



Summary of Quarterly Operations (October through December) with 2014 Annual Summary

EPA Contract No. EP-W-09-028

Introduction

This quarterly report summarizes results from the Clean Air Status and Trends Network (CASTNET) quality assurance/quality control (QA/QC) program for data collected during fourth quarter 2014. It also provides an annual summary that includes data from the three previous quarters. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; AMEC, 2013). The QAPP is comprehensive and includes standards and policies for all components of project operation from site selection through final data reporting. It is reviewed annually and updated as warranted.

Significant Events for 2014

During first quarter, AMEC began making adjustments and updates to CASTNET ozone systems in anticipation of proposed changes to Title 40, Part 58 of the Code of Federal Regulations (CFR). Changes included adjustment of the ozone quality control (QC) check values, range rescaling of designated site ozone transfer standards, and corresponding changes to the data logger programs. The new QC check targets of 60 parts per billion (ppb) for precision and 225 ppb for span were updated for all sites during first quarter. Other updates and adjustments were made at the sites during the semiannual 2014 calibration visits. The network change table in the CASTNET database was updated accordingly.

During January 2014, AMEC completed the activities necessary to apply for the annual surveillance assessment required to maintain International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2005 accreditation by the American Association for Laboratory Accreditation (A2LA). The surveillance assessment took place on March 18, 2014. AMEC's accredited status was approved through the remainder of its initial certification period, which ends May 2015. The next assessment is scheduled to occur prior to this date. Assessments for renewal of accreditation will then take place every two years.

During April 2014, AMEC verified that third-party performance evaluation (PE) audits of CASTNET ozone systems had been uploaded to EPA's Air Quality System (AQS). The PE audit of the PRK134, WI site by the State of Wisconsin was missing from AQS. AMEC uploaded the results and notified the State of Wisconsin.

The CASTNET QA Manager audited the shipping and receiving process for CASTNET during February 2014. The activities and facilities audited were in compliance with project requirements. It was noted that project documents should be updated to include additional procedures (e.g., trace-level gas monitor calibration kits). The QA Manager completed an audit of the data management and data documentation systems during July 2014. Recommendations included adding details to system description documentation and establishing formal training documentation.

During 2014, AMEC received results from sample analyses for proficiency test (PT) studies 103 and 104 for Rain and Soft Waters from the National Laboratory of Environmental Testing, a branch of the National Water Research Institute with Environment Canada that provides QA services. The eight parameters measured for CASTNET were free of systemic bias. AMEC's 5-year median rating remained "Very Good."

Providing a safe working environment is one of AMEC's goals. Sites are routinely checked for safe working conditions at each calibration (i.e., twice per year). Additionally, AMEC performs internal safety audits of selected sites. These safety audits provide a more in-depth review of site safety. Site safety audits were completed at the KIC003, KS and RED004, MN sites after each the site was installed (February and August 2014, respectively). These safety audits verified that the sites met safety criteria and were ready to begin operation.

Pursuant to results of the annual review of the CASTNET Quality Assurance Project Plan (QAPP), updates were performed culminating in Revision 8.2. The QAPP and related appendices were uploaded to AMEC's file transfer protocol (FTP) site for review by EPA on October 31, 2014.

AMEC updated the Site Status Report Form (SSRF) used at all CASTNET sites as a chain of custody form for the filter pack and as a source of information on other site operations and status. The form was revised to better match current activities and data retrieval methods. A markup of the form was provided to site operators as a guide with an explanation for the changes and instructions or descriptions (as appropriate) for different sections of the form to ease the transition.

AMEC met with EPA and EEMS, EPA's contracted auditor, at the BEL116, MD site during fourth quarter 2014 to discuss changes in the trace-level gas monitoring systems and to review

third-party audit procedures. EEMS plans to work with AMEC and EPA to improve trace-level gas audit procedures.

Quarterly/Annual Summary

Table 1 lists the quarters of data that were validated to Level 3 during 2014 by site calibration group. Table 2 lists the sites in each calibration group along with the calibration schedule. Table 3 presents the measurement criteria for continuous field measurements. These criteria apply to the instrument challenges performed during site calibrations. Table 4 presents the measurement criteria for laboratory filter pack measurements. These criteria apply to the QC samples listed in the following section of this report. Table 5 presents the critical criteria for ozone monitoring. Table 6 presents the critical criteria for trace-level gas monitoring.

Quality Control Analysis Count

The QC sample statistics presented in this report are for reference standards (RF) and continuing calibration verification spikes (CCV) used to assess accuracy and for replicate sample analyses (RP) used to assess “in-run” precision. In addition, laboratory method blanks (MB) containing reagents without a filter; laboratory blanks (LB) containing reagents and a new, unexposed filter; and field blanks (FB) containing reagents and an unexposed filter that was loaded into a filter pack assembly and shipped to and from the monitoring site while remaining in sealed packaging are also included. Tables 7 through 10 present the number of analyses in each category that were finalized by the laboratory by the time the QA report was produced during each quarter of 2014.

Sample Receipt Statistics

Ninety-five percent of field samples from EPA-sponsored sites must be received by the CASTNET laboratory in Gainesville, FL no later than 14 days after removal from the sampling tower. Table 11 presents the relevant sample receipt statistics for each of the four quarters of 2014 together with an annual summary for each category.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for fourth quarter 2014. All results were within the criteria listed in Table 4. Table 12 presents the percent recoveries and standard deviations for RF, CCV, and RP QC sample analyses for 2014.

Quarterly averages are all within criteria.

Table 13 presents quarterly collocated filter pack precision results for data validated to Level 3 during the year. The averaged results for MCK131/231, KY and ROM406/206, CO were within the criterion for all of the 11 parameters reported. The results for ROM406/206 for the fourth quarter of 2013 did not meet the precision criterion. Air Resource Specialists, Inc. (ARS) visited the ROM406 site for calibration on January 30, 2014, and the filter pack flow system failed by

37.8 percent because of a calibration on October 17, 2013 that was based on volumetric conditions instead of standard conditions. As a result, the ROM406 flow data were invalidated back to the last calibration on October 17, 2013. The incorrect flows at ROM406 for the fourth quarter led to a disparity/imprecision in filter pack concentrations measured at the two collocated sites. After the site calibration on January 30, 2014, the ROM406/206 precision measurements returned to normal.

Figure 4 presents completeness statistics for continuous measurements validated to Level 3 during the year. Meteorological parameters are only measured at four of the EPA-sponsored sites. All parameters met the 90 percent criterion with the exception of the wind-related parameters at 87 percent complete. The wind-related parameters were low due to 61 percent data capture for winds at the CHE185, OK site. This figure will not appear in future reports since meteorological data capture no longer has an impact on the calculation of deposition rates due to the data replacement protocol currently in use for calculating deposition velocities. Completion statistics for filter packs and ozone are presented in the CASTNET quarterly data reports.

Table 14 presents summary statistics of critical criteria measurements at ozone sites collected during fourth quarter 2014. The statistics presented contain data validated at Level 2 and Level 3. All data associated with QC checks that fail to meet the criteria listed in Table 5 were or will be invalidated unless the cause of failure has no affect on ambient data collection, and passing results still meet frequency criteria. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 15 presents observations associated with the shaded cell results in Table 14.

Table 16 presents summary statistics of critical criteria measurements at trace-level gas monitoring sites collected during fourth quarter 2014. The statistics presented contain data validated at Level 2 and Level 3. All data associated with QC checks that fail to meet the criteria listed in Table 6 were or will be invalidated unless the cause of failure has no affect on ambient data collection, and passing results still meet frequency criteria. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 17 presents observations associated with the shaded cell results in Table 16.

Laboratory Control Sample Analysis

The laboratory control sample (LCS) is a reagent blank spiked with the target analytes from the established analytical methods and carried through the same extraction process that field samples must undergo. LCS analyses are performed by the laboratory to monitor for potential sample handling artifacts and provide a means to identify possible analyte loss from extraction to extraction. Figure 5 presents LCS analysis results for fourth quarter 2014. All recovery values were between 90 percent and 112 percent.

Blank Results

Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for fourth quarter 2014. All fourth quarter results were within criteria (two times the reporting limit) listed in Table 4 with the exception of a single FB result for calcium which was within three times the reporting limit. Table 18 summarizes the record of filter blanks for 2014. All 2014 results were within the criteria listed in Table 4 with the exception of the fourth quarter FB result noted previously. All other blank QC checks in their respective batches were within criteria.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during each of the four quarters of 2014 are listed in Table 19. This table also includes associated site identification and a brief description of the reason the sample was flagged. During fourth quarter, 13 filter pack samples were invalidated.

Field Problem Count

Table 20 presents counts of field problems affecting continuous data collection for more than one day for each quarter during 2014. The problem counts are sorted by a 30-, 60-, or 90-day time period to resolution. A category for unresolved problems is also included. Time to resolution indicates the period taken to implement corrective action.

Field Calibration Results

A summary of field calibration failures by parameter for each quarter of 2014 is listed in Table 21. During 2014, all sites and parameters were within the criteria listed in Table 3 with the exception of the parameters at the eight sites that are listed in Table 21. Per CASTNET project protocols, data are flagged but still considered valid if the calibration criterion is not exceeded by more than its magnitude (i.e., if within two times the criterion). All calibration failures reported in 2014 for the indicated parameters were within two times the criterion with the exception of temperature at BVL130, IL; CAD150, AR; and CKT136, KY; and flow rate at ALC188, TX. Associated data were invalidated. Wind direction data at BEL116, MD failed by more than two times the criterion but accurate data adjustment by the known linear error was possible because the error was caused by an incorrectly oriented, but firmly installed, wind direction sensor alignment ring. The wind sensor had been installed by the site operator to replace a malfunctioning unit. The error was recorded and corrected during the subsequent site calibration visit.

Table 22 presents field accuracy results for 2014 based on instrument challenges performed using independent reference standards during site calibration visits. Each parameter was within its criterion with at least 90 percent frequency except wind direction at 88 percent frequency. Per CASTNET project protocols, data are flagged but still considered valid if the calibration criterion is not exceeded by more than its magnitude (i.e., if within two times the criterion).

