



# Clean Air Status and Trends Network

## Fourth Quarter 2016 Quality Assurance Report

### Summary of Quarterly Operations (September through December) with 2016 Annual Summary

EPA Contract No. EP-W-16-015

#### 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 2016. 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 Foster Wheeler, 2016). 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 2016

The annual management review meeting in support of maintaining International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2005 accreditation by the American Association for Laboratory Accreditation (A2LA) was held in early January 2016. The meeting participants discussed the annual management review report distributed to the management group in December 2015. The agenda covered discussion of the status of the program as well as program goals for 2015 and 2016.

During review of third quarter 2015 filter pack sulfur dioxide (SO<sub>2</sub>) concentrations, it became apparent that aggregates of the SO<sub>2</sub> data for the eastern reference sites were not reasonable when compared with long-term third quarter time series. The EPA Contract-level Project Officer was notified as per ISO 17025 management system protocol. After this discussion, Amec Foster Wheeler removed the SO<sub>2</sub>-related discussions from the third quarter 2015 report and worked with EPA to remove these data from the publicly available database. The cause of the anomalous measurements was confirmed to be correlated with the laboratory's change to a different supplier of the reagent used to prepare the cellulose filter impregnation solution. This supplier was used for filter pack samples that ran from mid-May through December 2015. The prepared impregnation solutions passed acceptance testing prior to use. Corrective action (CA) 0053 was developed, and the steps outlined in CA\_0053 and the Filter Pack SO<sub>2</sub> Issue Summary were implemented. A correction factor to adjust the SO<sub>2</sub> data collected from May through December 2015 was developed by EPA and implemented at their direction. The adjusted data were flagged in the database as "suspect." The adjusted data were restored to the EPA CASTNET database in December 2016.

Data from the 9-meter temperature sensor at the CKT136, KY site were suspect for up to 12 months. Amec Foster Wheeler reviewed data from the site and determined that six months of data required invalidation. The remaining six months were rescaled. A subcontractor was subject to corrective action for erroneous entry of temperature calibration factors. Retraining was completed by the subcontractor.

During first quarter 2016, two subcontractors were subject to corrective action for their failure to properly verify operation of site equipment: one for erroneous entry of temperature calibration factors at CKT136, KY (as described previously), and the other for failure to maintain specified operating temperatures during ozone instrument reverification at CVL151, MS. The CVL151 site was reverified at the specified operating temperatures as part of the corrective action.

During 2016, Amec Foster Wheeler received results for analyses submitted for proficiency test (PT) studies 0107 and 0108 for Rain and Soft Waters from the National Laboratory of Environmental Testing (NLET), a branch of the National Water Research Institute (NWRI) with Environment Canada that provides QA services. In PT study 0107, one ammonia sample was flagged “warning high.” Ammonia and sulfate results were “biased high.” In PT study 0108, all CASTNET measured parameters received a performance rating of “ideal.” However, analyses of conductivity were flagged “high bias” at 2.9 percent. These ratings require no formal corrective actions under the requirements of accreditation<sup>1</sup>. All other results were rated as “ideal.” Amec Foster Wheeler’s analytical laboratory continued to be rated “very good,” the highest rating available.

Personnel from the North Carolina Department of Environmental Quality (NCDEQ) completed audits of the ozone systems at CASTNET sites within the state and completed checks of the third-party data collection equipment installed by NCDEQ last year at these ozone sites. One of Amec Foster Wheeler’s field subcontractors met NCDEQ at each site. All sites passed the audits. The NCDEQ’s goal was to determine if CASTNET data are comparable with the North Carolina ozone network, and they are. It is likely that NCDEQ will regularly perform audits of CASTNET ozone sites in the future.

The CASTNET ozone site CNT169, WY failed an independent audit during July, but the auditor decided to re-audit the site after review of the audit data and metadata. These data indicated possible problems with the pneumatic connections during the audit. The audit of CNT169 was repeated in August, and results passed. Additionally, BFT142, NC failed a National

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<sup>1</sup> Formal corrective actions are required for:

- ◆ Individual test results that are greater than  $3\sigma$  from the assigned value.
- ◆ Youden average rank for a parameter outside of the 95 percent confidence interval of the overall rank with a bias percent slope greater than an absolute value of 5.
- ◆ Consecutive study results for the same parameter with Youden average rank outside of the 95 percent confidence interval of the overall rank without regard to bias percent slope.
- ◆ Three or more parameters with Youden average rank outside of the 95 percent confidence interval of the overall rank in a single study without regard to bias percent slope.

Performance Audit Program (NPAP) audit during the quarter. Review of the audit data and auditor field notes indicated system moisture intrusion was observed during the audit. Amec Foster Wheeler is evaluating possible actions to prevent such issues. EPA Region 4 will schedule a re-audit of the BFT142 site as its schedule permits.

During December 2016, preparation began for the annual management review report in support of maintaining ISO/IEC 17025:2005 accreditation by the A2LA. A report will be prepared during January 2017 for discussion by the management group.

Providing a safe working environment is one of Amec Foster Wheeler's goals. Sites are routinely checked for safe working conditions at each calibration (i.e., twice per year). During 2016, Amec Foster Wheeler performed internal safety audits of selected sites. These safety audits provide a more in-depth review of site safety and include a safety-related evaluation of infrastructure condition and maintenance, use of equipment, site operator activities at the site, and verification that procedures are understood and followed by site personnel. No safety issues were found.

