number of round-robin filters analyzed during 2011.

Table 3-45. Numbers of Round-Robin Filter Analyses Performed during 2011

Laboratory	Instrument	Filters Analyzed
CLN	Kevex 770	24
CLN	Kevex 772*	24
RTI	XRF 1	24
RTI	XRF 2	24
RTI	XRF 3	12
RTI	XRF 4	24

* - CLN 772 is not an approved instrument in the CSN PM2.5 Program, but CLN analyzed all 2011 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 2011.

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 3-46 through 3-48** 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 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.

Table 3-46. 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	0.9920	1.0159	-0.0221	24	0.9941	0.9592	0.0679
S	24	0.9999	0.9829	0.0101	24	0.9998	1.0005	-0.0359
K	24	0.9996	0.9853	0.0099	24	0.9994	1.0584	0.0026
Ca	24	0.9986	0.9809	0.0108	24	0.9981	1.0039	-0.0297
Fe	24	0.9957	1.0048	0.0651	24	0.9970	0.9753	0.0456
Ni	24	0.9954	0.9830	0.0023	24	0.9968	1.0039	0.0018
Cu	24	0.9978	1.0587	-0.0040	24	0.9936	1.0407	0.0046
Zn	24	0.9998	0.9944	0.0008	24	0.9997	1.0178	0.0020
Pb	24	0.9852	1.0648	-0.0033	24	0.9931	1.0135	-0.0010

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

Table 3-47. 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	0.9984	0.9694	-0.0664	24	0.9942	1.0060	0.0168
S	24	0.9997	0.9818	0.1978	24	0.9999	0.9922	0.1175
K	24	0.9998	0.9735	-0.0163	24	0.9997	0.9899	-0.0177
Ca	24	0.9992	1.0003	-0.0101	24	0.9979	0.9756	0.0163
Fe	24	0.9999	0.9958	-0.0006	24	0.9985	1.0019	0.0273
Ni	24	0.9812	1.0576	0.0048	24	0.9963	1.0045	0.0008
Cu	24	0.9917	0.9967	-0.0040	24	0.9931	0.9715	0.0066
Zn	24	0.9991	1.0002	-0.0571	24	0.9998	1.0031	0.0043
Pb	24	0.9652	0.9748	0.0040	24	0.9886	1.0246	-0.0042

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

Table 3-48. 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	0.9820	1.1315	-0.1480	24	0.9871	0.9785	0.0491
S	24	0.9972	1.1518	-0.9378	24	0.9989	1.0671	-0.7261
K	24	0.9984	1.0387	-0.0696	24	0.9996	0.9931	0.0350
Ca	24	0.9941	1.2112	-0.0717	24	0.9889	1.0853	-0.0592
Fe	24	0.9871	1.0594	-0.1842	24	0.9910	1.0079	-0.1075
Ni	24	0.9855	1.1751	-0.0020	24	0.9825	0.9395	-0.0138
Cu	24	0.9769	0.9604	-0.0198	24	0.9859	0.9020	0.0055
Zn	24	0.9990	0.9960	-0.0174	24	0.9994	1.0056	0.0034
Pb	24	0.9871	0.9456	-0.0128	24	0.9839	0.9035	0.0274

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

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 3-49**.

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:

$$\text{Uncertainty} = \text{slope} * A * \text{sqrt}\,(3 * \text{sqrt}\,(B * t) + B * t) / t$$

Where

A = scaling factor

B = background counts (cps) is incorporated during the importing of the data into the RTI XRF database

t = livetime.

Table 3-49. RTI Method Detection Limits – Interference-Free, 3-sigma, μg/filter

Element	RTI 1	RTI 2	RTI 3	RTI 4
Na	0.245	0.303	0.319	0.370
Mg	0.104	0.114	0.108	0.104
Al	0.234	0.129	0.247	0.254
Si	0.119	0.093	0.124	0.124
P	0.094	0.155	0.104	0.096
S	0.062	0.095	0.072	0.064
Cl	0.049	0.075	0.054	0.048
K	0.042	0.070	0.040	0.040
Ca	0.048	0.073	0.047	0.047
Ti	0.057	0.051	0.044	0.039
V	0.035	0.037	0.029	0.030
Cr	0.024	0.025	0.024	0.021
Mn	0.019	0.018	0.018	0.017
Fe	0.020	0.016	0.018	0.014
Co	0.015	0.013	0.013	0.012
Ni	0.014	0.012	0.012	0.010
Cu	0.022	0.016	0.049	0.015
Zn	0.023	0.017	0.016	0.016
As	0.031	0.009	0.021	0.020
Se	0.027	0.013	0.025	0.020
Br	0.025	0.013	0.024	0.019
Rb	0.030	0.019	0.023	0.019
Sr	0.041	0.023	0.033	0.019
Zr	0.346	0.032	0.270	0.202
Ag	0.471	0.126	0.249	0.197
Cd	0.573	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	0.136	0.110	0.114	0.107
Ba	0.099	0.105	0.110	0.101
Ce	0.074	0.094	0.070	0.075
Pb	0.052	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 2010 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.

Also during 2011, the RTI XRF laboratory served as the reference laboratory for the next inter-laboratory study being conducted in 2012. 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 2012.

3.5.2 Chester LabNet X-Ray Fluorescence Laboratory

During the period covered by this report, Chester 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:

- 2/24/11 – replaced 5707-7015 HVPS board.
- 3/9/11 – replaced 12V power supply.
- 7/1/11 – replaced cellulose prefilter with two thicknesses and recalibrated.
- 8/10/11 – replaced X-ray tube power supply

3.5.2.2 Description of QC Checks Applied

QC activities for the analysis of elements by EDXRF for the Chester LabNet XRF laboratory, their frequency of application and control limits, comments and corrective actions are shown in **Table 3-50.**

Table 3-50. QC Procedures Performed in Support of XRF Elemental Analysis

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

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 3-51**. The percent coefficient of variation (%CV) for the average of all data for each of the six elements ranged between 3.05 and 4.09%.

Table 3-51. Summary of Chester XRF 770 Laboratory QC Precision Data 1/1/2011 through 12/31/2011

Element	n	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Si	110	93.1	108.9	101.3	3.11	3.07	-1.34
Ti	110	91.6	105.0	99.1	3.32	3.35	-7.48
Fe	110	92.0	105.6	99.1	3.32	3.35	-7.48
Cd	110	97.2	108.6	102.4	3.13	3.05	2.31
Se	110	93.0	110.8	102.9	4.21	4.09	-3.63
Pb	110	94.2	110.2	102.8	4.28	4.09	-2.91

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 89.3 and 114.3% . Analysis of NIST Particle Standard SRM2783 yielded recoveries of 99.4% for Ca and 102.6% 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 <u>one</u> of the elements in **Table 3-52** 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 3-52. Recovery Determined from Analysis of NIST SRMs 1832, 1833, 2708 and 2783 for Chester XRF 770 -- 1/1/2011 through 12/31/2011

Element	Min	Max	Average	Std Dev	%CV	Slope (%/year)
Al	92.4	107.8	101.3	3.76	3.71	0.11
Si	97.2	106.3	101.5	2.29	2.26	0.59
Si	90.3	106.5	98.7	3.30	3.35	-5.82
S	90.4	106.2	98.1	3.74	3.81	0.15
K	100.5	111.1	105.4	2.59	2.46	2.26
Ca	89.3	106.7	99.4	4.03	4.06	7.80
Ti	90.1	99.3	96.0	1.86	1.94	0.04
V	91.0	101.8	96.0	2.52	2.62	-3.40
Mn	91.5	111.4	99.8	4.45	4.46	-12.98
Fe	90.0	105.9	97.4	4.14	4.24	6.07
Cu	96.5	114.3	103.4	3.99	3.86	-1.66
Zn	94.2	109.6	102.6	3.23	3.14	4.53
Pb	94.4	109.2	104.3	3.53	3.39	-4.47

<u>Reproducibility</u>

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 3-53** shows the correlation coefficient and average RPDs for the replicate analysis. The correlation coefficients range from 0.9843 to 0.9994.

Table 3-53. Replicate Data for Chester XRF 770

Kevex 770			
Element	**n**	**Correlation Coefficient**	**Average RPD**
Al	84	.9930	-0.77
Si	128	.9988	-5.03
S	128	.9991	-0.22
K	128	.9931	-1.52
Ca	128	.9993	-1.69
Fe	128	.9994	-1.49
Zn	116	.9843	-1.45

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 Chester'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 $PM_{2.5}$ 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 December 26, 2005. The calculated MDLs are presented in Appendix 2 of the RTI Quality Assurance Project Plan for Chemical Speciation of $PM_{2.5}$ Filter Samples.

3.5.2.6 Audits, PEs, Training, and Accreditations

Chester LabNet 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 Chester 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.

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 [IMPROVE]
- Standard Operating Procedure for Coating and Extracting Denuders for Capture of Ammonia and Its Measurement [specific for use with glass honeycomb denuder] [MetOne]
- 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

Mr. Jim O'Rourke coordinates the Denuder Refurbishment Laboratory. He 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 3-54 lists the denuders refurbished and the number of refurbishments completed in 2011.

Table 3-54. Denuder Refurbishments, January 1, 2011 through December 31, 2011

Denuder Type	Total Refurbished
Aluminum Honeycomb	979

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 was one major quality issues in the SHAL during 2011. On Wednesday June 8, 2011, there was a power outage at RTI's Sample Handling Laboratory. When power was restored, a power surge damaged the walk-in cooler where newly received packages from the field sites were stored prior to unpacking. The walk-in cooler was repaired within 18 hours, but packages inside the cooler reached a maximum temperature of 20°C (68°F) during this time. Although a deviation from RTI's normal procedures, there is likely to be little affect on the analytical results of the filters inside the cold room during the outage. This is due to the short duration of the temperature rise (relative to the sample collection/retrieval and normal assembly/ disassembly periods) as well as the relatively low temperatures experienced (i.e., room temperature storage). All filters that were stored in the cooler at the time of the outage were assigned a new data qualifying flag of "RTS - Refrigeration Lost Prior to Analysis". This flag does not invalidate the data and the results were posted to AQS without any qualifier, unless a monitoring agency instructed RTI to add a flag as part of their regular data review process. A total of 127 events from sampling date of June 2, 2011 and 62 events from sampling date of June 5, 2011 were assigned the RTS data qualifying flag.

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

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 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 2011, the SHAL shipped out and received back more than 32,000 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 3-55** lists those sites with less than 95% of their filters run on the intended sampling date.

Table 3-55. Sites with Less than 95% of Filters Run on Intended Sampling Date

AQS Site Code	POC	Location	Events(1)	On Date	Percent
460990008	5	Sioux Falls School Site(2)	218	86	39.4
150030010	5	Kapolei	214	184	86.0
360010005	5	Albany Co HD	224	193	86.2
471570075	5	Shelby Farms	186	162	87.1
490353006	5	Hawthorne	224	202	90.2
540390011	5	WV-Guthrie Agricultural Center	182	169	92.9

(1) For sites with both SASS and URG 3000 N, each sampler was counted separately.
(2) The Sioux Falls School Site often collected samples on dates other than the scheduled date during 2011.

3.7.5 Support Activities for Site Operators and Data Users

SHAL staff provided support to site operators and data users throughout 2011. A summary of email and phone communications with site operators and data users is presented in **Table 3-56**.

Table 3-56. Summary of SHAL Communications with Site Operators and Data Users

Description	Number of Communications
Site will send cooler late	193
Site needs schedule	45
Site did not receive cooler	60
Change of operator/site information	43
Sampler problems/questions	101
Field Blank/Trip Blank ran as routine sample	1
Request change of ship date from RTI	33
Site is stopping	20
Miscellaneous QA Issues	253
Data questions/reporting	147
Other	212

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 2011 is shown in **Table 3-57**.

Table 3-57. Review of SHAL Technician Processing Filter Modules

Module Type	Number Observed	Findings	Findings Reviewed with Technician
MET ONE	112	5	5
URG 3000N	112	0	0

3.7.7 Chemical Speciation Site Changes 2011

The University of Florida Ag School site (120111002) was supposed to stop at the end of 2010 and the samplers were to be moved to the Broward County Highway location. However, this move did not take place in 2011 because the new location was not ready.

Three sites changed from the 1-day-in-3 sample collection schedule to the Alternate 1-day-in-3 collection schedule during 2011. These were: Del Norte (350010023) in NM, Grand Rapids (260810020) in MI and North Birmingham (010730023) in AL.

Three sites in Minnesota stopped sampling for the entire month of July due to state budget problems. These were: Phillips (270530963), Blaine Anoka County Airport (270031002) and MN-Rochester (271095008).

A number of sites stopped permanently during 2011. The Water Treatment Plant (540690010) in WV stopped 8/13/11. The samplers were moved to the Moundsville Armory (540511002) site which began sampling on 8/19/11. The Hammond Purdue (180892004) site in IN stopped sampling on 9/30/11. The Philadelphia AMS Lab (421010004) site in PA, the Kingston (471451001) site in TN and the Army Reserve Center (191130037) site in IA all stopped permanently at the end of 2011

The Green Bay East HS (550090005) site in WI began sampling on 10/12/11. This is a new CSN site. And the Linn County Health (191130040) site in IA began sampling in January 2012. This is also a new CSN site.

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

No operational changes were made to data processing in 2011.

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 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.