References

AMEC Environment & Infrastructure, Inc. (AMEC). 2013. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 8.1*. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC. Contract No. EP-W-09-028. Gainesville, FL. <http://java.epa.gov/castnet/documents.do>.

American Society for Testing and Materials (ASTM). 2008. *ASTM E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*. ASTM International, West Conshohocken, PA, DOI:10.1520/E0029-08. www.astm.org.

U.S. Environmental Protection Agency (EPA). 2012. Appendix A to Part 58 – Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS), Special Purpose Monitors (SPMs), and Prevention of Significant Deterioration (PSD) Air Monitoring. 40 *CFR* Part 58.

Table 1 Data Validated to Level 3 through Fourth Quarter 2014

| Calibration Group* | Months Available | Number of Months | Complete Quarters | Number of Quarters |
|------------------------|-------------------------------|------------------|---------------------------------|--------------------|
| SE-4/MW-6 [†] | July 2013 – June 2014 | 12 | Quarter 3 2013 – Quarter 2 2014 | 4 |
| E-1/SE-5 | August 2013 – July 2014 | 12 | Quarter 4 2013 – Quarter 2 2014 | 3 |
| MW-7/W-9 | September 2013 – August 2014 | 12 | Quarter 4 2013 – Quarter 2 2014 | 3 |
| E-2 /MW-8 | October 2013 – September 2014 | 12 | Quarter 4 2013 – Quarter 3 2014 | 4 |
| E-3/W-10 [‡] | May 2013 – April 2014 | 12 | Quarter 3 2013 – Quarter 1 2014 | 3 |

Notes: * The sites contained in each calibration group are listed in Table 2.

[†] Contains MCK131/231 collocated pair

[‡] Contains ROM206 of the ROM406/ROM206 collocated pair

Table 2 Field Calibration Schedule for 2014

| Calibration Group | Months Calibrated | Sites Calibrated | | | |
|--------------------------------------|-------------------|--|--|--|--------------------------|
| Eastern Sites (23 Total) | | | | | |
| E-1 (8 Sites) | February/August | BEL116, MD BWR139, MD | WSP144, NJ CTH110, NY | ARE 128, PA PSU106, PA | PED108, VA VPI120, VA |
| E-2 (10 Sites) | April/October | ABT147, CT ASH135, ME HOW191, ME | WST109, NH CAT175, NY HWF187, NY | WFM105, NY NIC001, NY EGB181, ON | UND002, VT |
| E-3 (5 Sites) | May/November | KEF112, PA MKG113, PA | LRL117, PA PAR107, WV | CDR119, WV | |
| Southeastern Sites (10 Total) | | | | | |
| SE-4 (6 Sites) | January/July | SND152, AL GAS153, GA | BFT142, NC CND125, NC | COW137, NC SPD111, TN | |
| SE-5 (4 Sites) | February/August | CAD150, AR CVL151, MS | IRL141, FL SUM156, FL | | |
| Midwestern Sites (19 Total) | | | | | |
| MW-6 (6 Sites) | January/July | CDZ171, KY CKT136, KY | MCK131, KY MCK231, KY | PNF126, NC ESP127, TN | |
| MW-7 (9 Sites) | March/September | ALH157, IL BVL130, IL STK138, IL | VIN140, IN RED004, MN DCP114, OH | OXF122, OH QAK172, OH PRK134, WI | |
| MW-8 (4 Sites) | April/October | SAL133, IN HOX148, MI | ANA115, MI UVL124, MI | | |
| Western Sites (10 Total) | | | | | |
| W-9 (5 Sites) | March/September | KNZ184, KS KIC003, KS | CHE185, OK SAN189, NE | ALC188, TX | |
| W-10 (5 Sites) | May/November | GTH161, CO ROM206, CO | CNT169, WY PND165, WY | PAL190, TX | |

Table 3 Data Quality Indicators for CASTNET Continuous Measurements

| Measurement Parameter ² Method | | Criteria ¹ | |
|--|---------------------------|--|--|
| | | Precision | Accuracy |
| Filter pack flow | Mass flow controller | ± 10% | ± 5% |
| Ozone ³ | UV absorbance | All points within ± 2% of full scale of best fit straight line Linearity error < 5% | |
| Wind speed | Anemometer | ± 0.5 m/s | The greater of ± 0.5 m/s for winds < 5 m/s or ± 5% for winds ≥ 5 m/s |
| Wind direction | Wind vane | ± 5° | ± 5° |
| Sigma theta | Wind vane | Undefined | Undefined |
| Ambient temperature | Platinum RTD | ± 1.0°C | ± 0.5°C |
| Delta temperature | Platinum RTD | ± 0.5°C | ± 0.5°C |
| Relative humidity | Thin film capacitor | ± 10% (of full scale) | ± 10% |
| Precipitation | Tipping bucket rain gauge | ± 10% (of reading) | ± 0.05 inch ⁴ |
| Solar radiation | Pyranometer | ± 10% (of reading taken at local noon) | ± 10% |
| Surface wetness | Conductivity bridge | Undefined | Undefined |

Notes: °C = degrees Celsius
m/s = meters per second
RTD = resistance-temperature device
UV = ultraviolet

¹ Precision criteria apply to collocated instruments, and accuracy criteria apply to calibration of instruments. Collocated precision criteria do not apply to 40 CFR Part 58 ozone measurements.

² Meteorological parameters are only measured at four of the EPA-sponsored CASTNET sites: BVL130, IL; BEL116, MD; CHE185, OK; and PAL190, TX.

³ Ozone is not measured at eight EPA-sponsored CASTNET sites: KIC003, KS; KNZ184, KS; RED004, MN; EGB181, ON; CAT175, NY; NIC001, NY; WFM105, NY; and UND002, VT.

⁴ For target value of 0.50 inch

Table 4 Data Quality Indicators for CASTNET Laboratory Measurements

| Analyte | Method | Precision ¹ (MARPD) | Accuracy ² (%) | Nominal Reporting Limits | |
|--|---------|-----------------------------------|------------------------------|--------------------------|-----------|
| | | | | mg/L | µg/Filter |
| Ammonium (NH ₄ ⁺) | AC | 20 | 90 – 110 | 0.020* | 0.5 |
| Sodium (Na ⁺) | ICP-OES | 20 | 95 – 105 | 0.005 | 0.125 |
| Potassium (K ⁺) | ICP-OES | 20 | 95 – 105 | 0.006 | 0.15 |
| Magnesium (Mg ²⁺) | ICP-OES | 20 | 95 – 105 | 0.003 | 0.075 |
| Calcium (Ca ²⁺) | ICP-OES | 20 | 95 – 105 | 0.006 | 0.15 |
| Chloride (Cl ⁻) | IC | 20 | 95 – 105 | 0.020 | 0.5 |
| Nitrate (NO ₃ ⁻) | IC | 20 | 95 – 105 | 0.008* | 0.2 |
| Sulfate (SO ₄ ²⁻) | IC | 20 | 95 – 105 | 0.040 | 1.0 |

Notes: ¹ This column lists precision goals for both network precision calculated from collocated filter samples and laboratory precision based on replicate samples.

² This column lists laboratory accuracy goals based on reference standards and continuing calibration verification spikes. The criterion is 90–110 percent for ICP-OES reference standards.

AC = automated colorimetry
 IC = ion chromatography
 ICP-OES = inductively coupled plasma-optical emission spectrometry
 MARPD = mean absolute relative percent difference
 mg/L = milligrams per liter
 µg/Filter = micrograms per filter
 * = as nitrogen

Values are rounded according to American Society for Testing and Materials (ASTM) E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (ASTM, 2008).

For more information on analytical methods and associated precision and accuracy criteria, see the CASTNET QAPP (AMEC, 2013).

Table 5 Ozone Critical Criteria*

| Type of Check | Analyzer Response |
|-----------------|--|
| Zero | Less than or equal to ± 5 parts per billion (ppb) |
| Span | Less than or equal to ± 7 percent between supplied and observed concentrations |
| Single Point QC | Less than or equal to ± 7 percent between supplied and observed concentrations |

Notes: * Applies to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the Code of Federal Regulations (EPA, 2012). The minimum frequency for these checks is once every two weeks.

Values are rounded according to ASTM E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (ASTM, 2008).

Table 6 Trace-level Gas Monitoring Critical Criteria *

| Parameter | Analyzer Response | |
|-----------------|--------------------------------|---|
| | Zero Check | Span Check / Single Point QC Check |
| SO ₂ | Less than or equal to ± 3 ppb | Less than or equal to ± 10 percent between supplied and observed concentrations |
| NO _y | Less than or equal to ± 3 ppb | |
| CO | Less than or equal to ± 40 ppb | |

Notes: *Applies to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the Code of Federal Regulations (EPA, 2012). The minimum frequency for these checks is once every two weeks.

Values are rounded according to ASTM E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications E29 (ASTM, 2008).