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
133	2/14/2011	11/10/2010	1/10/2011	1,599	1,119		4	240	235
134	3/15/2011	1/6/2011	2/14/2011	1,437	1,208	75		77	77
135	4/14/2011	2/8/2011	3/12/2011	1,124	1,124				
136	5/13/2011	3/10/2011	4/12/2011	1,590	1,436			77	77
137	6/15/2011	4/9/2011	5/11/2011	1,826	1,116	180	178	177	175
138	7/15/2011	5/6/2011	6/13/2011	1,511	1,352		1	80	78
139	8/15/2011	6/8/2011	7/12/2011	1,563	1,205			180	178
140	9/14/2011	6/29/2011	8/9/2011	1,413	1,176	78	1	79	79
141	10/14/2011	8/7/2011	9/13/2011	1,696	1,342			178	176
142	11/14/2011	9/12/2011	10/9/2011	1,417	1,183		78	78	78
143	12/14/2011	10/6/2011	11/14/2011	1,889	1,357	178		177	177
144	1/13/2012	11/11/2011	12/11/2011	1,392	1,236			78	78
			Total	18,457	14,854	511	262	1,421	1,408

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		Total (1)	Routine	Blanks			Backup Filters (3)
Batch	Date	Earliest	Latest			Field	Trip	24 Hour(2)	Routine
133	2/14/2011	11/10/2010	1/10/2011	116,587	107,379		384	5,520	3,290
134	3/15/2011	1/6/2011	2/14/2011	124,251	115,902	5,500		1,771	1,078
135	4/14/2011	2/8/2011	3/12/2011	107,767	107,767				
136	5/13/2011	3/10/2011	4/12/2011	140,645	137,796			1,771	1,078
137	6/15/2011	4/9/2011	5/11/2011	130,606	106,801	13,190	4,094	4,071	2,450
138	7/15/2011	5/6/2011	6/13/2011	131,682	128,727		23	1,840	1,092
139	8/15/2011	6/8/2011	7/12/2011	121,460	114,828			4,140	2,492
140	9/14/2011	6/29/2011	8/9/2011	120,711	112,046	5,719	23	1,817	1,106
141	10/14/2011	8/7/2011	9/13/2011	138,473	131,737			4,272	2,464
142	11/14/2011	9/12/2011	10/9/2011	121,313	116,477		1,872	1,872	1,092
143	12/14/2011	10/6/2011	11/14/2011	154,141	134,013	13,402		4,248	2,478
144	1/13/2012	11/11/2011	12/11/2011	125,138	122,174			1,872	1,092
			Total	1,532,774	1,435,647	37,811	6,396	33,194	19,712

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.

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	
131	999	234	173	2	234
132	1,318	235		64	235
133	1,139	241		4	240
134	1,229	77	76		77
135	1,140				
136	1,455	78			78
137	1,141	178	181	178	178
138	1,373	81		1	81
139	1,226	180			180
140	1,199	79	78	1	79
141	1,375	178			178
142	1,190	78		78	78
Total	14,784	1,639	508	328	1,638

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	
131	57,708	3,042	7,799	116	3,042
132	76,044	3,055		3,706	3,055
133	65,429	3,133		232	3,120
134	70,733	1,001	3,427		1,001
135	65,725				
136	83,894	1,014			1,014
137	65,738	2,314	8,159	2,314	2,314
138	78,695	1,053		13	1,053
139	70,206	2,340			2,340
140	68,576	1,027	3,517	13	1,027
141	78,746	2,314			2,314
142	68,149	1,014		1,014	1,014
Total	849,643	21,307	22,902	7,408	21,294

1) URG 3000 N only

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

	Report Batch											
	131	132	133	134	135	136	137	138	139	140	141	142
Change Requests[1]	3	6	6	5	4	5	10	5	8	5	9	5

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 in September 2011.

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 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 2011 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 outgoing packages (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 2011. 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 2011 the flag percentages were low and stable. Increases in the percentages of flags such as DST, temperature of receipt above 4°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 a typical, 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	133	134	135	136	137	138	139	140	141	142	143	144
1	Critical Criteria Not Met				0.0%								
2	Operational criteria not met					0.2%	0.1%	0.0%	0.0%				0.0%
5	Outlier - cause unknown	2.5%	2.8%	2.4%	3.0%	3.6%	3.5%	3.8%	3.5%	4.7%	5.1%	4.7%	5.4%
IC	Chem. Spills and Industrial Accidents	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.3%	0.4%	0.3%	0.4%	0.3%	0.4%
ID	Cleanup After a Major Disaster	0.3%	0.3%	0.2%	0.2%	0.2%	0.1%	0.3%	0.4%	0.3%	0.4%	0.3%	0.4%
IH	Fireworks							0.3%					
II	High Pollen Count				0.2%	0.3%	0.2%						
IJ	High Winds	0.3%	0.8%	0.1%		0.4%	0.1%	0.1%		0.2%	0.1%	0.1%	0.3%
IL	Other	0.2%	0.4%	0.2%	0.6%	0.6%	0.4%	0.1%	0.2%	0.3%	0.1%	0.1%	0.2%
IM	Prescribed Fire			0.1%	0.1%			0.1%			0.2%	0.2%	
IN	Seismic Activity			0.1%						0.0%			
IP	Structural Fire	0.1%											
IT	Wildfire-U. S.						0.2%	0.1%	0.2%	0.4%	0.2%		
W	Flow Rate average out of spec	0.2%	0.3%	0.0%				0.1%	0.2%	0.1%	0.0%	0.1%	0.2%
X	Filter Temp. Diff out of spec	0.4%	0.7%	0.4%	0.6%	0.4%	0.5%	0.9%	0.5%	1.1%	0.8%	0.6%	1.2%
Y	Elapsed Sample time out of spec				0.0%			0.1%	0.0%	0.0%	0.0%	0.1%	0.1%

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

Flag	Description	133	134	135	136	137	138	139	140	141	142	143	144
AB	Technician Unavailable	0.7%	0.6%	0.7%	0.5%	0.2%	0.1%	0.4%	0.2%	0.4%	0.4%	0.2%	1.0%
AC	Construction/Repairs in Area										0.0%	0.0%	0.1%
AD	Shelter Storm Damage												0.1%
AF	Scheduled but not Collected	1.8%	2.0%	1.3%	0.6%	0.8%	1.1%	1.9%	2.0%	1.9%	0.8%	0.7%	2.1%
AG	Sample Time out of Limits	0.5%	0.8%	0.9%	0.6%	1.0%	0.7%	0.8%	0.5%	1.0%	0.7%	0.7%	0.7%
AH	Sample Flow Rate out of Limits	1.2%	0.8%	0.9%	0.7%	0.4%	0.4%	0.7%	0.3%	0.7%	0.5%	0.4%	0.8%
AI	Insufficient Data (Can't Calculate)	0.4%	0.4%	0.0%	0.1%	0.1%	0.3%	0.2%	0.1%	0.2%	0.1%	0.2%	0.1%
AJ	Filter Damage	0.2%	0.4%	0.5%	0.4%	0.1%	0.1%	0.1%	0.2%	0.2%	0.2%	0.1%	0.1%
AK	Filter Leak											0.0%	
AL	Voided by Operator	0.2%	0.3%	0.6%	0.5%	0.1%	0.4%	0.2%	0.4%	0.1%	0.1%	0.3%	0.3%
AM	Miscellaneous Void	0.0%	0.1%	0.1%	0.0%	0.1%		0.0%	0.5%	0.1%	0.3%	0.0%	0.1%
AN	Machine Malfunction	2.2%	1.2%	0.8%	0.8%	0.4%	0.7%	0.9%	0.7%	1.3%	0.5%	0.6%	1.2%
AO	Bad Weather	0.2%	0.7%	0.1%	0.0%	0.2%	0.3%	0.1%	0.1%	0.4%			0.1%
AP	VANDALISM					0.1%						0.0%	0.1%
AQ	Collection Error	0.1%	0.1%	0.4%	0.2%	0.2%	0.1%	0.3%	0.3%	0.0%	0.5%	0.2%	0.2%
AR	Lab Error	0.1%	0.2%	0.1%	0.1%	0.1%	0.3%	0.2%	0.0%	0.2%	0.0%	0.1%	0.1%
AS	Poor Quality Assurance Results	0.0%											
AU	Monitoring Waived	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%			0.1%
AV	Power Failure	0.5%	0.5%	0.4%	0.6%	1.0%	0.8%	0.8%	0.6%	1.5%	0.4%	0.6%	0.6%
AW	Wildlife Damage					0.1%		0.1%					
BA	Maintenance/Routine Repairs	0.3%	0.0%		0.4%	0.3%	0.0%	0.2%	0.2%	0.3%	0.1%	0.1%	0.1%
BB	Unable to Reach Site	0.5%	0.1%	0.2%		0.1%	0.1%	0.0%		0.1%	0.1%	0.1%	0.3%
BE	Building/Site Repairs				0.1%	0.1%							0.1%
BI	Lost or Damaged in Transit	0.0%			0.1%	0.1%							
BJ	Operator Error							0.1%					

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

Flag	Description	133	134	135	136	137	138	139	140	141	142	143	144
DEC	Module end cap missing						0.0%						
DFM	Filter missing			0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%		0.0%	0.0%
DST	Received Temperature > 4°C	5.7%	7.3%	9.7%	18.3%	28.3%	28.7%	49.1%	50.3%	34.9%	24.9%	14.6%	12.5%
FBS	Field or Trip Blank appears to be actual sample					0.1%			0.1%			0.0%	
FC3	Channel 3 used instead of designated channel	0.5%	0.4%	0.5%	0.5%	0.5%	0.5%	0.6%	0.5%	0.6%	0.6%	0.5%	1.0%
FC4	Channel 4 used instead of designated channel	0.2%	0.1%	0.2%	0.2%	0.2%	0.1%	0.2%	0.2%	0.2%	0.2%	0.2%	0.4%
FC5	Channel 5 used instead of designated channel	1.0%	0.8%	0.9%	0.7%	0.7%	0.9%	1.3%	1.0%	1.2%	1.2%	0.8%	1.2%
FC6	Channel 6 used instead of designated channel	0.4%	0.3%	0.4%	0.3%	0.3%	0.4%	0.6%	0.4%	0.5%	0.5%	0.4%	0.5%
FC7	Channel 7 used instead of designated channel	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%	0.2%
FCE	Corrected - operator data entry	1.5%	1.1%	2.2%	1.0%	1.1%	1.6%	1.4%	2.1%	1.8%	1.0%	1.0%	1.4%
FES	Field Environmental Data Substituted	0.1%	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%
FHT	Pickup holding time exceeded	10.6%	21.4%	16.9%	8.1%	18.2%	14.3%	22.6%	7.4%	15.7%	16.9%	9.0%	20.0%
FSB	Sample is blank											0.1%	
LFA	Filter inspection - Filter wet	0.1%	0.3%	0.3%	0.2%		0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
LFH	Filter inspection - Holes in filter	0.0%				0.1%			0.0%	0.1%			
LFO	Filter inspection flags* -Other			0.0%		0.0%						0.0%	
LFT	Filter inspection - Tear				0.0%	0.0%	0.1%	0.1%			0.1%		0.1%
QAC	Cation/Anion Ratio out of limits	0.2%	0.3%	0.5%	0.2%	0.1%	0.3%	0.3%	0.2%	0.5%	0.4%	0.3%	0.4%
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	Reconstituted mass balance outside limits	2.3%	2.4%	1.9%	2.8%	3.4%	3.1%	3.5%	3.1%	4.2%	4.6%	4.4%	5.0%
RTS	Room Temperature Storage						13.1%			2.8%			

5.3 Analysis of Collocated Data

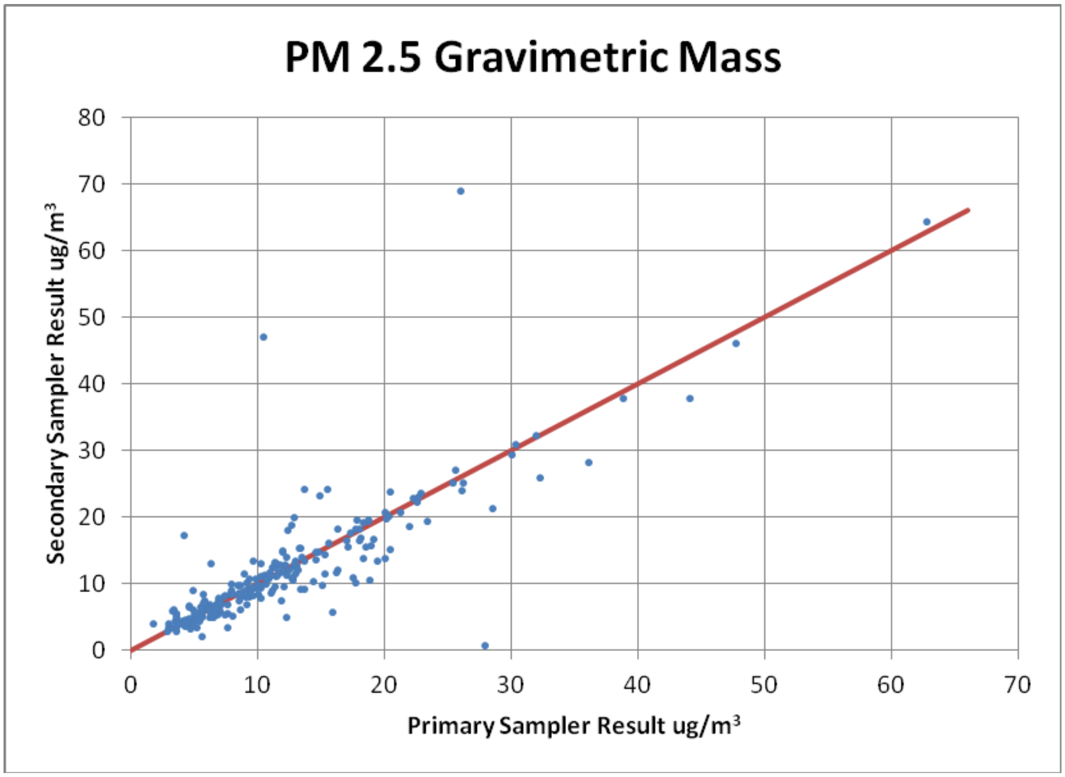
The CSN program operated six sites with collocated samplers during 2011, shown in **Table 5-4**. All six sites included collocated MetOne samplers for Teflon and nylon filters, plus the URG 3000N samplers for quartz on both the primary and collocated sampler. The primary samplers at these sites run on 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.