SO₂ = sulfur dioxide

NO_y = total reactive oxides of nitrogen

CO = carbon monoxide

ppb = parts per billion

Table 7 QC Analysis Count for First Quarter 2014

| Filter Type | Parameter | RF Sample Count | CCV Sample Count | RP Sample Count | MB Sample Count | LB Sample Count | FB Sample Count |
|-------------|-------------------------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|
| Teflon | SO ₄ ²⁻ | 46 | 173 | 77 | 16 | 26 | 44 |
| | NO ₃ ⁻ | 46 | 173 | 77 | 16 | 26 | 44 |
| | NH ₄ ⁺ | 32 | 158 | 75 | 16 | 26 | 44 |
| | Cl ⁻ | 46 | 173 | 77 | 16 | 26 | 44 |
| | Ca ²⁺ | 32 | 159 | 75 | 16 | 26 | 44 |
| | Mg ²⁺ | 32 | 159 | 75 | 16 | 26 | 44 |
| | Na ⁺ | 32 | 159 | 75 | 16 | 26 | 44 |
| | K ⁺ | 32 | 159 | 75 | 16 | 26 | 44 |
| Nylon | SO ₄ ²⁻ | 32 | 167 | 76 | 16 | 28 | 44 |
| | NO ₃ ⁻ | 32 | 167 | 76 | 16 | 28 | 44 |
| Cellulose | SO ₄ ²⁻ | 36 | 174 | 83 | 18 | 28 | 44 |

Table 8 QC Analysis Count for Second Quarter 2014

| Filter Type | Parameter | RF Sample Count | CCV Sample Count | RP Sample Count | MB Sample Count | LB Sample Count | FB Sample Count |
|-------------|-------------------------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|
| Teflon | SO ₄ ²⁻ | 36 | 136 | 57 | 17 | 26 | 131 |
| | NO ₃ ⁻ | 36 | 136 | 57 | 17 | 26 | 131 |
| | NH ₄ ⁺ | 24 | 115 | 55 | 17 | 26 | 92 |
| | Cl ⁻ | 36 | 136 | 57 | 17 | 26 | 131 |
| | Ca ²⁺ | 24 | 121 | 54 | 17 | 26 | 91 |
| | Mg ²⁺ | 24 | 121 | 54 | 17 | 26 | 91 |
| | Na ⁺ | 24 | 121 | 54 | 17 | 26 | 91 |
| | K ⁺ | 24 | 121 | 54 | 17 | 26 | 91 |
| Nylon | SO ₄ ²⁻ | 23 | 118 | 55 | 16 | 26 | 100 |
| | NO ₃ ⁻ | 23 | 118 | 55 | 16 | 26 | 100 |
| Cellulose | SO ₄ ²⁻ | 24 | 117 | 55 | 17 | 26 | 91 |

Table 9 QC Analysis Count for Third Quarter 2014

| Filter Type | Parameter | RF Sample Count | CCV Sample Count | RP Sample Count | MB Sample Count | LB Sample Count | FB Sample Count |
|-------------|-------------------------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|
| Teflon | SO ₄ ²⁻ | 48 | 184 | 75 | 16 | 26 | 48 |
| | NO ₃ ⁻ | 48 | 184 | 75 | 16 | 26 | 48 |
| | NH ₄ ⁺ | 32 | 166 | 86 | 16 | 26 | 48 |
| | Cl ⁻ | 48 | 184 | 75 | 16 | 26 | 48 |
| | Ca ²⁺ | 33 | 171 | 84 | 16 | 26 | 48 |
| | Mg ²⁺ | 33 | 171 | 84 | 16 | 26 | 48 |
| | Na ⁺ | 33 | 171 | 84 | 16 | 26 | 48 |
| | K ⁺ | 33 | 171 | 84 | 16 | 26 | 48 |
| Nylon | SO ₄ ²⁻ | 34 | 166 | 76 | 17 | 26 | 48 |
| | NO ₃ ⁻ | 34 | 166 | 76 | 17 | 26 | 48 |
| Cellulose | SO ₄ ²⁻ | 34 | 166 | 75 | 17 | 26 | 48 |

Table 10 QC Analysis Count for Fourth Quarter 2014

| Filter Type | Parameter | RF Sample Count | CCV Sample Count | RP Sample Count | MB Sample Count | LB Sample Count | FB Sample Count |
|-------------|-------------------------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|
| Teflon | SO ₄ ²⁻ | 49 | 182 | 86 | 16 | 26 | 88 |
| | NO ₃ ⁻ | 49 | 182 | 86 | 16 | 26 | 88 |
| | NH ₄ ⁺ | 34 | 167 | 78 | 17 | 26 | 88 |
| | Cl ⁻ | 32 | 182 | 86 | 16 | 26 | 88 |
| | Ca ²⁺ | 32 | 171 | 82 | 16 | 26 | 88 |
| | Mg ²⁺ | 32 | 171 | 82 | 16 | 26 | 88 |
| | Na ⁺ | 32 | 171 | 82 | 16 | 26 | 88 |
| | K ⁺ | 32 | 171 | 82 | 16 | 26 | 88 |
| Nylon | SO ₄ ²⁻ | 32 | 164 | 74 | 16 | 26 | 88 |
| | NO ₃ ⁻ | 34 | 166 | 75 | 17 | 26 | 88 |
| Cellulose | SO ₄ ²⁻ | 37 | 170 | 74 | 16 | 26 | 88 |

Table 11 Filter Pack Receipt Summary for 2014

| Description | First Quarter | Second Quarter | Third Quarter | Fourth Quarter | Annual Summary |
|---|---------------|----------------|---------------|----------------|----------------|
| Count of samples received more than 14 days after removal from tower: | 14 | 6 | 14 | 15 | 49 |
| Count of all samples received: | 1,142 | 785 | 861 | 861 | 3649 |
| Fraction of samples received within 14 days: | 0.988 | 0.992 | 0.984 | 0.983 | 0.987 |
| Average interval in days: | 4.09 | 3.87 | 4.15 | 4.95 | 4.27* |
| First receipt date: | 01/02/2014 | 04/01/2014 | 07/03/2014 | 10/01/2014 | 01/02/2014 |
| Last receipt date: | 03/31/2014 | 06/23/2014 | 09/30/2014 | 12/31/2014 | 12/31/2014 |

Notes: *annual average

Table 12 Filter Pack QC Summary for 2014

| Filter Type | Parameter | Reference Sample ¹ Recovery (%R) | | | Continuing Calibration Verification Samples (%R) | | | In-Run Replicate ² (RPD) | | |
|-------------|-------------------------------|---|-----------|--------------------|--|-----------|--------------------|-------------------------------------|-----------|--------------------|
| | | Mean | Std. Dev. | Count ³ | Mean | Std. Dev. | Count ³ | Mean | Std. Dev. | Count ³ |
| Teflon | SO ₄ ²⁻ | 99.00 | 1.32 | 178 | 100.72 | 1.32 | 671 | 0.65 | 0.92 | 291 |
| | NO ₃ ⁻ | 101.22 | 1.41 | 178 | 99.32 | 1.89 | 671 | 1.31 | 1.71 | 291 |
| | NH ₄ ⁺ | 99.48 | 1.45 | 122 | 99.78 | 1.11 | 612 | 0.53 | 0.80 | 296 |
| | Ca ²⁺ | 101.15 | 1.97 | 121 | 100.52 | 1.34 | 629 | 1.14 | 1.15 | 297 |
| | Mg ²⁺ | 101.38 | 1.61 | 121 | 99.92 | 1.23 | 629 | 0.93 | 0.97 | 297 |
| | Na ⁺ | 100.64 | 1.46 | 121 | 100.07 | 1.32 | 629 | 1.06 | 1.00 | 297 |
| | K ⁺ | 99.69 | 1.87 | 121 | 100.06 | 1.18 | 629 | 1.40 | 1.33 | 297 |
| | Cl ⁻ | 99.59 | 1.53 | 178 | 103.10 | 1.31 | 671 | 1.77 | 2.36 | 291 |
| Nylon | SO ₄ ²⁻ | 98.12 | 1.19 | 122 | 100.93 | 1.21 | 618 | 2.24 | 13.13 | 283 |
| | NO ₃ ⁻ | 100.99 | 0.97 | 124 | 99.76 | 1.72 | 620 | 1.92 | 12.81 | 284 |
| Cellulose | SO ₄ ²⁻ | 99.20 | 1.17 | 131 | 101.25 | 1.21 | 634 | 1.42 | 1.89 | 293 |

Notes: % R = percent recovery
RPD = relative percent difference

¹ Results of reference sample analyses provide accuracy estimates

² Results of replicate analyses provide precision estimates

³ Number of QC Samples

Table 13 Precision Results for Third Quarter 2013 through Second Quarter 2014

| Site Pairs | SO ₄ ²⁻ | NO ₃ ⁻ | NH ₄ ⁺ | Ca ²⁺ | Mg ²⁺ | Na ⁺ | K ⁺ | Cl ⁻ | HNO ₃ | SO ₂ | Total NO ₃ ⁻ |
|-----------------------|-------------------------------|------------------------------|------------------------------|------------------|------------------|-----------------|----------------|-----------------|------------------|-----------------|------------------------------------|
| MCK131/231, KY | | | | | | | | | | | |
| 2013 Q3 | 3.23 | 8.77 | 3.53 | 5.37 | 5.52 | 3.73 | 4.07 | 0.34 | 5.29 | 5.47 | 4.87 |
| 2013 Q4 | 3.75 | 6.54 | 3.45 | 10.10 | 8.51 | 4.81 | 9.11 | 3.35 | 4.03 | 3.50 | 4.33 |
| 2014 Q1 | 2.68 | 5.42 | 2.79 | 9.15 | 6.97 | 5.39 | 4.03 | 9.95 | 4.09 | 4.82 | 3.57 |
| 2014 Q2 | 1.26 | 4.56 | 1.62 | 3.49 | 3.73 | 1.61 | 5.91 | 1.25 | 3.94 | 2.00 | 2.43 |
| Average | 2.73 | 6.32 | 2.85 | 7.03 | 6.18 | 3.89 | 5.78 | 3.72 | 4.34 | 3.95 | 3.80 |
| ROM406/206, CO | | | | | | | | | | | |
| 2013 Q3 | 7.68 | 14.78 | 4.70 | 15.88 | 13.94 | 14.66 | 3.95 | 11.09 | 7.27 | 5.13 | 5.75 |
| 2013 Q4 | 31.58 | 28.23 | 30.14 | 29.10 | 22.71 | 34.38 | 26.11 | 14.24 | 31.34 | 20.69 | 28.93 |
| 2014 Q1 | 16.92 | 19.27 | 17.22 | 11.27 | 13.86 | 18.34 | 15.97 | 13.05 | 20.45 | 10.87 | 15.57 |
| 2014 Q2 | 2.93 | 7.92 | 3.60 | 4.49 | 4.09 | 5.42 | 4.13 | 1.62 | 8.52 | 9.43 | 4.98 |
| Average | 14.78 | 17.55 | 13.92 | 15.19 | 13.65 | 18.20 | 12.54 | 10.00 | 16.90 | 11.53 | 13.81 |