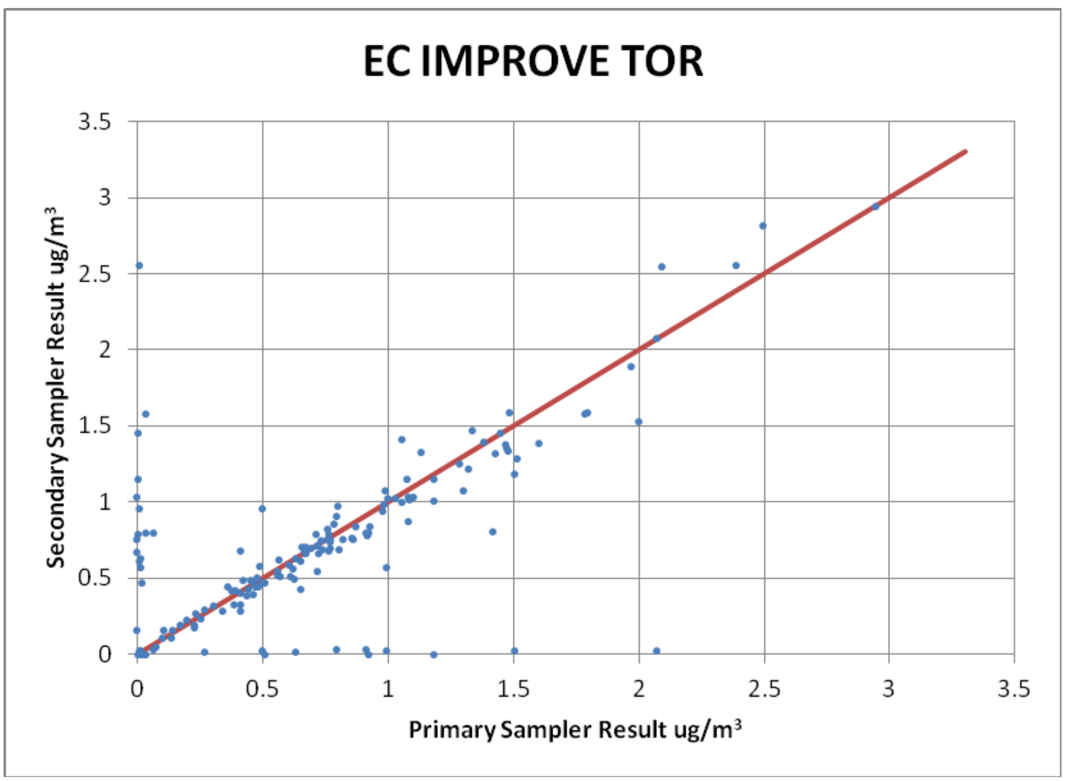
Table 5-4. Collocated Sites in the CSN During 2011.

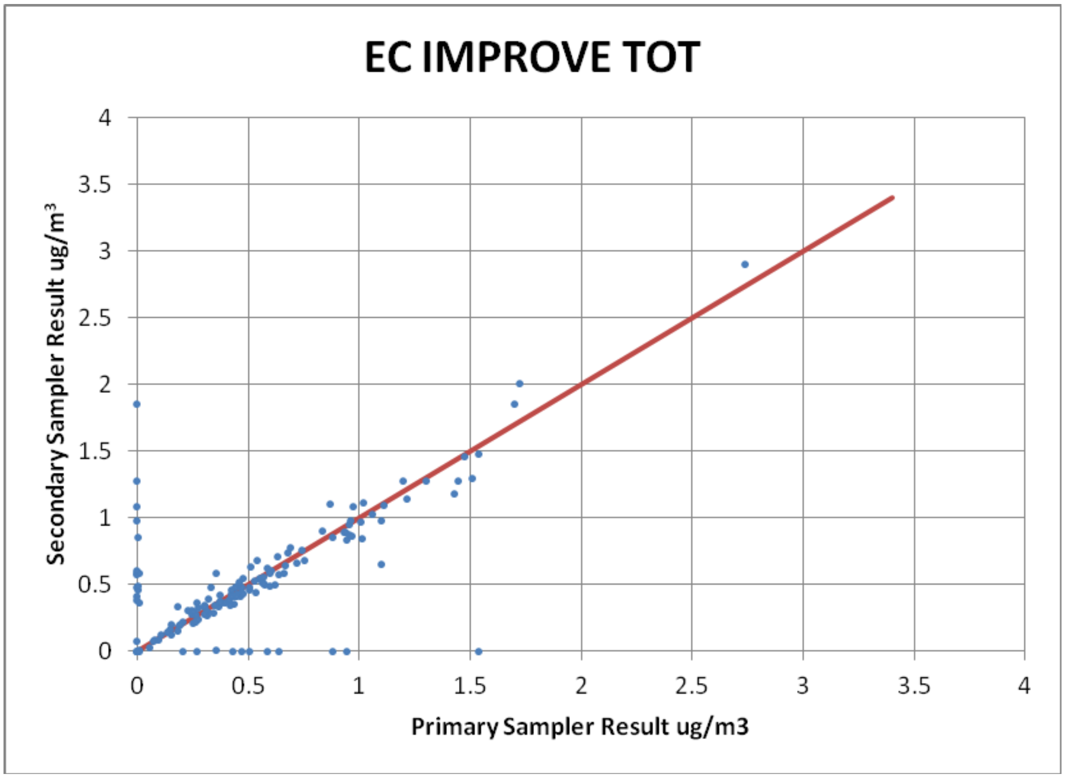
Location Name	State	AQS Code	Sampler Type
Bakersfield-California Ave	California	60290014	MetOne SASS + URG 3000N
Deer Park	Texas	482011039	MetOne SASS + URG 3000N
G.T. Craig	Ohio	390350060	MetOne SASS + URG 3000N
New Brunswick	New Jersey	340230006	MetOne SASS + URG 3000N
Riverside-Rubidoux	California	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 2011.







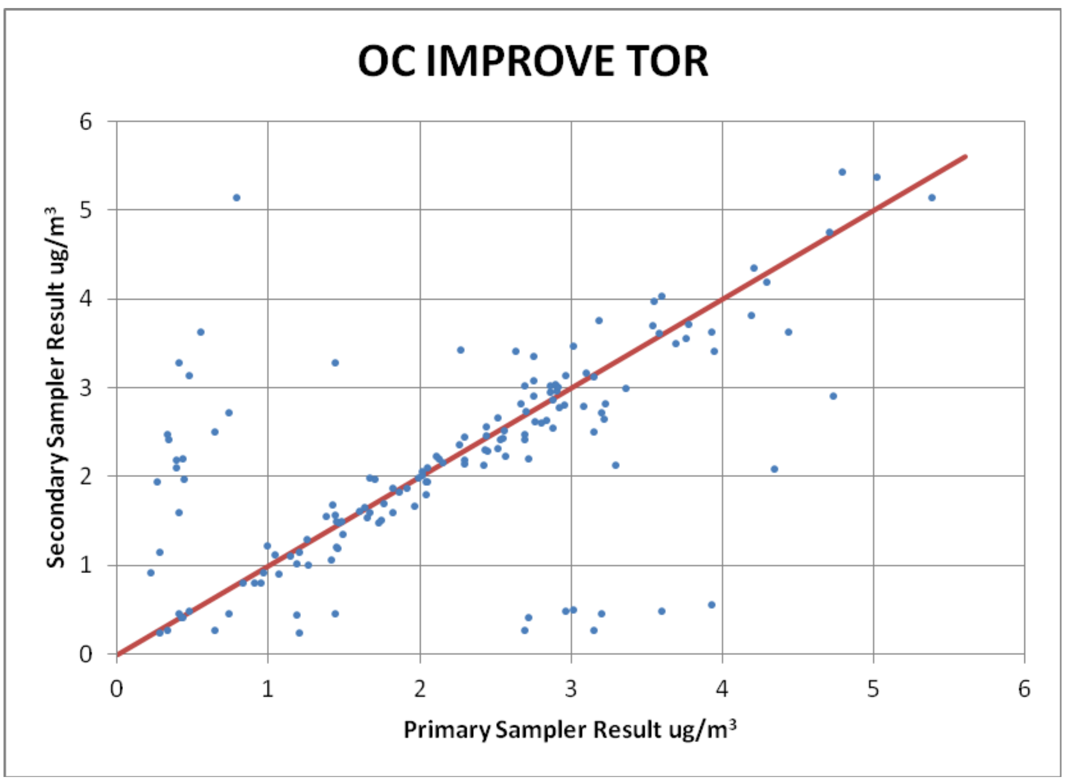
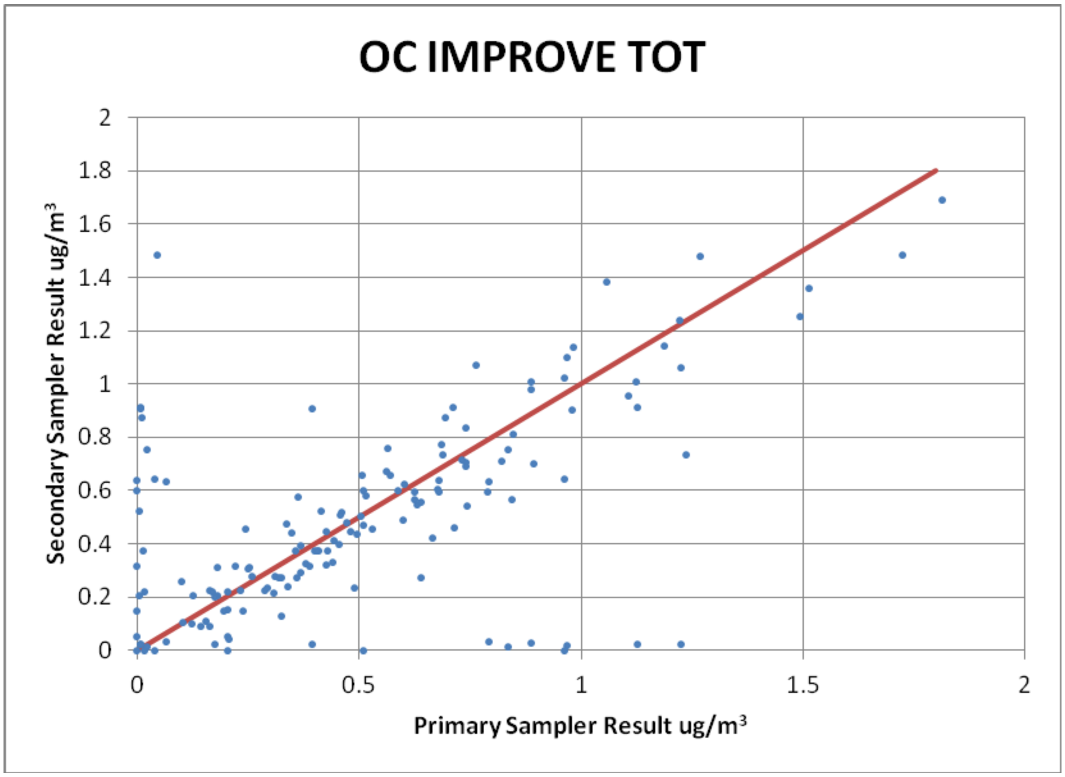


Figure 5-1. (continued).



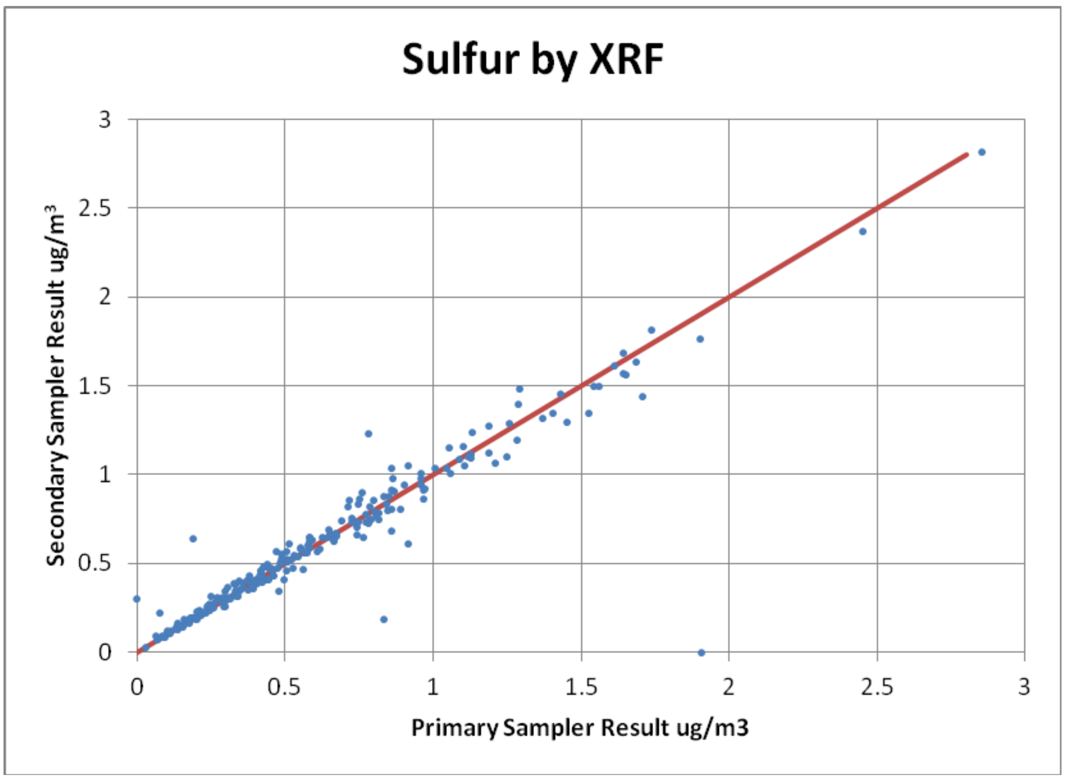
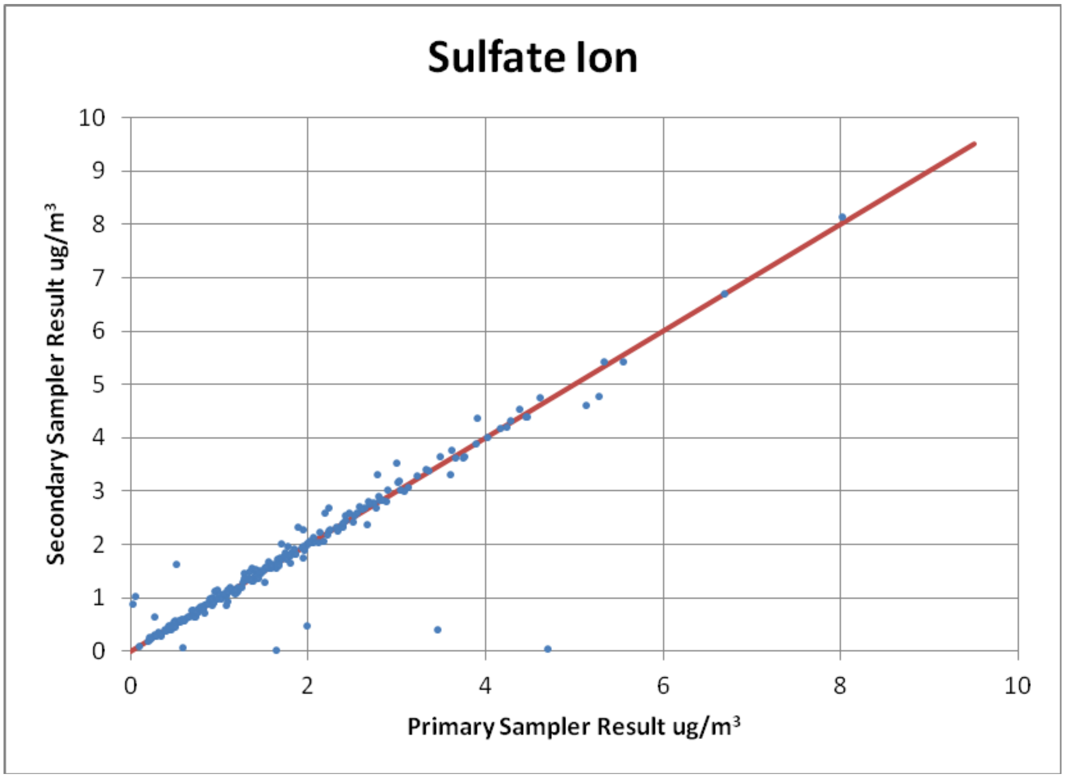


Figure 5-1. (continued).



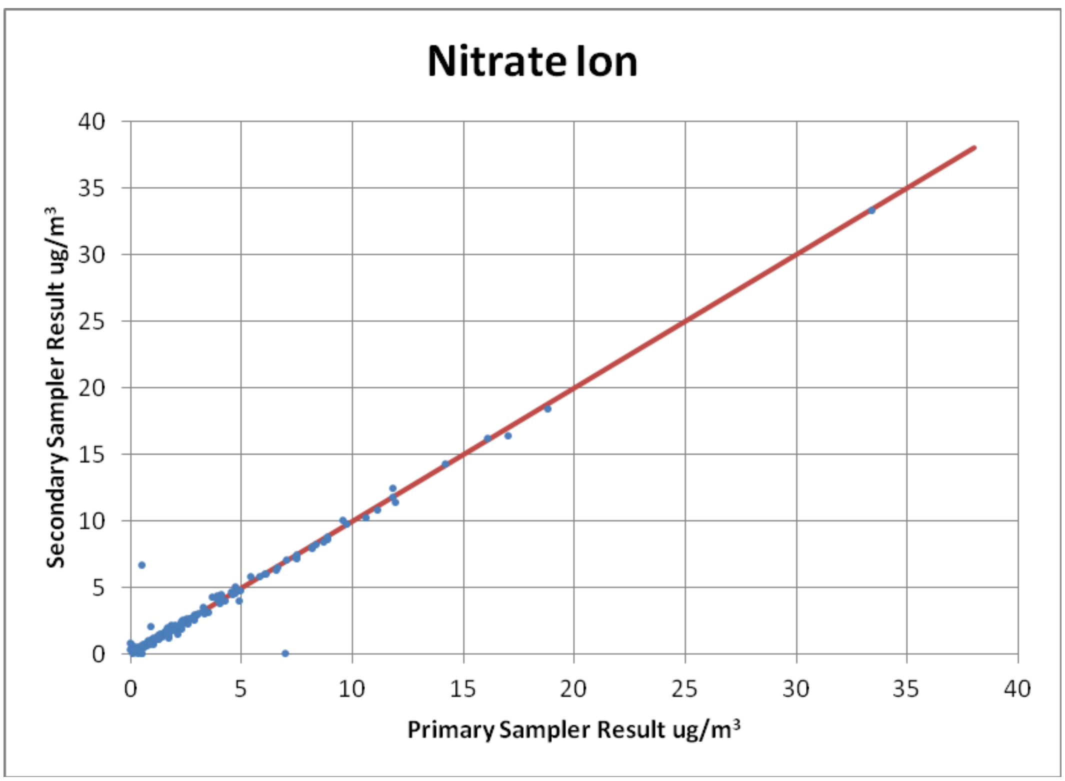


Figure 5-1. (continued).

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:

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

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 Unc." is simply the grand average of all the relative uncertainties associated with the C_1 and C_2 values and is calculated as follows:

$$AvAQS = \frac{1}{n} \sum_i \sum_j \frac{U_{ij}}{C_{ij}}$$

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).
- n refers to the total number of measurements (i.e., 2 * i)

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 2011. 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:

- Calcium (42%) and Iron (34%) were less than 50% while Lead (232%) was greater than 200%.

Table 5-5. Precision of Collocated Samplers

Analyte	Sampler 1		Sampler 2		Avg Rel Diff[2]	Avg Rel AQS Unc[3]	Ratio AQS/ ARD[4]	Counts[5]
	Avg. Conc	St Dev[1]	Avg. Conc	St Dev[1]				
PARTICULATE MATTER (GRAVIMETRY)								
Particulate matter 2.5u	11.857	7.570	11.857	7.570	12%	7%	53%	292
ANIONS AND CATIONS BY IC								
Potassium	0.066	0.045	0.066	0.045	18%	13%	74%	197
Sodium	0.225	0.229	0.225	0.229	18%	14%	80%	175
Ammonium	1.064	1.256	1.064	1.256	8%	7%	90%	283
Nitrate	2.130	3.462	2.130	3.462	10%	8%	73%	291
Sulfate	1.939	1.362	1.939	1.362	7%	7%	107%	291
TRACE ELEMENTS BY XRF								
Aluminum	0.117	0.145	0.117	0.145	34%	22%	64%	139
Calcium	0.065	0.076	0.065	0.076	27%	12%	**42%**	287
Iron	0.113	0.122	0.113	0.122	23%	8%	**34%**	291
Potassium	0.071	0.060	0.071	0.060	16%	9%	60%	289
Magnesium	0.043	0.030	0.043	0.030	29%	21%	73%	67
Sodium	0.196	0.200	0.196	0.200	22%	20%	91%	184
Lead	0.010	0.006	0.010	0.006	14%	31%	**232%**	15
Sulfur	0.686	0.479	0.686	0.479	6%	7%	131%	290
Silicon	0.184	0.290	0.184	0.290	28%	14%	51%	251
Zinc	0.010	0.012	0.010	0.012	22%	17%	79%	195
ORGANIC AND ELEMENTAL CARBON BY IMPROVE_A METHOD (Sampled by URG 3000N)								
EC IMPROVE TOR	0.670	0.445	0.670	0.445	9%	N/A	N/A	293
EC IMPROVE TOT	0.433	0.332	0.433	0.332	9%	N/A	N/A	293
OC IMPROVE TOR	2.114	1.065	2.114	1.065	7%	N/A	N/A	293
OC IMPROVE TOT	2.351	1.197	2.351	1.197	6%	N/A	N/A	293

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

Beginning in 2011, in the CSN program, the MET ONE SASS samplers collect Field Blank samples at a frequency of 3%. No Trip Blank samples are collected for the MET ONE SASS samplers. For the URG 3000N samplers Trip Blanks are collected at a frequency of 2% and 24 hour Blank Filters and Backup filters are collected at a frequency of 10%. 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 2011.

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 2011. 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 133 through 142).

Species	Mean (ug/m^3)	Percentiles of Concentration (ug/m^3)						
		5	10	25	Median	75	90	95
Cations and Anions by Ion Chromatography								
Ammonium	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.015
Potassium	0.005	0.000	0.000	0.000	0.000	0.000	0.021	0.040
Sodium	0.018	0.000	0.000	0.000	0.000	0.019	0.038	0.063
Nitrate	0.046	0.000	0.000	0.000	0.038	0.058	0.098	0.140
Sulfate	0.036	0.000	0.000	0.020	0.034	0.045	0.056	0.072
Mass by Gravimetry								
Particulate matter 2.5µ	0.625	-0.313	0.000	0.104	0.521	0.938	1.469	2.083
Organic and elemental carbon by IMPROVE A Method (TOT and TOR)								
E1 IMPROVE	0.002	0.000	0.000	0.000	0.000	0.000	0.004	0.009
E2 IMPROVE	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.004
E3 IMPROVE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EC IMPROVE TOR	0.002	0.000	0.000	0.000	0.000	0.000	0.005	0.011
EC IMPROVE TOT	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.004
O1 IMPROVE	0.012	0.000	0.000	0.000	0.010	0.018	0.027	0.032
O2 IMPROVE	0.042	0.018	0.022	0.030	0.039	0.052	0.066	0.076
O3 IMPROVE	0.068	0.031	0.035	0.044	0.057	0.075	0.102	0.132
O4 IMPROVE	0.008	0.000	0.000	0.000	0.004	0.010	0.018	0.027
OC IMPROVE TOR	0.131	0.058	0.070	0.087	0.114	0.150	0.192	0.243
OC IMPROVE TOT	0.132	0.058	0.070	0.087	0.114	0.151	0.193	0.248
OP IMPROVE TOR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OP IMPROVE TOT	0.001	0.000	0.000	0.000	0.000	0.000	0.003	0.007
TC IMPROVE	0.133	0.058	0.070	0.087	0.115	0.151	0.195	0.252
Trace elements by XRF (33 Elements)								
Aluminum	0.003	0.000	0.000	0.000	0.000	0.003	0.009	0.015
Antimony	0.005	0.000	0.000	0.000	0.001	0.009	0.015	0.018
Arsenic	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Barium	0.001	0.000	0.000	0.000	0.000	0.000	0.004	0.006
Bromine	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002
Cadmium	0.004	0.000	0.000	0.000	0.000	0.009	0.014	0.017
Calcium	0.001	0.000	0.000	0.000	0.000	0.001	0.002	0.002
Cerium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
Cesium	0.002	0.000	0.000	0.000	0.000	0.003	0.005	0.007
Chlorine	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.003
Chromium	0.001	0.000	0.000	0.000	0.000	0.001	0.002	0.002
Cobalt	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002
Copper	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Indium	0.005	0.000	0.000	0.000	0.000	0.009	0.016	0.019
Iron	0.003	0.000	0.000	0.000	0.001	0.002	0.006	0.013
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	0.006
Manganese	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001