Notes: 10 of 88 site-quarter-parameters were outside criterion
MARPD = mean absolute relative percent difference

Table 14 Ozone QC Summary for Fourth Quarter 2014 (1 of 2)

| Site ID | % Span Pass ¹ | Span %D ² | % Single Point QC Pass ¹ | Single Point QC %D ² | Single Point QC CL ³ | % Zero Pass ¹ | Zero Average (ppb) ² |
|------------|--------------------------|------------------------|-------------------------------------|-----------------------------------|---------------------------------|--------------------------|---------------------------------|
| ABT147, CT | 100.00 | 1.23 | 100.00 | 1.13 | 0.14 | 100.00 | 0.16 |
| ALC188, TX | 98.90 | 1.78 | 98.90 | 4.59 | 6.15 | 100.00 | 0.18 |
| ALH157, IL | 100.00 | 1.55 | 100.00 | 0.75 | 0.07 | 100.00 | 0.12 |
| ANA115, MI | 93.75 | 1.51 | 100.00 | 1.54 | 0.27 | 100.00 | 0.16 |
| ARE128, PA | 100.00 | 2.08 | 100.00 | 1.21 | 0.14 | 100.00 | 0.34 |
| ASH135, ME | 100.00 | 1.09 | 100.00 | 1.03 | 0.08 | 100.00 | 0.16 |
| BEL116, MD | 100.00 | 1.52 | 100.00 | 2.36 | 0.29 | 100.00 | 1.66 |
| BFT142, NC | 100.00 | 1.19 | 100.00 | 1.17 | 0.18 | 100.00 | 0.21 |
| BVL130, IL | 100.00 | 1.20 | 100.00 | 2.50 | 0.15 | 100.00 | 1.27 |
| BWR139, MD | 100.00 | 0.79 | 100.00 | 1.49 | 0.12 | 100.00 | 0.18 |
| CAD150, AR | 95.24 | 5.07 | 95.18 | 4.77 | 2.84 | 95.12 | 1.41 |
| CDR119, WV | 100.00 | 1.48 | 100.00 | 1.58 | 0.14 | 100.00 | 0.23 |
| CDZ171, KY | 100.00 | 0.56 | 98.90 | 0.67 | 0.25 | 100.00 | 0.13 |
| CKT136, KY | 100.00 | 1.37 | 100.00 | 2.53 | 0.12 | 100.00 | 0.19 |
| CND125, NC | 97.92 | 1.22 | 100.00 | 0.66 | 0.11 | 100.00 | 0.19 |
| CNT169, WY | 92.22 | 7.23 | 92.22 | 4.99 | 2.55 | 92.22 | 3.81 |
| COW137, NC | 100.00 | 0.75 | 100.00 | 1.18 | 0.14 | 100.00 | 0.24 |
| CTH110, NY | 100.00 | 1.08 | 100.00 | 1.06 | 0.15 | 100.00 | 0.39 |
| CVL151, MS | 82.46 | 69.60 | 81.42 | 9.04 | 3.30 | 81.25 | 5.28 |
| DCP114, OH | 97.75 | 2.62 | 97.75 | 2.83 | 2.53 | 100.00 | 0.11 |
| ESP127, TN | 100.00 | 1.69 | 100.00 | 1.56 | 0.16 | 100.00 | 0.17 |
| GAS153, GA | 100.00 | 0.67 | 100.00 | 0.68 | 0.10 | 100.00 | 0.40 |
| GTH161, CO | 97.78 | 2.81 | 97.78 | 1.58 | 0.49 | 97.78 | 1.24 |
| HOX148, MI | 100.00 | 0.36 | 100.00 | 0.83 | 0.09 | 100.00 | 0.60 |
| HWF187, NY | 100.00 | 2.71 | 94.67 | 4.23 | 0.29 | 98.65 | 1.69 |
| IRL141, FL | 100.00 | 0.51 | 100.00 | 0.99 | 0.09 | 100.00 | 0.40 |
| KEF112, PA | 100.00 | 0.75 | 97.92 | 1.31 | 0.38 | 100.00 | 0.51 |
| LRL117, PA | 100.00 | 0.85 | 100.00 | 0.40 | 0.06 | 100.00 | 0.24 |
| MCK131, KY | 100.00 | 1.22 | 97.87 | 1.12 | 0.27 | 100.00 | 0.36 |
| MCK231, KY | 100.00 | 1.22 | 100.00 | 0.96 | 0.10 | 100.00 | 0.43 |
| MKG113, PA | 100.00 | 0.39 | 100.00 | 0.74 | 0.11 | 100.00 | 0.41 |
| OXF122, OH | 100.00 | 0.43 | 100.00 | 0.45 | 0.06 | 100.00 | 0.67 |
| PAL190, TX | 93.68 | 2.49 | 93.68 | 2.78 | 1.00 | 100.00 | 0.38 |
| PAR107, WV | 100.00 | 0.52 | 100.00 | 1.17 | 0.17 | 100.00 | 0.52 |
| PED108, VA | 100.00 | 2.13 | 98.91 | 2.58 | 0.20 | 100.00 | 0.33 |
| PND165, WY | 100.00 | 1.44 | 100.00 | 2.47 | 0.18 | 100.00 | 1.13 |
| PNF126, NC | 100.00 | 2.58 | 100.00 | 3.26 | 0.19 | 100.00 | 0.67 |

Table 14 Ozone QC Summary for Fourth Quarter 2014 (2 of 2)

| Site ID | % Span Pass ¹ | Span %D ² | % Single Point QC Pass ¹ | Single Point QC %D ² | Single Point QC CL ³ | % Zero Pass ¹ | Zero Average (ppb) ² |
|------------|--------------------------|------------------------|-------------------------------------|-----------------------------------|---------------------------------|--------------------------|---------------------------------|
| PRK134, WI | 100.00 | 0.48 | 100.00 | 1.52 | 0.12 | 100.00 | 0.45 |
| PSU106, PA | 100.00 | 2.09 | 100.00 | 1.66 | 0.15 | 100.00 | 0.54 |
| QAK172, OH | 100.00 | 1.06 | 100.00 | 0.48 | 0.11 | 100.00 | 0.18 |
| ROM206, CO | 100.00 | 0.94 | 96.10 | 1.69 | 0.36 | 100.00 | 1.67 |
| SAL133, IN | 100.00 | 0.47 | 100.00 | 0.80 | 0.10 | 100.00 | 0.21 |
| SAN189, NE | 100.00 | 0.63 | 100.00 | 0.52 | 0.13 | 100.00 | 0.16 |
| SND152, AL | 100.00 | 1.78 | 100.00 | 1.88 | 0.12 | 100.00 | 0.35 |
| SPD111, TN | 95.56 | 5.36 | 95.56 | 5.32 | 3.57 | 100.00 | 0.14 |
| STK138, IL | 100.00 | 0.51 | 100.00 | 0.62 | 0.07 | 100.00 | 0.58 |
| SUM156, FL | 100.00 | 1.01 | 96.91 | 1.34 | 0.42 | 100.00 | 0.53 |
| UVL124, MI | 100.00 | 0.62 | 100.00 | 0.86 | 0.08 | 100.00 | 0.11 |
| VIN140, IN | 100.00 | 0.47 | 100.00 | 0.61 | 0.09 | 100.00 | 0.22 |
| VPI120, VA | 98.89 | 2.70 | 100.00 | 1.16 | 0.12 | 100.00 | 0.56 |
| WSP144, NJ | 100.00 | 1.04 | 100.00 | 0.62 | 0.09 | 100.00 | 0.41 |
| WST109, NH | 100.00 | 0.63 | 100.00 | 0.63 | 0.10 | 100.00 | 0.13 |

Notes: ¹ Percentage of comparisons that pass the criteria listed in Table 5. Values falling below 90 percent are addressed in Table 15.

² Absolute value of the average percent differences between the on-site transfer standard and the site monitor. Values exceeding the criteria listed in Table 5 are addressed in Table 15.

³ 90 percent confidence limit of the coefficient of variation. This should be less than or equal to the 7 percent single point QC check critical criterion. Values exceeding this criterion are addressed in Table 15.

%D = percent difference

CL = confidence limit

ppb = parts per billion

Table 15 Ozone QC Observations for Fourth Quarter 2014

| Site ID | QC Criterion | Comments |
|------------|---|--|
| CVL151, MS | % Span Pass Span %D % Single Point QC Pass Single Point QC %D % Zero Pass | The cap used for performing leak checks on the sampling system was left in place for a few days in early November. Several zero/span/precision QC check failures were recorded during mid-November. The data associated with these periods were invalidated. |

Note: %D = percent difference

Table 16 Trace-level Gas QC Summary for Fourth Quarter 2014

| Parameter | % Span Pass ¹ | Span %D ² | % Single Point QC Pass ¹ | Single Point QC %D ² | Single Point QC CL ³ | % Zero Pass ¹ | Zero Average (ppb) ² |
|-------------------|--------------------------|------------------------|-------------------------------------|-----------------------------------|---------------------------------|--------------------------|---------------------------------|
| BEL116, MD | | | | | | | |
| SO ₂ | 95.00 | 4.72 | 91.89 | 5.61 | 0.99 | 100.00 | 0.29 |
| NO _y | 100.00 | 3.09 | 100.00 | 3.95 | 0.71 | 100.00 | 0.40 |
| BVL130, IL | | | | | | | |
| SO ₂ | 100.00 | 3.11 | 96.97 | 4.21 | 4.76 | 100.00 | 0.40 |
| NO _y | 100.00 | 5.44 | 95.92 | 5.86 | 0.96 | 95.92 | 0.86 |
| CO | 100.00 | 1.20 | 77.42 | 8.39 | 3.06 | 87.88 | 20.71 |
| HWF187, NY | | | | | | | |
| NO _y | 92.86 | 8.95 | 95.24 | 6.90 | 6.11 | 97.78 | 1.03 |
| PNF126, NC | | | | | | | |
| NO _y | 100.00 | 4.86 | 100.00 | 4.19 | 0.56 | 100.00 | 0.44 |
| ROM206, CO | | | | | | | |
| NO _y | 96.15 | 3.14 | 96.00 | 3.56 | 0.97 | 100.00 | 0.14 |
| PND165, WY | | | | | | | |
| NO _y | 100.00 | 2.63 | 100.00 | 3.77 | 0.57 | 97.83 | 1.79 |

Notes: ¹ Percentage of comparisons that pass the criteria listed in Table 6. Values falling below 90 percent are addressed in Table 17.