Species	Mean (ug/m^3)	Percentiles of Concentration (ug/m^3)						
		5	10	25	Median	75	90	95
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	0.002	0.004
Potassium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
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	0.001	0.001	0.001
Silicon	0.001	0.000	0.000	0.000	0.000	0.000	0.003	0.005
Silver	0.004	0.000	0.000	0.000	0.000	0.006	0.012	0.016
Sodium	0.003	0.000	0.000	0.000	0.000	0.001	0.007	0.024
Strontium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002
Sulfur	0.002	0.000	0.000	0.000	0.000	0.000	0.001	0.002
Tin	0.004	0.000	0.000	0.000	0.000	0.006	0.012	0.016
Titanium	0.000	0.000	0.000	0.000	0.000	0.000	0.001	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	0.001
Zirconium	0.001	0.000	0.000	0.000	0.000	0.001	0.003	0.004

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

Analyte	Mean	Percentiles of Concentration (as ug/m^3)						
		5	10	20	50 (median)	70	90	95
EC IMPROVE TOR	0.0079	0.0000	0.0000	0.0000	0.0022	0.0111	0.0236	0.0319
EC IMPROVE TOT	0.0018	0.0000	0.0000	0.0000	0.0000	0.0004	0.0057	0.0099
OC IMPROVE TOR	0.3065	0.1189	0.1479	0.2028	0.2808	0.3845	0.4939	0.5728
OC IMPROVE TOT	0.3127	0.1191	0.1479	0.2037	0.2851	0.3920	0.5128	0.5926
TC IMPROVE	0.3144	0.1191	0.1479	0.2041	0.2863	0.3948	0.5176	0.5947
E1 IMPROVE	0.0073	0.0000	0.0000	0.0000	0.0010	0.0098	0.0204	0.0316
E2 IMPROVE	0.0032	0.0000	0.0000	0.0000	0.0000	0.0050	0.0104	0.0139
E3 IMPROVE	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
O1 IMPROVE	0.0308	0.0000	0.0000	0.0003	0.0215	0.0441	0.0714	0.1006
O2 IMPROVE	0.0992	0.0398	0.0490	0.0668	0.0923	0.1227	0.1605	0.1844
O3 IMPROVE	0.1349	0.0546	0.0654	0.0855	0.1197	0.1664	0.2132	0.2607
O4 IMPROVE	0.0389	0.0032	0.0072	0.0158	0.0309	0.0545	0.0779	0.0954
OP IMPROVE TOR	0.0027	0.0000	0.0000	0.0000	0.0000	0.0000	0.0067	0.0196
OP IMPROVE TOT	0.0088	0.0000	0.0000	0.0000	0.0009	0.0117	0.0264	0.0383

6.0 External Audits

6.1 Performance Evaluation (PE) Audit Results

Annual multi-laboratory intercomparison studies have been conducted since 2007 as part of EPA's QA oversight for the CSN and the Interagency Monitoring of Protected Visual Environments (IMPROVE) Program. The PE samples for these annual studies are prepared at the National Air and Radiation Environmental Laboratory (NAREL) located in Montgomery, AL. The filters used as PE 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 is the primary metric of performance.

The multi-lab PE study requires each participating laboratory to analyze a set of blind PE samples. 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

6.1.1 Performance Evaluation Audit Results for 2011

Results of the PE samples were received and analyzed during late 2010 and early 2011 were received in May, 2011. NAREL's final report can be found at the following URL:

http://www.epa.gov/ttnamti1/files/ambient/pm25/spec/20110615MultilabSpeciation.pdf

X-ray Fluorescence. The RTI XRF laboratory served as the reference lab for the 2011 round. As the reference lab, RTI analyzed all of the 47mm filters used as PE samples in late 2010 so that NAREL could distribute them to the other participating laboratories. RTI did not re-analyze filters that it had already analyzed as the reference laboratory.

Gravimetric Mass and Ion Chromatography. RTI's performance on gravimetric mass and IC was uniformly within the range of the other laboratories and in good agreement with the designated reference labs. However, an issue was noted with RTI's PE results for OC/EC as described below.

It was pointed out in NAREL's May, 2011, report that duplicate analysis results did not agree well between two of RTI's analyzers for several of the organic carbon subfractions and the pyrolysis carbon fraction. The disagreement was between results for two filters analyzed in duplicate on two RTI instruments ("R" and "T"). At the time of the report, RTI could not provide a technical reason for the observed discrepancies. It was noted that the carbon subfractions have high relative uncertainty; subfraction data are of limited utility for source apportionment or other data uses; duplicate results in terms of total OC, total EC, and TC agreed well.

In early 2012, RTI's new OC/EC laboratory supervisor was able to diagnose the cause for the discrepancy in the duplicate results. After consulting with Sunset Labs, maker of analyzers R and T, it was determined that the most likely cause for the differences between instruments was the algorithm used to identify the integration start times. The R and T analyzers run different versions of the Sunset Labs software because the T analyzer was upgraded to "dual mode" in 2006, while the R analyzer was not upgraded.

Analyzer R uses fixed integration times based on analysis of sucrose standards by detecting minima in the FID signal that occurs at the end of each temperature step. These fixed integration times are included in instrument parameter files and are used by the instrument software when calculating the areas of each peak. The integration times determined in this way are typically used for many months before updating. Analyzer T's dual-mode software automatically determines integration times for each individual filter using a similar algorithm. Thus, the integration times may vary from filter to filter on analyzer T, and integration times determined by T may not agree well with those determined for R by analysis of sucrose standards. RTI confirmed this explanation by reanalyzing on the R instrument of raw data acquired on the T instrument (after necessary data scaling and reformatting were done to make the raw data files compatible). The reanalysis results for the OC fractions and pyrolysis carbon duplicates were significantly closer than the original results that had been reported to NAREL in early 2011.

6.1.2 Performance Evaluation Audit Analyses 2012

As with the 2011 interlaboratory study, the RTI XRF laboratory served as the reference lab for the 2012 round. As the reference lab, RTI analyzed all of the 47mm filters used as PE samples in late 2011 so that NAREL could distribute them to the other participating laboratories in early 2012. RTI did not re-analyze filters that it had analyzed as the reference laboratory. Filter analysis results for the gravimetry, ion chromatography, and OC/EC laboratories were submitted on February 15, 2012.

6.2 *Technical Systems Audit (TSA) Results*

EPA did not perform a TSA during 2010/2011. 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 References

7.1 List of CSN 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	O'Rourke	
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	9/19/2011	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	7/8/2008	Greene	
SOP	Analysis of Elements in Air Particulates by X-Ray Fluorescence (Kevex 770 & 772)	2/3/2009	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	8/19/2009	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	

Type	Title	Date Revised	Author	Document No.
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	2/13/2009	Peterson	
SOP	Standard Operating Procedures for Temperature Calibration of the Sample Thermocouple in a Sunset Laboratory or a DRI Model 2001 Carbon Aerosol Analyzer	2/16/2009	Peterson	
SOP	Standard Operating Procedure for the Determination of Organic, Elemental, and Total Carbon in Particulate Matter Using a Thermal/Optical-Transmittance Carbon Analyzer	2/13/2009	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	7/8/2009	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	5/9/2008	Eaton	
SOP	Procedures for Coating R&P Speciation Sampler Chemcomb™ Denuders with Sodium Carbonate	5/21/2008	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	3/12/2010	Eaton	
SOP	Standard Operating Procedure for Database Operations	5/8/2008	Rickman	

Type	Title	Date Revised	Author	Document No.
SOP	Standard Operating Procedure for Assigning Data Validation Flags for the Chemical Speciation Network	5/15/2008	Wall	
SOP	Standard Operating Procedure—Speciation Data Processing Disaster Recovery Plan	5/21/2008	Rickman	
SOP	Standard Operating Procedure for the X-Series ICP-MS for the Analysis of Particulate Deposits on Teflon Filters	7/8/2008	Weber	
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	2/18/2009	D. Haas	
SOP	Standard Operating Procedure for Corrective Action for the $PM_{2.5}$ Chemical Speciation Program	5/21/2008	Flanagan/Haas	
SOP	Standard Operating Procedure for Training for Staff Working on the $PM_{2.5}$ Chemical Speciation Program	5/8/2008	Haas	
QAPP	QAPP for PM2.5 of Chemical Speciation Samples	9/6/2011	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
Report	2009 Annual Data Summary Report	3/1/2010	RTI and Subs	RTI/0212053/01ADS
Report	2010 Annual Data Summary Report	2/28/2011	RTI and Subs	RTI/0212053/02ADS
Report	2011 Annual Data Summary Report	2/28/2012	RTI and Subs	RTI/0212053/03ADS

Appendix A

Method Detection Limits

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Appendix A
Method Detection Limits (Network-wide Maximum)

Analysis	Species	Mass_MDL (µg/filter)	Concentration (µg/m^3) by sampler type	
			SASS	URG 3000N
Gravimetry	Particulate matter 2.5u	7.5	0.82	
Anions and Cations	Ammonium	0.24	0.026	
	Potassium	0.23	0.025	
	Nitrate	0.21	0.023	
	Sodium	0.29	0.033	
	Sulfate	0.34	0.037	
Organic and Elemental Carbon	E1 IMPROVE	3.0		0.096
	E2 IMPROVE	2.0		0.064
	E3 IMPROVE	2.0		0.064
	EC IMPROVE TOR	2.0		0.064
	EC IMPROVE TOT	2.0		0.064
	Elemental carbon	2.4	0.25	
	O1 IMPROVE	2.0		0.064
	O2 IMPROVE	2.0		0.064
	O3 IMPROVE	3.0		0.096
	O4 IMPROVE	3.0		0.096
	OC IMPROVE TOR	2.0		0.064
	OC IMPROVE TOT	2.0		0.064
	OP IMPROVE TOR	3.0		0.096
	OP IMPROVE TOT	2.0		0.064
	Organic carbon	2.4	0.25	
	Pk1_OC	2.4	0.25	
	Pk2_OC	2.4	0.25	
	Pk3_OC	2.4	0.25	
	Pk4_OC	2.4	0.25	
	PyrolC	2.4	0.25	
	TC IMPROVE	3.0		0.096
	Total carbon	2.4	0.25	
Trace Elements (XRF)	Aluminum	0.24	0.026	
	Antimony	0.50	0.054	
	Arsenic	0.026	0.0028	
	Barium	0.57	0.062	
	Bromine	0.022	0.0024	
	Cadmium	0.22	0.023	
	Calcium	0.073	0.0081	
	Cerium	0.84	0.090	
	Cesium	0.44	0.048	
	Chlorine	0.11	0.012	
	Chromium	0.025	0.0027	
	Cobalt	0.019	0.0020	
	Copper	0.024	0.0028	