² Absolute value of the average percent differences between the supplied and observed concentrations. Values exceeding the criteria listed in Table 6 are addressed in Table 17.

³ 90 percent confidence limit of the coefficient of variation. This should be less than or equal to the 10 percent single point QC check critical criterion. Values exceeding this criterion are addressed in Table 17.

%D = percent difference

CL = confidence limit

ppb = parts per billion

Table 17 Trace-level Gas QC Observations for Fourth Quarter 2014

| Site ID | Parameter | QC Criterion | Comments |
|------------|-----------|-------------------------------------|--|
| BVL130, IL | CO | Single Point QC Pass % Zero Pass | Several zero and precision QC check failures occurred at the beginning of October, which most likely were due to an elevated baseline resulting from an erroneous zero point auto-reference by the analyzer. |

Table 18 Summary of Filter Blanks for 2014 (1 of 2)

| Parameter Name | Detection Limit Total μg | Total Number | Number > Detection Limit | Average Total μg | Average Absolute Deviation | Maximum Total μg |
|---|-------------------------------------|--------------|--------------------------|-----------------------------|----------------------------|-----------------------------|
| FIELD BLANKS | | | | | | |
| Teflon-NH ₄ ⁺ -N | 0.500 | 312 | 0 | 0.500 | 0.000 | 0.500 |
| Teflon- NO ₃ ⁻ -N | 0.200 | 312 | 4 | 0.201 | 0.002 | 0.275 |
| Teflon- SO ₄ ²⁻ | 1.000 | 312 | 1 | 1.001 | 0.002 | 1.385 |
| Cl ⁻ | 0.500 | 312 | 2 | 0.501 | 0.003 | 0.763 |
| Ca ²⁺ | 0.150 | 312 | 8 | 0.152 | 0.004 | 0.418 |
| Mg ²⁺ | 0.075 | 312 | 0 | 0.075 | 0.000 | 0.075 |
| Na ⁺ | 0.125 | 312 | 0 | 0.125 | 0.000 | 0.125 |
| K ⁺ | 0.150 | 312 | 2 | 0.150 | 0.001 | 0.256 |
| Nylon- NO ₃ ⁻ -N | 0.200 | 312 | 0 | 0.200 | 0.000 | 0.200 |
| Nylon - SO ₄ ²⁻ | 1.000 | 312 | 0 | 1.000 | 0.000 | 1.000 |
| Cellulose - SO ₄ ²⁻ | 2.000 | 312 | 2 | 2.004 | 0.008 | 2.815 |
| LABORATORY BLANKS | | | | | | |
| Teflon-NH ₄ ⁺ -N | 0.500 | 104 | 0 | 0.500 | 0.000 | 0.500 |
| Teflon- NO ₃ ⁻ -N | 0.200 | 104 | 3 | 0.201 | 0.001 | 0.225 |
| Teflon- SO ₄ ²⁻ | 1.000 | 104 | 0 | 1.000 | 0.000 | 1.000 |
| Cl ⁻ | 0.500 | 104 | 0 | 0.500 | 0.000 | 0.500 |
| Ca ²⁺ | 0.150 | 104 | 0 | 0.150 | 0.000 | 0.150 |
| Mg ²⁺ | 0.075 | 104 | 0 | 0.075 | 0.000 | 0.075 |
| Na ⁺ | 0.125 | 104 | 0 | 0.125 | 0.000 | 0.125 |
| K ⁺ | 0.150 | 104 | 0 | 0.150 | 0.000 | 0.150 |
| Nylon- NO ₃ ⁻ -N | 0.200 | 106 | 0 | 0.200 | 0.000 | 0.200 |
| Nylon -SO ₄ ²⁻ | 1.000 | 106 | 0 | 1.000 | 0.000 | 1.000 |
| Cellulose -SO ₄ ²⁻ | 2.000 | 106 | 0 | 2.000 | 0.000 | 2.000 |
| METHOD BLANKS | | | | | | |
| Teflon-NH ₄ ⁺ -N | 0.500 | 67 | 0 | 0.500 | 0.000 | 0.500 |
| Teflon- NO ₃ ⁻ -N | 0.200 | 66 | 0 | 0.200 | 0.000 | 0.200 |
| Teflon- SO ₄ ²⁻ | 1.000 | 66 | 0 | 1.000 | 0.000 | 1.000 |
| Cl ⁻ | 0.500 | 66 | 0 | 0.500 | 0.000 | 0.500 |
| Ca ²⁺ | 0.150 | 66 | 0 | 0.150 | 0.000 | 0.150 |
| Mg ²⁺ | 0.075 | 66 | 0 | 0.075 | 0.000 | 0.075 |
| Na ⁺ | 0.125 | 66 | 0 | 0.125 | 0.000 | 0.125 |
| K ⁺ | 0.150 | 66 | 0 | 0.150 | 0.000 | 0.150 |
| Nylon- NO ₃ ⁻ -N | 0.200 | 67 | 0 | 0.200 | 0.000 | 0.200 |
| Nylon -SO ₄ ²⁻ | 1.000 | 66 | 0 | 1.000 | 0.000 | 1.000 |
| Cellulose -SO ₄ ²⁻ | 2.000 | 69 | 0 | 2.000 | 0.000 | 2.000 |

Table 18 Summary of Filter Blanks for 2014 (2 of 2)

| Parameter Name | Detection Limit Total µg | Total Number | Number > Detection Limit | Average Total µg | Average Absolute Deviation | Maximum Total µg |
|--|--------------------------|--------------|--------------------------|------------------|----------------------------|------------------|
| ACCEPTANCE TEST VALUES | | | | | | |
| Teflon-NH ₄ ⁺ -N | 0.500 | 192 | 0 | 0.500 | 0.000 | 0.500 |
| Teflon- NO ₃ ⁻ -N | 0.200 | 192 | 0 | 0.200 | 0.000 | 0.200 |
| Teflon- SO ₄ ²⁻ | 1.000 | 192 | 0 | 1.000 | 0.000 | 1.000 |
| Cl ⁻ | 0.500 | 192 | 0 | 0.500 | 0.000 | 0.500 |
| Ca ²⁺ | 0.150 | 192 | 0 | 0.150 | 0.000 | 0.150 |
| Mg ²⁺ | 0.075 | 192 | 0 | 0.075 | 0.000 | 0.075 |
| Na ⁺ | 0.125 | 192 | 0 | 0.125 | 0.000 | 0.125 |
| K ⁺ | 0.150 | 192 | 0 | 0.150 | 0.000 | 0.150 |
| Nylon- NO ₃ ⁻ -N | 0.200 | 220 | 0 | 0.200 | 0.000 | 0.200 |
| Nylon -SO ₄ ²⁻ | 1.000 | 220 | 0 | 1.000 | 0.000 | 1.000 |
| Cellulose -SO ₄ ²⁻ | 2.000 | 288 | 0 | 2.000 | 0.000 | 2.000 |

Note: Cellulose filters are not analyzed for ambient NO₃. The blank results are used only for QC.

Table 19 Filter Packs Flagged as Suspect or Invalid

| Site ID | Sample | Reason |
|----------------------------|--------------------------|--------------------------|
| First Quarter 2014 | | |
| BWR139, MD | 1402001-13 | Insufficient flow volume |
| FOR605, WY | 1405003-02 | Insufficient flow volume |
| GAS153, GA | 1405001-32 | Insufficient flow volume |
| JOT403, CA | 1405001-42 | Insufficient flow volume |
| PNF126, NC | 1404001-63 | Insufficient flow volume |
| SHE604, WY | 1402003-03 1407003-03 | Insufficient flow volume |
| SND152, AL | 1405001-74 | Insufficient flow volume |
| Second Quarter 2014 | | |
| CAT175, NY | 1416001-16 | Insufficient flow volume |
| FOR605, WY | 1418003-02 | Insufficient flow volume |
| HWF187, NY | 1414001-40 | Insufficient flow volume |
| JOT403, CA | 1418001-42 | Insufficient flow volume |
| KEF112, PA | 1418001-43 | Insufficient flow volume |
| MCK131, KY | 1416001-49 | Insufficient flow volume |
| MKG113, PA | 1415001-52 | Insufficient flow volume |
| UND002, VT | 1415001-79 | Insufficient flow volume |
| UVL124, MI | 1414001-80 | Insufficient flow volume |

| Site ID | Sample | Reason |
|----------------------------|--|--|
| Third Quarter 2014 | | |
| EGB181, ON | 1435001-29 | Insufficient flow volume |
| EVE419, FL | 1431001-31 | Insufficient flow volume |
| FOR605, WY | 1431003-02 | Insufficient flow volume |
| GLR468, MT | 1431001-33 | Insufficient flow volume |
| JOT403, CA | 1431001-42 | Insufficient flow volume |
| PNF126, NC | 1436001-63 1437001-63 | Site power failure and subsequent loss of data logger settings |
| UND002, VT | 1430001-79 | Extended site power failure |
| Fourth Quarter 2014 | | |
| ANA115, MI | 1433001-05 | Suspect concentration data |
| EVE419, FL | 1434001-31 1435001-31 | Insufficient flow volume |
| GLR468, FL | 1432001-33 | Suspect concentration data |
| MKG113, PA | 1438001-52 1439001-52 | Insufficient flow volume |
| PNF126, NC | 1436001-63 | Site power failure |
| RED004, MN | 1437001-67 | Insufficient flow volume |
| THR422, ND | 1431001-78 1432001-78 1433001-78 1434001-78 | Insufficient flow volume |
| UND002, VT | 1430001-79 | Site power failure |