Analysis	Species	Mass_MDL (µg/filter)	Concentration (µg/m^3) by sampler type	
			SASS	URG 3000N
	Indium	0.32	0.034	
	Iron	0.032	0.0034	
	Lead	0.061	0.0066	
	Magnesium	0.18	0.020	
	Manganese	0.028	0.0030	
	Nickel	0.018	0.0019	
	Phosphorus	0.15	0.017	
	Potassium	0.11	0.012	
	Rubidium	0.025	0.0027	
	Selenium	0.025	0.0029	
	Silicon	0.18	0.020	
	Silver	0.36	0.039	
	Sodium	0.53	0.060	
	Strontium	0.034	0.0036	
	Sulfur	0.095	0.011	
	Tin	0.35	0.038	
	Titanium	0.051	0.0056	
	Vanadium	0.037	0.0041	
	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	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
Alabama (TN)	TN	471570024	5	SASS with URG 3000N	100	82	89	100	100	100	100	100	100	100	100	100
Alabama (TN)	TN	471570024	5	URG 3000N	100	89	93	100	100	100	100	100	100	100	100	100
Allen Park	MI	261630001	5	URG 3000N	100	100	100	95	90	100	94	100	100	100	100	50
Allen Park	MI	261630001	5	SASS with URG 3000N	100	100	100	100	90	100	100	100	100	100	100	89
Bakersfield-California Ave	CA	060290014	5	SASS with URG 3000N	78	78	100	88	75	100	100	100	86	88	99	63
Bakersfield-California Ave	CA	060290014	5	URG 3000N	86	86	100	93	88	94	100	100	92	100	100	43
Bakersfield-California Ave (Collocated)	CA	060290014	6	URG 3000N		60	50	100	100	67	100	100	100	100	100	80
Bakersfield-California Ave (Collocated)	CA	060290014	6	SASS with URG 3000N		83	100	80	75	100	100	100	100	80	100	60
Beacon Hill - Met One	WA	530330080	6	SASS with URG 3000N	100	100	100	88	100	100	100	80	100	89	100	100
Beacon Hill - Met One	WA	530330080	6	URG 3000N	100	100	100	93	88	100	100	50	92	93	94	100
Blair Street	MO	295100085	6	URG 3000N	100	100	100	100	80	95	94	100	100	100	100	100
Blair Street	MO	295100085	6	SASS with URG 3000N	100	100	100	90	100	100	99	100	100	100	100	100
Burlington	VT	500070012	5	SASS with URG 3000N	81	100	100	100	100	89	100	100	100	88	43	
Burlington	VT	500070012	5	URG 3000N	100	100	100	93	100	94	100	100	100	50	67	
Capitol - Met One	LA	220330009	5	URG 3000N	100	83	69	94	90	95	100	100	100	100	100	100
Capitol - Met One	LA	220330009	5	SASS with URG 3000N	80	84	90	90	90	91	100	100	73	100	100	100
Chamizal - Met One	TX	481410044	5	URG 3000N	100	100	75	39	100	95	100	100	94	94	100	100
Chamizal - Met One	TX	481410044	5	SASS with URG 3000N	89	100	90	70	100	100	100	84	90	100	92	100
Chicopee	MA	250130008	5	SASS with URG 3000N	100	100	100	100	100	100	99	100	100	89	77	100
Chicopee	MA	250130008	5	URG 3000N	93	69	63	89	80	95	88	25	83	56	0	
Com Ed - Met One	IL	170310076	5	URG 3000N	100	100	90	93	100	100	100	100	100	100	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch 131	132	133	134	135	136	137	138	139	140	141	142
Com Ed - Met One	IL	170310076	5	SASS with URG 3000N	100	100	84	88	100	100	100	100	100	100	100	100
Commerce City	CO	080010006	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Commerce City	CO	080010006	5	SASS with URG 3000N	100	100	83	100	100	100	100	100	100	100	100	100
CPW	SC	450190049	5	URG 3000N	100	94	50									
CPW	SC	450190049	5	SASS with URG 3000N	100	91	100									
Criscuolo Park	CT	090090027	5	URG 3000N	100	100	100	93	100	94	100	50	100	93	94	100
Criscuolo Park	CT	090090027	5	SASS with URG 3000N	100	100	100	77	100	82	100	100	100	100	88	100
Deer Park - Met One	TX	482011039	6	URG 3000N	93	94	88	100	100	100	100	100	100	100	100	94
Deer Park - Met One	TX	482011039	6	SASS with URG 3000N	100	100	100	100	100	100	100	82	100	100	100	100
Deer Park Collocated - Met One	TX	482011039	7	URG 3000N	100	100	100	80	100	100	100	100	100	100	100	100
Deer Park Collocated - Met One	TX	482011039	7	SASS with URG 3000N	100	100	100	100	100	100	100	80	100	100	100	100
Dover	DE	100010003	5	SASS with URG 3000N	100	100	83	100	100	100	80	80	0	0	20	98
Dover	DE	100010003	5	URG 3000N	100	100	75	100	100	100	88	100	100	100	100	100
East Providence	RI	440071010	5	SASS with URG 3000N	100	91	100	99	90	100	100	100	100	100	85	100
East Providence	RI	440071010	5	URG 3000N	93	94	56	89	70	90	88	95	83	88	82	44
El Cajon	CA	060730003	5	SASS with URG 3000N	100	100	71	99	100	100	83	100	100	100	100	91
El Cajon	CA	060730003	5	URG 3000N	100	100	65	100	100	100	90	100	100	86	100	100
Elizabeth Lab	NJ	340390004	5	SASS with URG 3000N	100	100	86	100	100	100	100	100	100	88	65	88
Elizabeth Lab	NJ	340390004	5	URG 3000N	100	100	75	100	100	100	100	100	100	50	81	79
Essex - Met One	MD	240053001	5	URG 3000N	100	100	50	100	100	100	100	100	100	93	94	100
Essex - Met One	MD	240053001	5	SASS with URG 3000N	100	100	71	78	75	100	100	100	100	100	100	100
Fargo NW	ND	380171004	5	SASS with URG 3000N	92	100	80	100	92	100	100	82	100	100	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch 131	132	133	134	135	136	137	138	139	140	141	142
Fargo NW	ND	380171004	5	URG 3000N	100	89	56	100	100	100	100	85	100	100	100	100
Fresno - First Street	CA	060190008	5	URG 3000N	68	89	100	100	100	100	44	100	100	100	100	100
Fresno - First Street	CA	060190008	5	SASS with URG 3000N	89	91	100	75	100	100	89	100	92	100	100	100
G.T. Craig	OH	390350060	5	SASS with URG 3000N	100	100	99	100	78	93	83	90	100	100	100	100
G.T. Craig	OH	390350060	5	URG 3000N	100	100	80	79	75	83	100	100	100	100	94	100
G.T. Craig - Collocated	OH	390350060	6	SASS with URG 3000N	94	75	97	77	95	62						
G.T. Craig - Collocated	OH	390350060	6	URG 3000N	100	88	100	80	100	100						
Garinger High School	NC	371190041	5	SASS with URG 3000N	100	100	100	90	100	93	100	100	100	100	92	100
Garinger High School	NC	371190041	5	URG 3000N	93	89	81	83	80	90	81	95	83	94	86	94
Hawthorne	UT	490353006	5	URG 3000N	100	100	100	100	70	100	100	100	83	75	100	86
Hawthorne	UT	490353006	5	SASS with URG 3000N	100	100	100	100	80	89	90	100	90	56	99	75
Henrico Co.	VA	510870014	5	URG 3000N	100	100	100	100	88	100	90	100	92	100	81	100
Henrico Co.	VA	510870014	5	SASS with URG 3000N	100	100	100	100	88	100	100	100	86	100	67	88
Hinton - Met One	TX	481130069	5	SASS with URG 3000N	100	100	100	86	100	100	100	90	100	98	97	100
Hinton - Met One	TX	481130069	5	URG 3000N	100	100	100	93	100	100	100	94	100	93	94	100
Jackson UMC	MS	280490019	5	URG 3000N	100	93	100	86	63	78	0	94	83	93	100	93
Jackson UMC	MS	280490019	5	SASS with URG 3000N	100	100	100	88	75	100	50	90	86	88	100	88
JFK Center	KS	202090021	5	URG 3000N	100	80	100	100	100	100	100	100	92	93	100	100
JFK Center	KS	202090021	5	SASS with URG 3000N	100	50	100	100	89	100	100	100	86	99	100	100
Lawrenceville	PA	420030008	6	SASS with URG 3000N	100	71	100	100	100	81	100	100	100	100	100	100
Lawrenceville	PA	420030008	6	URG 3000N	75	100	100	100	100	100	100	100	100	100	100	100
Lindon	UT	490494001	5	URG 3000N	50	100	100	100	100	100	100	100	100	100	88	100
Lindon	UT	490494001	5	SASS with URG 3000N	100	83	100	100	100	87	100	100	100	85	80	100
McMillan Reservoir - Met	DC	110010043	5	SASS with URG	100	100	100	100	91	100	100	90	100	100	76	100

Site	State	AQS Code	POC	Sampler Type	Report Batch 131	132	133	134	135	136	137	138	139	140	141	142
One				3000N												
McMillan Reservoir - Met One	DC	110010043	5	URG 3000N	100	100	100	93	100	100	90	94	100	100	81	100
MLK	DE	100032004	5	URG 3000N	100	75	71	89	80	95	94	95	94	50	86	100
MLK	DE	100032004	5	SASS with URG 3000N	50	80	73	61	51	100	100	100	90	87	75	99
New Brunswick	NJ	340230006	5	SASS with URG 3000N	99	100	100	91	100	100	100	100	100	100	78	100
New Brunswick	NJ	340230006	5	URG 3000N	75	100	90	100	100	100	100	100	100	100	81	100
New Brunswick (Collocated)	NJ	340230006	6	URG 3000N	33	90	88	80	100	83	100	80	88	100	88	100
New Brunswick (Collocated)	NJ	340230006	6	SASS with URG 3000N	93	78	73	75	93	82	100	100	100	80	60	100
North Birmingham	AL	010730023	5	SASS with URG 3000N	100	100	64	90	100	100	89	100	100	88	79	100
North Birmingham	AL	010730023	5	URG 3000N	93	94	100	89	90	95	94	95	100	86	94	93
Parklane	SC	450790007	5	SASS with URG 3000N			97	96	96	87	97	96	97	86	89	85
Parklane	SC	450790007	5	URG 3000N			50	100	90	39	88	95	94	100	100	100
Peoria Site 1127	OK	401431127	5	SASS with URG 3000N	100	89	100	88	75	100	100	90	100	100	100	100
Peoria Site 1127	OK	401431127	5	URG 3000N	100	93	75	93	100	100	100	94	100	93	100	100
PHILA - AMS Laboratory	PA	421010004	7	SASS with URG 3000N	89	100	88	100	100	100	99	100	100	100	100	100
PHILA - AMS Laboratory	PA	421010004	7	URG 3000N	50	50	68	100	100	100	50	100	100	100	50	100
Philips	MN	270530963	5	URG 3000N	100	100	69	100	100	100	94	100	81	100	100	100
Philips	MN	270530963	5	SASS with URG 3000N	92	100	80	100	100	100	89	92	67	100	100	90
Phoenix Supersite	AZ	040139997	7	SASS with URG 3000N	100	100	100	90	90	100	100	100	100	100	85	100
Phoenix Supersite	AZ	040139997	7	URG 3000N	100	100	100	100	90	5	94	100	100	100	100	100
Portland - SE Lafayette	OR	410510080	6	SASS with URG 3000N	75	30	92	100	80	91	100	100	100	87		89
Portland - SE Lafayette	OR	410510080	6	URG 3000N	33	38	100	100	100	95	100	90	94	71		75
Reno	NV	320310016	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
Reno	NV	320310016	5	URG 3000N	100	100	100	100	80	100	94	90	100	100	100	100
Riverside-Rubidoux	CA	060658001	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Riverside-Rubidoux	CA	060658001	5	SASS with URG 3000N	100	100	92	100	100	91	100	100	100	100	100	100
Riverside-Rubidoux (Collocated)	CA	060658001	6	SASS with URG 3000N	100	100	80	100	100	100	100	100	100	100	100	100
Riverside-Rubidoux (Collocated)	CA	060658001	6	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Roxbury (Boston)	MA	250250042	5	URG 3000N	100	94	100	100	100	100	100	100	94	100	100	100
Roxbury (Boston)	MA	250250042	5	SASS with URG 3000N	100	100	100	90	100	100	100	100	100	100	100	100
Roxbury (Boston) - collocated	MA	250250042	6	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Roxbury (Boston) - collocated	MA	250250042	6	URG 3000N	100	100	100	100	100	100	100	100	88	100	100	100
Sacramento - Del Paso Manor	CA	060670006	5	URG 3000N	100	100	100	89	100	100	100	100	100	100	100	100
Sacramento - Del Paso Manor	CA	060670006	5	SASS with URG 3000N	100	100	100	90	100	100	100	100	100	100	100	100
San Jose - Jackson Street	CA	060850005	5	URG 3000N	100	75	100	100	100	94	100	100	92	100	69	50
San Jose - Jackson Street	CA	060850005	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	88
SER-DNR Headquarters	WI	550790026	5	SASS with URG 3000N	100	100	100	100	90	100	89	100	100	100	100	100
SER-DNR Headquarters	WI	550790026	5	URG 3000N	100	100	100	50	90	100	94	50	100	100	100	100
Sieben Flats	MT	300490004	5	SASS with URG 3000N			67	98	100	100	100	100	85	100	100	100
Sieben Flats	MT	300490004	5	URG 3000N			0	71	75	100	100	100	100	93	100	93
Simi Valley	CA	061112002	5	SASS with URG 3000N	100	100	88	88	88	70	83	60	71	63	56	66
Simi Valley	CA	061112002	5	URG 3000N	100	100	100	50	88	83	90	33	42	79	75	86
South DeKalb - Met One	GA	130890002	5	URG 3000N	92	100	100	72	88	100	100	100	92	93	94	100
South DeKalb - Met One	GA	130890002	5	SASS with URG 3000N	100	90	100	78	100	90	100	100	86	97	90	100
Springfield Pumping Station - Met One	IL	170310057	5	SASS with URG 3000N	100	100	83	100	100	100	100	100	83	80	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
Springfield Pumping Station - Met One	IL	170310057	5	URG 3000N	100	100	100	100	100	100	75	75	100	80	100	80
St. Lukes Meridian (IMS)	ID	160010010	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
St. Lukes Meridian (IMS)	ID	160010010	5	SASS with URG 3000N	100	93	100	92	90	100	100	100	100	100	100	100
Sydney	FL	120573002	5	SASS with URG 3000N	100	91	100	100	90	90	100	100	99	100	100	90
Sydney	FL	120573002	5	URG 3000N	100	94	100	100	100	95	100	100	100	100	100	100
Univ. of Florida Ag School	FL	120111002	5	URG 3000N	100	100	100	100	90	100	94	100	100	100	100	88
Univ. of Florida Ag School	FL	120111002	5	SASS with URG 3000N	92	100	97	100	90	100	89	99	100	92	93	100
Washington Park	IN	180970078	5	URG 3000N	100	100	100	100	88	100	90	94	100	93	100	86
Washington Park	IN	180970078	5	SASS with URG 3000N	89	100	100	55	91	91	85	90	100	100	100	100
Woolworth St	NE	310550019	5	SASS with URG 3000N	96	73	96	94	96	88	96	96	96	96	96	96
Woolworth St	NE	310550019	5	URG 3000N	100	86	75	100	25	22	100	100	100	93	94	100
WV - Guthrie Agricultural Center	WV	540390011	5	SASS with URG 3000N	100	100	85	100	87	90	100	100	86	100	89	100
WV - Guthrie Agricultural Center	WV	540390011	5	URG 3000N	100	100	90	100	63	78	30	11	83	86	94	93

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

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
5 Points	OH	391530023	5	URG 3000N	100	90	100	100	100	83	100	100	100	100	88	100
5 Points	OH	391530023	5	SASS with URG 3000N	100	81	96	83	97	82	93	96	98	98	100	100
AIRS	NC	370630099	5	URG 3000N							67	96	91	90	100	100
AL - Phenix City	AL	011130001	5	SASS with URG 3000N	100	83	100	100	100	100	100	100	100	100	100	100
AL - Phenix City	AL	011130001	5	URG 3000N	100	100	88	100	100	83	0	40	75	60	100	40
Albany Co HD	NY	360010005	5	SASS with URG 3000N	100	91	90	100	100	82	100	100	90	89	92	100
Albany Co HD	NY	360010005	5	URG 3000N	93	64	63	100	100	45	100	95	94	100	91	100
Arendtsville	PA	420010001	5	SASS with URG 3000N	100	100	100	100	75	83	100	100	100	100	100	100
Arendtsville	PA	420010001	5	URG 3000N	100	100	100	100	100	83	100	100	100	100	100	100
Army Reserve Center - Met One	IA	191130037	5	URG 3000N	100	90	100	100	75	50	100	100	100	100	100	100
Army Reserve Center - Met One	IA	191130037	5	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	90	100	100	95	100	100	100	100
Arnold West - Met One	MO	290990019	6	SASS with URG 3000N	100	100	100	100	100	100	100	93	90	100	100	100
Ashland Health Department	KY	210190017	5	URG 3000N	100	100	100	100	100	83	100	100	100	100	88	80
Ashland Health Department	KY	210190017	5	SASS with URG 3000N	100	100	100	100	100	71	100	100	100	100	100	100
Athens - Met One	GA	130590001	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Athens - Met One	GA	130590001	5	SASS with URG 3000N	100	100	100	80	100	100	100	100	100	100	100	100
Augusta - Met One	GA	132450091	5	SASS with URG 3000N	100	83	80	100	75	83	100	100	100	100	100	80
Augusta - Met One	GA	132450091	5	URG 3000N	100	90	88	100	75	83	100	100	100	100	100	80
Baxter Water Treatment	PA	421011002	5	URG 3000N				100	90	100	100	100	100	100	86	94

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
Plant																
Baxter Water Treatment Plant	PA	421011002	5	SASS with URG 3000N				100	100	100	100	100	83	100	92	100
Blaine Anoka County Airport	MN	270031002	5	SASS with URG 3000N			100	33	100	100	100	91	63	80	100	90
Blaine Anoka County Airport	MN	270031002	5	URG 3000N			100	50	90	90	88	45	71	100	82	94
Bonne Terre - Met One	MO	291860005	5	SASS with URG 3000N	100	50	50			100	100	100	100	100	100	100
Bonne Terre - Met One	MO	291860005	5	URG 3000N	0	50	25			70	100	100	100	100	100	100
Bountiful	UT	490110004	5	URG 3000N	100	100	100	100	100	100	100	100	83	100	100	100
Bountiful	UT	490110004	5	SASS with URG 3000N	97	100	100	100	100	100	100	100	75	100	100	100
Buffalo - Met One	NY	360290005	6	SASS with URG 3000N	75	98	100	100	100	100	80	60	100	100	100	100
Buffalo - Met One	NY	360290005	6	URG 3000N	100	100	100	100	100	100	100	80	100	100	88	100
Buncombe County Board of Education	NC	370210034	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	80
Buncombe County Board of Education	NC	370210034	5	SASS with URG 3000N	100	100	100	100	100	100	80	100	100	80	100	100
Butte-Greeley School	MT	300930005	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Butte-Greeley School	MT	300930005	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Cannons Lane	KY	211110067	6	SASS with URG 3000N	99	100	100	100	90	100	100	100	90	99	84	100
Cannons Lane	KY	211110067	6	URG 3000N	100	100	30	100	70	100	100	100	89	100	50	100
Canton Fire Station	OH	391510017	5	URG 3000N	100	100	38	80	100	100	100	100	100	100	100	100
Canton Fire Station	OH	391510017	5	SASS with URG 3000N	100	100	100	80	78	98	100	80	65	40	20	100
Chester	NJ	340273001	5	SASS with URG 3000N	100	100	100	100	88	100	98	89	100	91	78	100
Chester	NJ	340273001	5	URG 3000N	100	100	55	0	100	100	100	100	100	100	94	100
Chesterfield	SC	450250001	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Chesterfield	SC	450250001	5	SASS with URG 3000N	78	100	99	100	100	99	98	100	100	99	96	99

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
Children's Park	AZ	040191028	5	URG 3000N	100	100	100	89	70	95	88	95	83	94	86	94
Children's Park	AZ	040191028	5	SASS with URG 3000N	100	87	100	80	79	91	78	91	70	69	75	80
Clarksville	TN	471251009	5	URG 3000N	83	50	100	100	100	100	100	100	100	100	100	100
Clarksville	TN	471251009	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	98	100	100	100
Columbus - Met One	GA	132150011	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Columbus - Met One	GA	132150011	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	83	100	100	100
Dearborn	MI	261630033	5	SASS with URG 3000N	100	71	100	100	74	100	100	100	100	100	100	100
Dearborn	MI	261630033	5	URG 3000N	83	90	100	100	100	83	100	80	100	100	50	100
Del Norte - Met One	NM	350010023	5	SASS with URG 3000N	100	100	100	90	100	100	87	100	75	100	100	100
Del Norte - Met One	NM	350010023	5	URG 3000N	100	90	100	89	100	100	100	100	100	100	100	100
Denver Animal Shelter	CO	080310025	5	URG 3000N	100	100	100	93	100	100	100	100	92	100	100	100
Denver Animal Shelter	CO	080310025	5	SASS with URG 3000N	100	100	83	69	100	80	100	100	86	100	92	99
Division St.	NY	360610134	5	SASS with URG 3000N	100	91	60	90	100	100	100	91	100	100	92	100
Division St.	NY	360610134	5	URG 3000N	86	69	50	78	80	95	88	95	83	94	86	94
Douglas - Met One	GA	130690002	5	URG 3000N	100	100	100	100	75	100	100	100	100	100	100	100
Douglas - Met One	GA	130690002	5	SASS with URG 3000N	75	100	100	100	100	100	80	100	100	100	100	100
Downtown Library	OH	391130032	5	URG 3000N	100	100	38		100	100	100	100	100	100	100	100
Downtown Library	OH	391130032	5	SASS with URG 3000N	100	100	20		100	100	100	100	100	100	100	100
Elkhart Prairie Street	IN	180390008	5	SASS with URG 3000N	100	100	100	85	100	100	100	100	100	100	100	80
Elkhart Prairie Street	IN	180390008	5	URG 3000N	100	90	100	100	100	100	100	100	100	100	100	80
Erie	PA	420490003	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Erie	PA	420490003	5	SASS with URG 3000N	100	100	100	85	100	100	100	100	100	100	100	100
Evansville Buena Vista Rd	IN	181630021	5	URG 3000N	100	80	100	100	100	100	100	80	100	100	100	100
Evansville Buena Vista Rd	IN	181630021	5	SASS with URG	100	83	100	100	99	100	100	79	100	80	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
				3000N												
Fairbanks State Bldg	AK	020900010	6	SASS with URG 3000N	100	91	10	70	91	100	100	100	81	100	100	92
Fairbanks State Bldg	AK	020900010	6	URG 3000N	100	94	6	56	100	100	93	100	94	94	100	100
Florence	PA	421255001	5	URG 3000N	100	100	100	100	75	100	75	40	100	100	100	100
Florence	PA	421255001	5	SASS with URG 3000N	100	100	100	100	100	100	60	40	100	100	100	100
Freemansburg	PA	420950025	5	URG 3000N	50	90	100	100	100	100	100	100	100	100	100	100
Freemansburg	PA	420950025	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	83	100	100
Gary Iitri	IN	180890022	5	SASS with URG 3000N	100	100	83	100	100	100	80	80	100	100	100	100
Gary Iitri	IN	180890022	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Grand Rapids	MI	260810020	5	URG 3000N	100	100	90	89	100	100	100	100	100	100	100	50
Grand Rapids	MI	260810020	5	SASS with URG 3000N	100	83	100	80	100	100	100	100	100	100	90	88
Granite City	IL	171190024	5	URG 3000N	100	100	50	100	100	83	75	80	88	80	100	40
Granite City	IL	171190024	5	SASS with URG 3000N	96	96	57	79	99	80	94	74	76	96	96	97
Grayson	KY	210430500	5	URG 3000N	100	90	100	100	100	100	100	100	100	100	100	80
Grayson	KY	210430500	5	SASS with URG 3000N	100	67	100	100	100	100	100	100	100	100	100	100
Greensburg	PA	421290008	5	URG 3000N	100	100	100	100	100	100	100	100	90	0	75	0
Greensburg	PA	421290008	5	SASS with URG 3000N	100	100	100	100	100	100	100	75	100	80	83	100
Greenville ESC	SC	450450015	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	80	80
Greenville ESC	SC	450450015	5	URG 3000N	83	90	100	100	100	100	100	100	50	100	88	100
Hammond Purdue	IN	180892004	5	SASS with URG 3000N	100	86	85	100	100	100	99	100	100	100	100	100
Hammond Purdue	IN	180892004	5	URG 3000N	100	100	100	80	100	100	100	100	100	100	100	100
Harrisburg	PA	420430401	5	SASS with URG 3000N	100	100	80	100	100	100	100	100	100	100	100	100
Harrisburg	PA	420430401	5	URG 3000N	100	90	100	100	100	100	100	100	100	100	100	100
Hattie Avenue	NC	370670022	5	SASS with URG	75	100	100	80	50	98	60	80	63	100	100	80

Site	State	AQS Code	POC	Sampler Type	Report Batch 131	132	133	134	135	136	137	138	139	140	141	142
				3000N												
Hattie Avenue	NC	370670022	5	URG 3000N	83	90	100	60	50	33	25	60	0	60	63	80
Head Start	OH	390990014	5	URG 3000N	100	100	100	100	100	83	100	80	100	100	100	100
Head Start	OH	390990014	5	SASS with URG 3000N	100	100	83	83	100	83	100	100	100	100	100	100
Hickory	NC	370350004	5	SASS with URG 3000N	100	71	100	100	100	100	100	100	100	100	100	100
Hickory	NC	370350004	5	URG 3000N	100	80	100	100	100	100	100	100	100	100	100	100
Horicon Palmatory	WI	550270001	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Horicon Palmatory	WI	550270001	5	SASS with URG 3000N	100	100	92	100	100	100	100	100	100	100	100	100
Houghton Lake	MI	261130001	5	SASS with URG 3000N	100	71	100	100	100	100	80	100	100	80	100	80
Houghton Lake	MI	261130001	5	URG 3000N	100	100	100	100	100	100	100	100	100	80	100	80
HU-Beltsville Met One	MD	240330030	5	SASS with URG 3000N	100	100	71	41	100	100	100	100	100	100	78	88
HU-Beltsville Met One	MD	240330030	5	URG 3000N	100	100	50	36	100	100	100	100	100	100	88	86
Huntsville Old Airport	AL	010890014	5	URG 3000N	100	100	100	100	100	100	75	100	100	100	100	100
Huntsville Old Airport	AL	010890014	5	SASS with URG 3000N	100	100	100	100	100	100	60	100	100	100	100	100
Jasper Post Office	IN	180372001	5	SASS with URG 3000N	100	100	100	100	99	100	100	100	100	100	80	100
Jasper Post Office	IN	180372001	5	URG 3000N	100	100	50	100	100	100	100	80	100	100	100	100
Jefferson Elementary - Met One	IA	191630015	5	SASS with URG 3000N	100	100	100	100	100	100	100	91	100	100	94	100
Jefferson Elementary - Met One	IA	191630015	5	URG 3000N	100	100	100	94	90	100	100	95	100	100	95	94
Jeffersonville Walnut St	IN	180190006	5	URG 3000N	100	100	100	100	100	100	88	100	100	100	100	80
Jeffersonville Walnut St	IN	180190006	5	SASS with 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	100	98	100	70	89	100	100	100	100	100	100	100
Jerome Mack Middle School	NV	320030540	5	URG 3000N	100	100	100	89	44	0	0	100	100	93	100	100
Johnstown	PA	420210011	5	SASS with URG	100	100	100	100	100	83	100	100	100	100	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
				3000N												
Johnstown	PA	420210011	5	URG 3000N	100	100	100	100	75	83	88	100	100	100	100	100
Kapolei	HI	150030010	5	URG 3000N	100	80	90	94	80	45	94	95	94	100	100	100
Kapolei	HI	150030010	5	SASS with URG 3000N	100	100	83	90	90	74	88	91	90	100	100	100
Karnack - Met One	TX	482030002	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Karnack - Met One	TX	482030002	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Kingston	TN	471451001	5	SASS	100	100	100	100	100	100	100	100	100	100	100	100
Lancaster	PA	420710007	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Lancaster	PA	420710007	5	SASS with URG 3000N	100	100	100	98	100	100	100	100	63	100	100	100
Laurel	MS	280670002	5	URG 3000N	100	90	75	80	100	100	100	100	100	100	100	100
Laurel	MS	280670002	5	SASS with URG 3000N	100	100	80	100	100	100	100	100	100	100	100	100
Lawrence County	TN	470990002	5	URG 3000N	100	100	88	100	75	100	100	100	100	100	50	100
Lawrence County	TN	470990002	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	60	60	100
Lexington Health Department	KY	210670012	5	SASS with URG 3000N	100	100	83	100	100	100	100	100	100	100	79	100
Lexington Health Department	KY	210670012	5	URG 3000N	100	40	100	100	100	100	100	100	100	100	50	100
(NC) - Lexington	NC	370570002	5	URG 3000N	100	50	88	100	100	100	100	100	100	100	100	80
(NC) - Lexington	NC	370570002	5	SASS with URG 3000N	75	100	100	100	100	100	100	100	100	100	100	100
Liberty - Met One	MO	290470005	5	URG 3000N	100	100	100	94	90	100	100	100	94	100	100	100
Liberty - Met One	MO	290470005	5	SASS with URG 3000N	100	100	100	90	90	100	100	100	90	100	100	100
(PA) Liberty	PA	420030064	6	SASS with URG 3000N	100	99	63	83	81	100	100	100	100	100	100	83
(PA) Liberty	PA	420030064	6	URG 3000N	100	90	88	100	100	100	100	100	100	100	88	100
Lockeland School - Met One	TN	470370023	5	SASS with URG 3000N	100	100	76	100	100	100	100	100	100	100	100	85
Lockeland School - Met One	TN	470370023	5	URG 3000N	83	100	100	80	100	100	100	80	88	100	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
Lorain	OH	390933002	5	SASS with URG 3000N	80	100	100	100	78	83	100	100	98	100	100	100
Lorain	OH	390933002	5	URG 3000N	100	30	13	80	0	67	100	100	100	100	80	80
Luna Pier	MI	261150005	5	URG 3000N	100	90	100	100	100	67	100	100	88	100	100	100
Luna Pier	MI	261150005	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Macon - Met One	GA	130210007	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	88	100
Macon - Met One	GA	130210007	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	80	100
Maple Canyon	OH	390490081	6	URG 3000N	100	90	75	100	75	100	100	100	100	100	100	100
Maple Canyon	OH	390490081	6	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Marysville - 7th Ave	WA	530611007	5	SASS with URG 3000N	67	100	100	100	100	100	80	100	100	100	100	100
Marysville - 7th Ave	WA	530611007	5	URG 3000N	50	100	100	100	75	100	88	100	100	100	100	100
Mechanicsburg	IN	180650003	5	SASS with URG 3000N	100	100	100	100	99	100	100	80	100	100	100	100
Mechanicsburg	IN	180650003	5	URG 3000N	100	100	100	80	75	83	100	80	100	80	100	100
Millbrook	NC	371830014	5	URG 3000N	100	94	100	94	90	95	100	100	94	100	100	94
Millbrook	NC	371830014	5	SASS with URG 3000N	100	91	90	100	90	100	100	100	90	100	77	100
Mingo Junction	OH	390811001	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Mingo Junction	OH	390811001	5	SASS with URG 3000N	100	100	40	80	100	100	100	100	100	100	100	100
MN - Rochester	MN	271095008	5	URG 3000N	100	90	13	100	100	100	100	80	83	100	100	100
MN - Rochester	MN	271095008	5	SASS with URG 3000N	100	100	100	100	78	99	100	100	75	100	100	100
MOMS	AL	011011002	5	SASS with URG 3000N	100	100	100	100	75	83	93	100	100	100	100	100
MOMS	AL	011011002	5	URG 3000N	100	70	100	100	100	100	100	100	100	100	100	80
Moundsville Armory	WV	540511002	5	SASS with URG 3000N											100	100
Moundsville Armory	WV	540511002	5	URG 3000N											100	100
Naperville	IL	170434002	5	URG 3000N	100	100	100	60	67	100	100	100	100	100	100	100
Naperville	IL	170434002	5	SASS with URG	96	96	96	76	96	96	96	96	96	91	96	96