Table 20 Field Problems Affecting Data Collection

| Days to Resolution | Problem Count |
|-----------------------------------|----------------------|
| First Quarter 2014 | |
| 30 | 226 |
| 60 | 10 |
| 90 | 3 |
| Unresolved by End of Quarter | 4 |
| Second Quarter 2014 | |
| 30 | 224 |
| 60 | 4 |
| 90 | 1 |
| Unresolved by End of Quarter | 9 |
| Third Quarter 2014 | |
| 30 | 225 |
| 60 | 9 |
| 90 | 1 |
| Unresolved by End of Quarter | 3 |
| Fourth Quarter 2014 | |
| 30 | 235 |
| 60 | 9 |
| 90 | 1 |
| Unresolved by Date of Publication | 6 |

Table 21 Field Calibration Failures by Parameter for 2014

| Site ID | Parameter(s) |
|----------------------------|--------------------------|
| First Quarter 2014 | |
| ALC188, TX | Flow Rate |
| ALH157, IL | Temperature |
| BEL116, MD | Wind Direction |
| Second Quarter 2014 | |
| None | |
| Third Quarter 2014 | |
| BVL130, IL | Flow Rate Temperature |
| CAD150, AR | Temperature |
| CDZ171, KY | Flow Rate |
| CKT136, KY | Temperature |
| Fourth Quarter 2014 | |
| None | |

Note: Per CASTNET project protocols, data for all parameters except flow are flagged as “suspect” (S) but still considered valid if the calibration criterion is not exceeded by more than its magnitude (i.e., if within 2x the criterion). If flow calibrations fall within 2x the criterion, these data are adjusted per approved protocol described in the CASTNET QAPP, (AMEC, 2013). Please refer to Table 14 for documentation of the QC failures affecting the validity of ozone data.

Table 22 Accuracy Results for 2014 Field Measurements

| Parameter | Percent Within Criterion |
|-----------------------------|--------------------------|
| Flow Rate* | 98 |
| Wind Speed < 5 m/s | 100 |
| Wind Speed ≥ 5 m/s | 100 |
| Wind Direction North* | 88 |
| Wind Direction South* | 88 |
| Temperature (0°C)* | 97 |
| Temperature (ambient)* | 97 |
| Delta Temperature (0°C) | 100 |
| Delta Temperature (ambient) | 100 |
| Relative Humidity | 100 |
| Precipitation | 100 |
| Solar Radiation | 90 |
| Wetness (w/in 0.5 volts) | 100 |

Notes: °C = degrees Celsius

m/s = meters per second

* = Per CASTNET project protocols, data are flagged as “suspect” (S) but still considered valid if the calibration criterion is not exceeded by more than its magnitude (i.e., if within 2x the criterion). All calibration failures reported in 2014 for the indicated parameters were within 2x the criterion with the exception of temperature at BVL130, IL; CAD159, AR; and CKT136, KY; and flow rate at ALC188, TX. Associated data were invalidated. Wind direction data at BEL116, MD failed by more than 2x the criterion but accurate data adjustment by the known linear error was possible because the error was caused by an incorrectly oriented, but firmly installed, wind direction sensor alignment ring.

Figure 1 Reference Standard Results for Fourth Quarter 2014 (percent recovery)

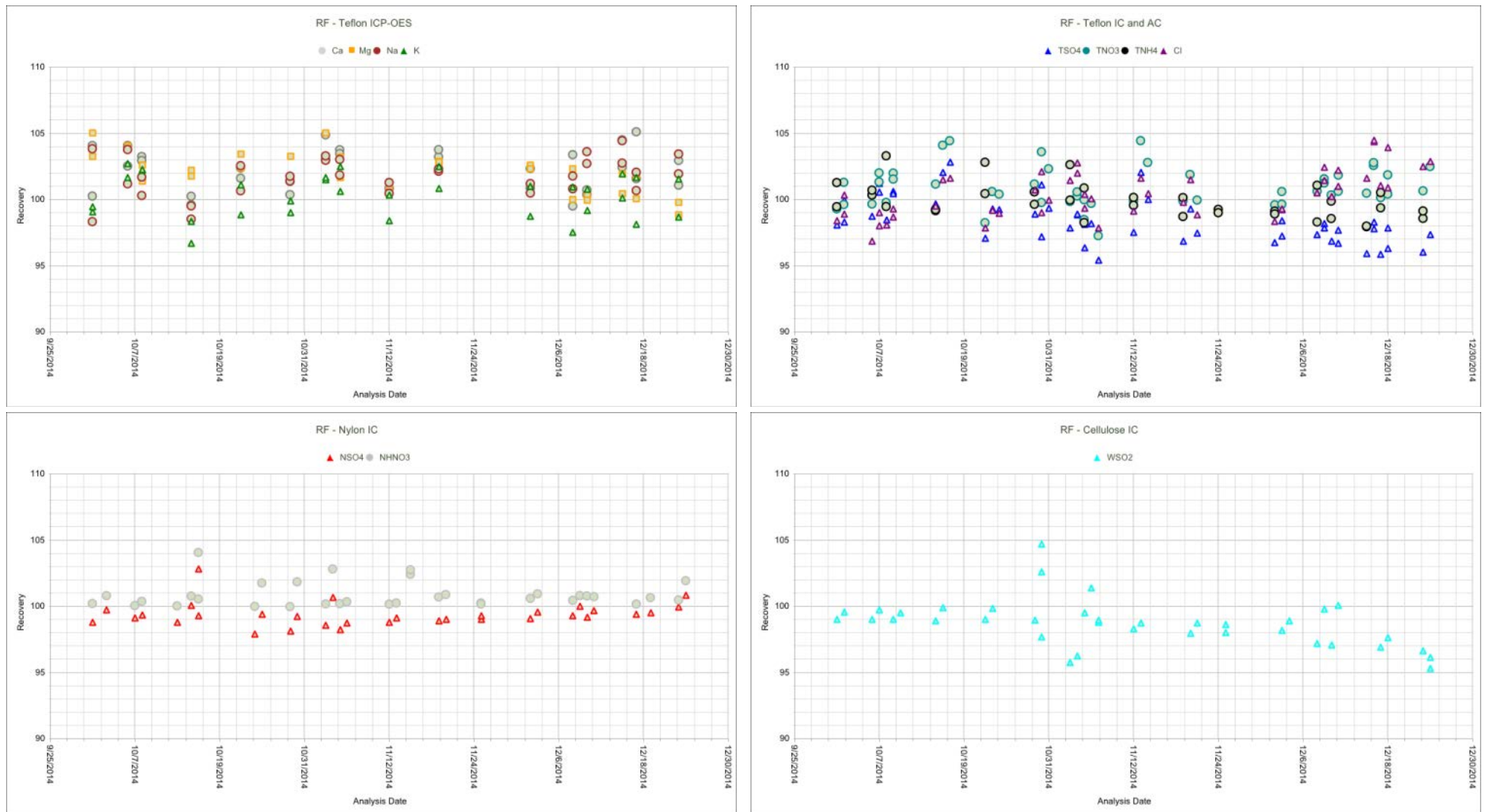


Figure 2 Continuing Calibration Spike Results for Fourth Quarter 2014 (percent recovery)