Site	State	AQS Code	POC	Sampler Type	Report Batch 131	132	133	134	135	136	137	138	139	140	141	142
				3000N												
National Trail High School	OH	391351001	5	URG 3000N			100	100	100	100	100	100	89	94	91	100
National Trail High School	OH	391351001	5	SASS with URG 3000N			100	100	92	100	100	100	82	100	100	100
New Garden	PA	420290100	5	SASS with URG 3000N	50	100	100	80	100	83	100	100	100	100	100	100
New Garden	PA	420290100	5	URG 3000N	100	100	88	80	100	83	100	100	100	100	100	100
Newark	NJ	340130003	5	SASS	100	99	100	100	88	100	100	90	100	88	89	100
NLR Parr	AR	051190007	5	URG 3000N	100	100	100	75	70	90	88	100	94	94	95	94
NLR Parr	AR	051190007	5	SASS with URG 3000N	100	100	100	64	70	91	78	100	90	88	92	89
North Los Angeles	CA	060371103	5	SASS with URG 3000N	97	100	100	100	90	91	100	92	100	89	100	89
North Los Angeles	CA	060371103	5	URG 3000N	100	90	100	100	90	100	100	100	100	100	100	94
Northbrook	IL	170314201	5	SASS with URG 3000N	96	96	96	86	96	87	96	96	67	96	96	96
Northbrook	IL	170314201	5	URG 3000N	100	100	50	89	17	57	100	100	94	100	100	100
OCUSA Campus	OK	401091037	5	SASS with URG 3000N	100	100	100	63	78	85	100	100	100	100	100	100
OCUSA Campus	OK	401091037	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
ODOT Garage	OH	390870012	5	SASS with URG 3000N	100	100	96	99	100	100	100	99	100	100	100	100
ODOT Garage	OH	390870012	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
PerkinstownCASNET	WI	551198001	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
PerkinstownCASNET	WI	551198001	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Pinnacle State Park - Met One	NY	361010003	5	SASS with URG 3000N	100	99	99	100	100	92	100	91	80	100	100	100
Pinnacle State Park - Met One	NY	361010003	5	URG 3000N	100	69	63	83	50	95	81	95	83	100	86	94
Platteville	CO	081230008	5	URG 3000N	100	100	100	80	100	100	100	100	100	100	100	100
Platteville	CO	081230008	5	SASS with URG 3000N	100	100	100	100	100	100	100	80	100	100	100	100
Port Huron	MI	261470005	5	SASS with URG 3000N	100	100	80	100	100	100	100	100	100	100	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch											
					131	132	133	134	135	136	137	138	139	140	141	142
Port Huron	MI	261470005	5	URG 3000N	100	100	100	100	100	100	100	80	100	100	100	100
Public Health Building - Met One	IA	191530030	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	83	100	100	100
Public Health Building - Met One	IA	191530030	5	URG 3000N	100	100	100	100	100	100	75	80	100	100	100	100
Queens College - Met One	NY	360810124	6	SASS with URG 3000N	100	100	100	82	100	91	100	100	92	100	92	100
Queens College - Met One	NY	360810124	6	URG 3000N	100	100	100	100	100	95	100	50	100	100	95	100
Reading Airport	PA	420110011	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	88	100
Reading Airport	PA	420110011	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Ritner	PA	421010055	5	SASS with URG 3000N	100	100	98	99	78	82	100	99	100	99	98	100
Ritner	PA	421010055	5	URG 3000N	83	100	100	100	75	83	25	100	100	100	100	100
Rochester Primary - Met One	NY	360551007	5	URG 3000N	68	94	94	89	80	94	100	100	90	88	91	100
Rochester Primary - Met One	NY	360551007	5	SASS with URG 3000N	78	91	90	80	80	90	100	100	91	89	92	100
Rockwell	NC	371590021	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	60	100	100	100
Rockwell	NC	371590021	5	URG 3000N	100	100	100	100	100	83	100	80	100	100	100	100
Rome Elementary	GA	131150003	5	SASS with URG 3000N	75	85	100	100	100	100	80	100	100	100	100	100
Rome Elementary	GA	131150003	5	URG 3000N	100	100	100	100	100	100	88	100	88	100	88	100
Rossville - Met One	GA	132950002	5	URG 3000N	100	100	100	100	100	100	75	80	88	100	100	100
Rossville - Met One	GA	132950002	5	SASS with URG 3000N	100	100	100	100	100	100	80	100	100	100	100	100
Scranton	PA	420692006	5	URG 3000N	100	100	100	100	100	83	100	100	88	100	100	100
Scranton	PA	420692006	5	SASS with URG 3000N	100	100	100	98	100	87	100	100	80	100	100	100
Shelby Farms	TN	471570075	6	URG 3000N				100	90	100	94	100	100	94	100	100
Shelby Farms	TN	471570075	6	SASS with URG 3000N				100	100	100	89	100	100	89	100	100
Shreveport Airport - Met One	LA	220150008	5	URG 3000N	100	90	100	83	100	100	100	100	100	100	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch 131	132	133	134	135	136	137	138	139	140	141	142
Shreveport Airport - Met One	LA	220150008	5	SASS with URG 3000N	100	83	97	67	100	100	100	100	100	100	100	100
Sioux Falls School Site	SD	460990008	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	80	91	100
Sioux Falls School Site	SD	460990008	5	URG 3000N	100	100	100	95	100	100	100	100	100	89	95	100
Skyview	FL	121030026	5	URG 3000N	38	90	100	100	100	83	100	100	88	20	88	60
Skyview	FL	121030026	5	SASS with URG 3000N	100	100	85	100	100	83	100	100	100	80	80	80
South Charleston Library	WV	540391005	5	SASS with URG 3000N	100	100	85	98	100	100	100	100	100	80	83	100
South Charleston Library	WV	540391005	5	URG 3000N	100	100	88	100	100	100	100	100	100	100	100	100
Spring Hill Elementary School	TN	470931020	5	URG 3000N	100	50	100	100	100	100	88	100	75	100	100	100
Spring Hill Elementary School	TN	470931020	5	SASS with URG 3000N	100	100	100	100	100	33	20	100	80	100	100	100
St Theo	OH	390350038	6	SASS with URG 3000N	100	100	100	99	81	100	100	65	99	100	100	100
St Theo	OH	390350038	6	URG 3000N	100	100	100	100	100	100	88	100	100	100	88	100
State College	PA	420270100	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
State College	PA	420270100	5	SASS with URG 3000N	100	100	59	100	100	87	100	100	100	100	100	100
SW HS	MI	261630015	5	URG 3000N	100	100	100	100	100	100	100	100	75	100	100	100
SW HS	MI	261630015	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	60	100	60	100
Tacoma - Met One	WA	530530029	5	SASS with URG 3000N	100	87	80	100	100	100	80	60	100	80	100	60
Tacoma - Met One	WA	530530029	5	URG 3000N	50	10	88	100	100	50	88	60	100	80	100	60
Taft	OH	390610040	5	SASS with URG 3000N	100	100	100	100	100	100	89	91	100	100	67	100
Taft	OH	390610040	5	URG 3000N	100	100	100	100	100	100	94	100	100	100	100	100
Tallahassee Community College	FL	120730012	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Tallahassee Community College	FL	120730012	5	URG 3000N		100	100	100	100	100	100	100	100	100	100	100
Tecumseh	MI	260910007	5	URG 3000N	100	100	100	80	75	83	100	80	88	100	100	100

Site	State	AQS Code	POC	Sampler Type	Report Batch 131	132	133	134	135	136	137	138	139	140	141	142
Tecumseh	MI	260910007	5	SASS with URG 3000N	100	100	100	100	100	83	100	100	100	100	100	100
Toledo Airport	OH	390950026	5	URG 3000N	100	100	100	100	100	100	100	100	88	100	75	100
Toledo Airport	OH	390950026	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	80	100	20	0
UTC	TN	470654002	5	URG 3000N	100	100	100	100	100	67	100	100	100	100	100	100
UTC	TN	470654002	5	SASS with URG 3000N	100	100	17	0	100	100	100	100	100	100	80	100
VAN4PLN2	WA	530110013	5	URG 3000N	100	100	100	100	100	100	100	80	100	100	100	100
VAN4PLN2	WA	530110013	5	SASS with URG 3000N	100	100	100	100	100	98	100	100	100	100	99	100
Water Treatment Plant	WV	540690010	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	
Water Treatment Plant	WV	540690010	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	
Waukesha, Cleveland Ave. Site	WI	551330027	5	URG 3000N	100	100	100	100	75	100	100	100	100	100	100	80
Waukesha, Cleveland Ave. Site	WI	551330027	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	79	100	80	80
Whiteface - Met One	NY	360310003	5	SASS with URG 3000N	100	100	100	100	100	100	80	60	100	98	80	100
Whiteface - Met One	NY	360310003	5	URG 3000N			100	100	100	100	100	100	100	100	88	100
Wichita Dept. of Env. Health - Met One	KS	201730010	5	SASS with URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Wichita Dept. of Env. Health - Met One	KS	201730010	5	URG 3000N	100	100	100	100	100	100	100	100	100	100	100	100
Wylam	AL	010732003	5	URG 3000N	100	100	100	100	100	100	88	80	100	100	100	80
Wylam	AL	010732003	5	SASS with URG 3000N	100	100	100	100	100	100	80	100	100	100	100	80
Yakima Mental Health	WA	530770009	5	URG 3000N	100	100	100	80	100	100	50	100	100	100	100	100
Yakima Mental Health	WA	530770009	5	SASS with URG 3000N	100	100	100	80	75	100	100	100	100	100	100	100
York	PA	421330008	5	URG 3000N	100	40	100	100	100	100	88	40	88	100	100	80
York	PA	421330008	5	SASS with URG 3000N	100	100	100	100	100	100	100	80	100	100	100	100