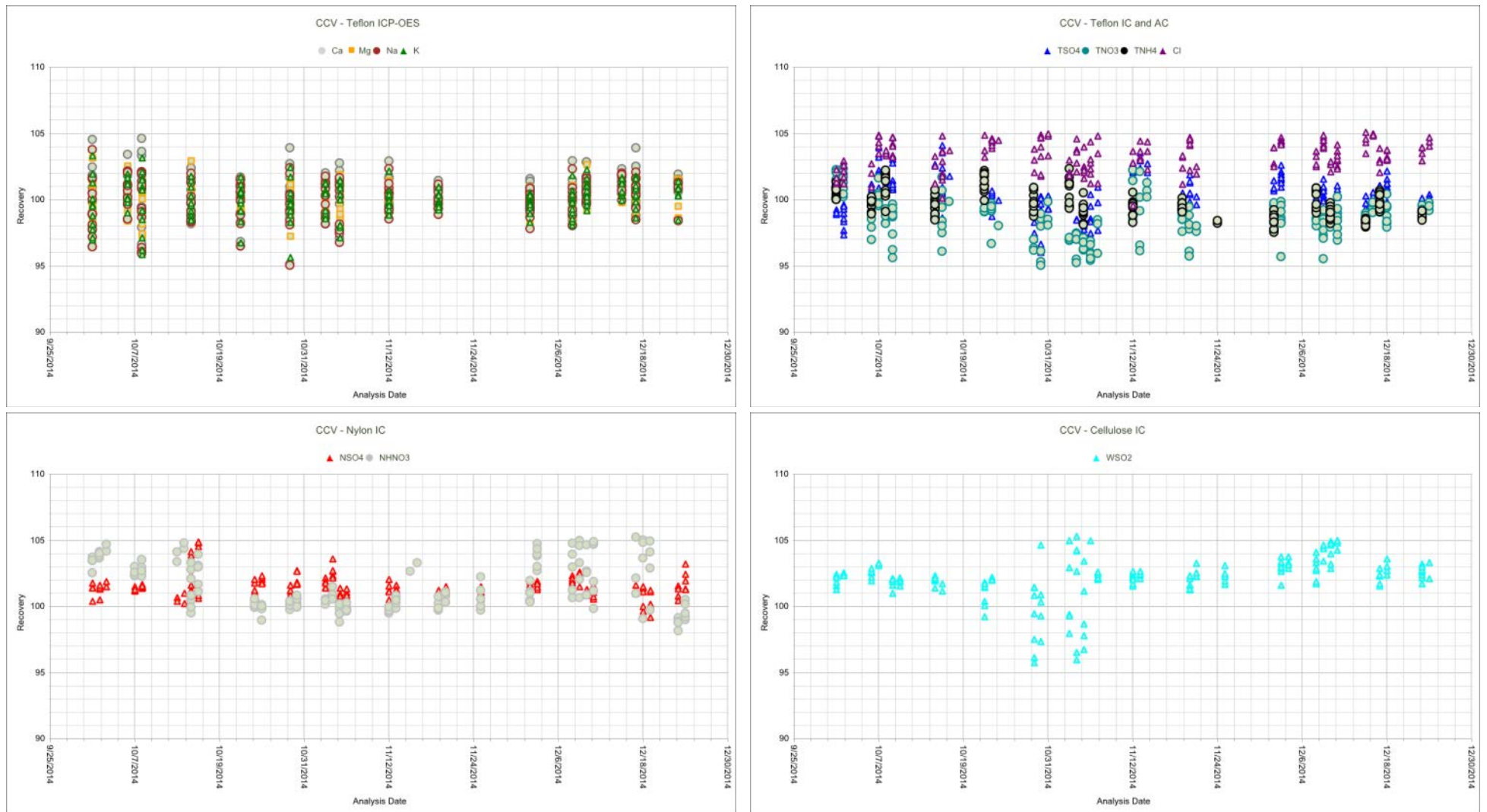


Figure 3 Replicate Sample Analysis Results for Fourth Quarter 2014 (percent difference)

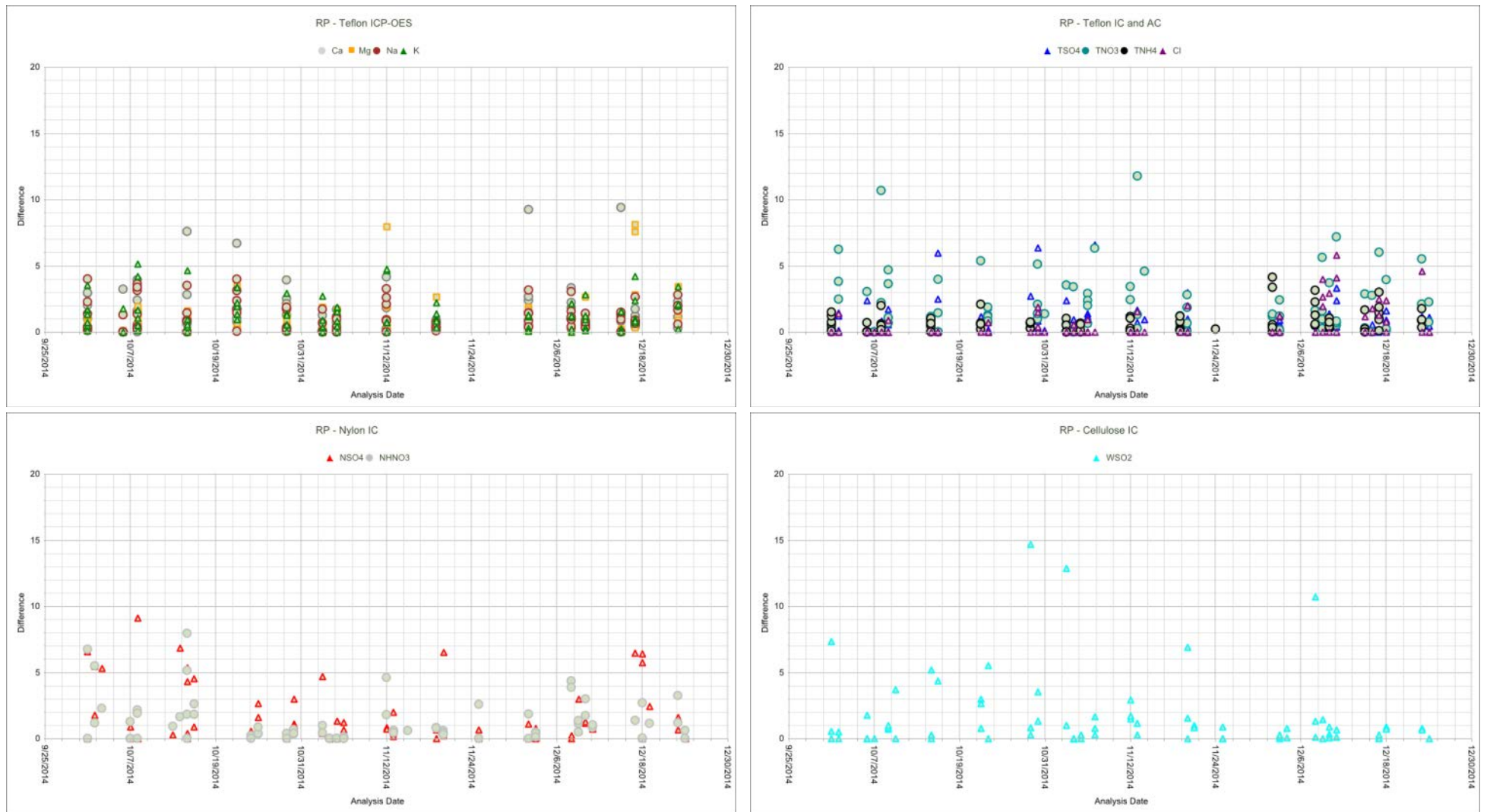
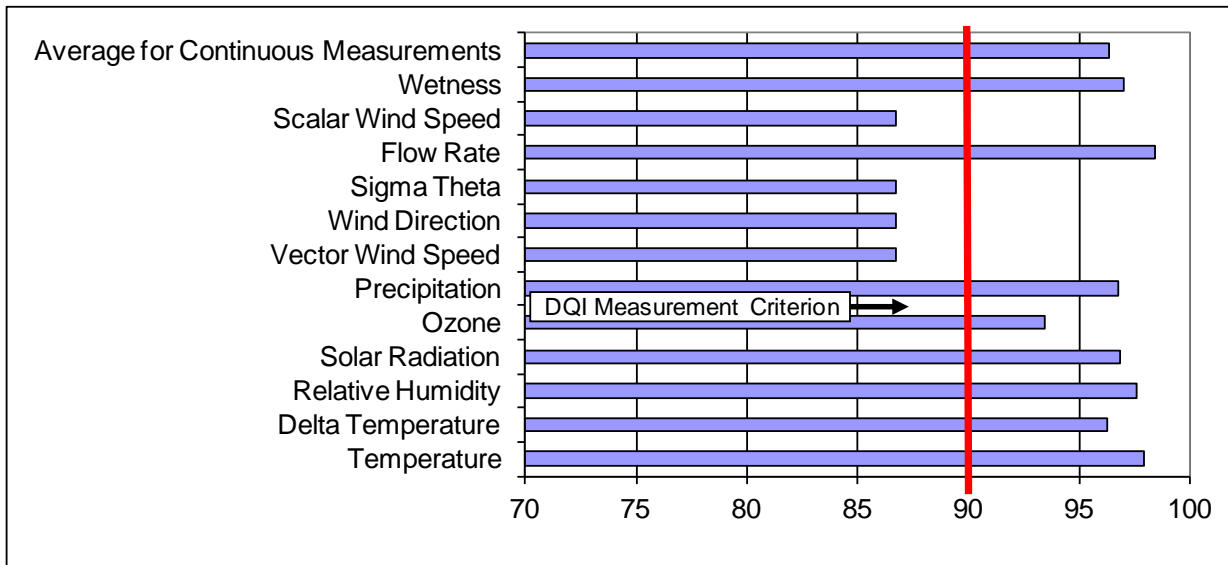


Figure 4 Percent Completeness of Measurements for Second Quarter 2013 through Third Quarter 2014*



Note: *Presents Level 3 data available during the fourth quarter of 2014

Figure 5 Laboratory Control Sample Results for Fourth Quarter 2014 (percent recovery)

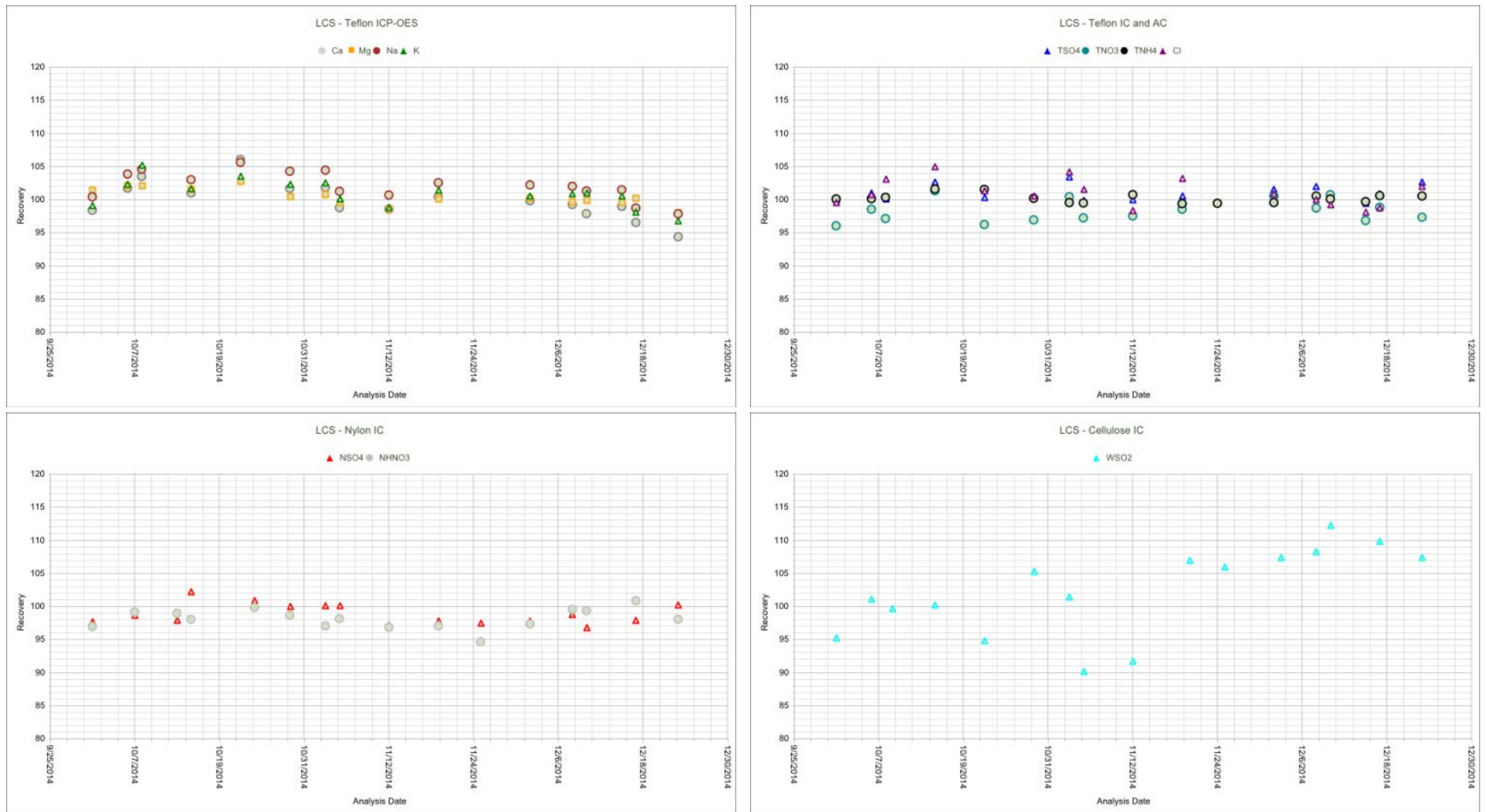


Figure 6 Method Blank Analysis Results for Fourth Quarter 2014 (total micrograms)

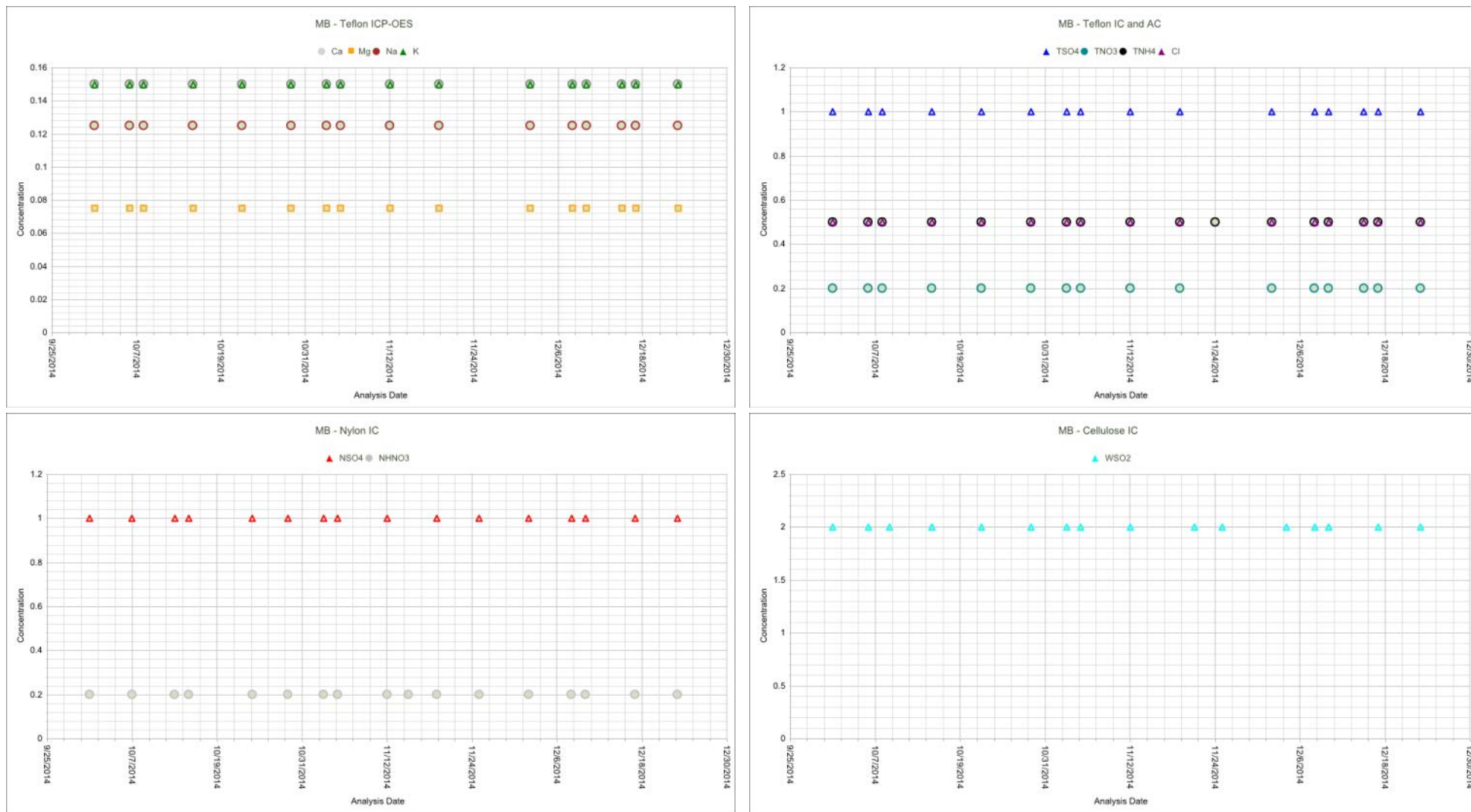


Figure 7 Laboratory Blank Analysis Results for Fourth Quarter 2014 (total micrograms)

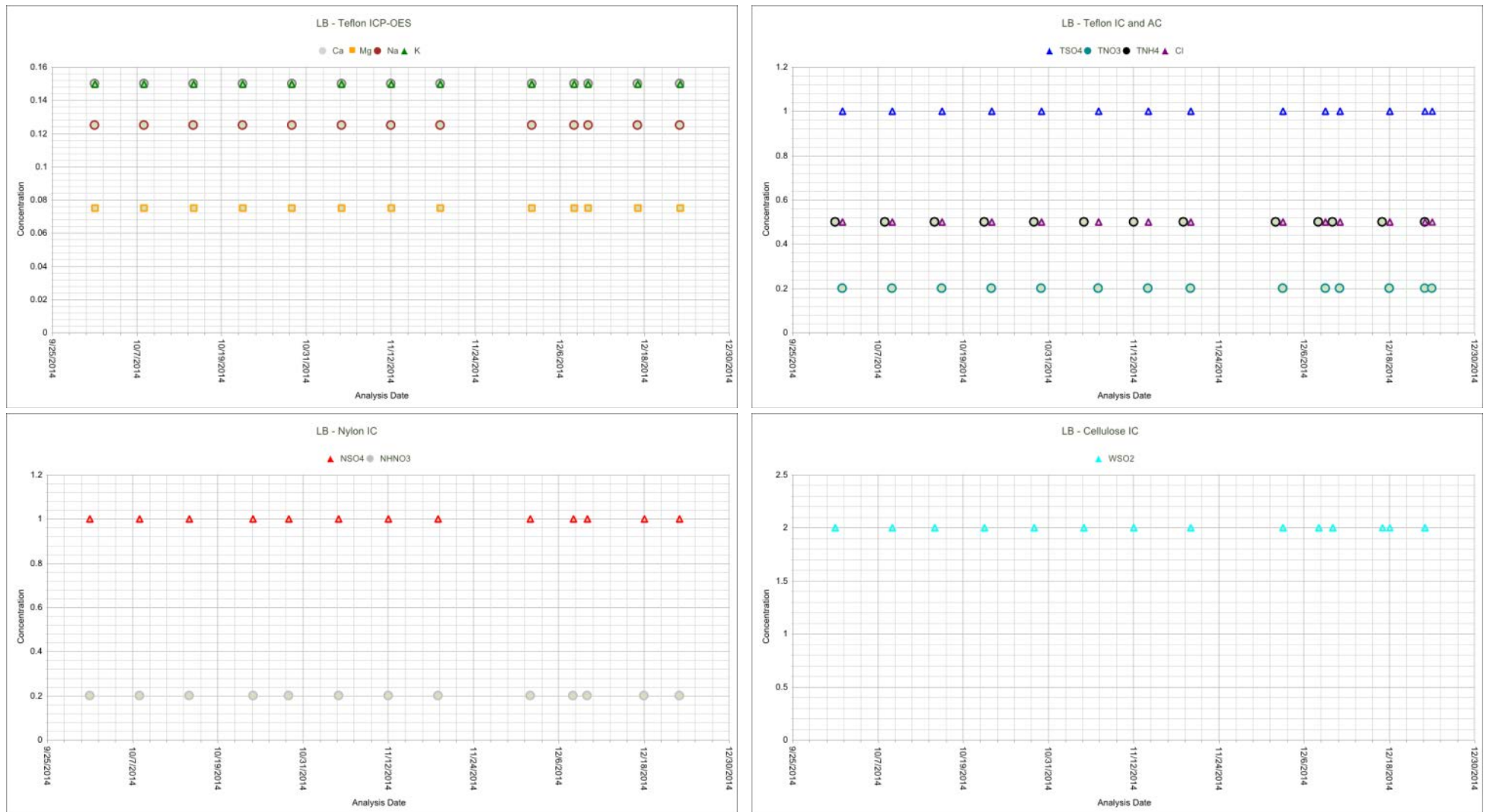


Figure 8 Field Blank Analysis Results for Fourth Quarter 2014 (total micrograms)