### **Quarterly/Annual Summary**

Table 1 lists the quarters of data that were validated to Level 3 during 2016 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 performed during each quarter of 2016.

### **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 2016 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 2016. 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 2016. Quarterly averages are all within criteria.

Table 13 presents quarterly collocated filter pack precision results for data validated to Level 3 during the year. Results for MCK131/231, KY and ROM406/206, CO were within the criterion for all of the 11 parameters reported.

Figure 4 presents completeness statistics for continuous measurements validated to Level 3 during the year. All parameters met the 90 percent criterion.

Table 14 presents summary statistics of critical criteria measurements at ozone sites collected during fourth quarter 2016. 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 effect 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 2016. 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 effect on ambient data collection, and passing results still meet frequency criteria. During fourth quarter, no values exceeded documented criteria or were otherwise notable.

### **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. The LCS is not required by the CASTNET QA/QC program. 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 2016. All recovery values were between 91 percent and 105 percent.

### **Blank Results**

Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for fourth quarter 2016. All fourth quarter results were within criteria (two times the reporting limit) listed in Table 4 with the exception of a single Teflon nitrate FB result. This result was investigated and no problems were found with the laboratory analysis or associated concentration data from the

monitoring site (HWF187, NY) during the quarter. Table 17 summarizes the record of filter blanks for 2016.

### **Suspect/Invalid Filter Pack Samples**

Filter pack samples that were flagged as suspect or invalid during each of the four quarters of 2016 are listed in Table 18. This table also includes associated site identification and a brief description of the reason the sample was flagged. During fourth quarter, 16 filter pack samples were invalidated.

### **Field Problem Count**

Table 19 presents counts of field problems affecting continuous data collection for more than one day for each quarter during 2016. 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 2016 is listed in Table 20. During 2016, all sites and parameters were within the criteria listed in Table 3 with the exception of the parameters at the 11 sites that are listed in Table 20.

Table 21 presents field accuracy results for 2016 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 solar radiation at 72.7 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 2x the criterion). All calibration failures reported in 2016 for the indicated parameters were within 2x the criterion with the exception of flow rate at NPT006, ID and temperature at ALC188, TX; CKT137, KY; and VIN140, IN. Associated temperature data were invalidated. The calibration factors entered for flow rate during installation of the NPT006 flow system in April were determined to be incorrect. The existing factors had been correct before the calibration adjustment. Associated flow rate data were adjusted to comport with the factors existing prior to the April calibration as per EPA direction.

### **References**

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler). 2016. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 8.3*. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC. Contract No. EP-W-16-015. Gainesville, FL. <https://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](http://www.astm.org).

U.S. Environmental Protection Agency (EPA). 2015. Appendix A to Part 58 – Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards. 40 *CFR* Part 58.

**Table 1** Data Validated to Level 3 through Fourth Quarter 2016

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
SE-4/MW-6†	July 2015 – June 2016	12	Quarter 3 2015 – Quarter 2 2016	4
E-1/SE-5	August 2015 – July 2016	12	Quarter 4 2015 – Quarter 2 2016	3
MW-7/W-9	September 2015 – August 2016	12	Quarter 4 2015 – Quarter 2 2016	3
E-2 /MW-8	October 2015 – September 2016	12	Quarter 4 2015 – Quarter 3 2016	4
E-3/W-10‡	May 2015 – April 2016	12	Quarter 3 2015 – Quarter 1 2016	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 2016

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (24 Total)					
E-1 (8 Sites)	February/August	BEL116, MD <sup>1</sup> BWR139, MD	WSP144, NJ CTH110, NY	ARE 128, PA PSU106, PA	PED108, VA VPI120, VA
E-2 (11 Sites)	April/October	ABT147, CT ASH135, ME HOW191, ME	WST109, NH CAT175, NY HWF187, NY <sup>2</sup>	NIC001, NY WFM007, NY WFM105, NY	EGB181, ON UND002, VT
E-3 (5 Sites)	May/November	KEF112, PA MKG113, PA	LRL117, PA PAR107, WV	CDR119, WV	
Southeastern Sites (11 Total)					
SE-4 (7 Sites)	January/July	SND152, AL GAS153, GA	BFT142, NC CND125, NC	COW005, 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 <sup>2</sup> ESP127, TN	
MW-7 (9 Sites)	March/September	ALH157, IL BVL130, IL <sup>3</sup> 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 (11 Total)					
W-9 (5 Sites)	March/September	KNZ184, KS KIC003, KS	CHE185, OK SAN189, NE	ALC188, TX	
W-10 (6 Sites)	May/November	GTH161, CO ROM206, CO <sup>1</sup>	NPT006, ID CNT169, WY	PND165, WY <sup>1</sup> PAL190, TX	

**Notes:** <sup>1</sup> Trace-level gas calibrations are performed quarterly in February, May, August, and November.

<sup>2</sup> Trace-level gas calibrations are performed quarterly in January, April, July, and October.

<sup>3</sup> Trace-level gas calibrations are performed quarterly in March, June, September, and December.

**Table 3** Data Quality Indicators for CASTNET Continuous Measurements

Measurement		Criteria <sup>1</sup>	
Parameter <sup>2</sup>	Method	Precision	Accuracy
Filter pack flow	Mass flow controller	± 10%	± 5%
Ozone <sup>3</sup>	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 <sup>4</sup>
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

<sup>1</sup> Precision criteria apply to collocated instruments, and accuracy criteria apply to calibration of instruments. Collocated precision criteria do not apply to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the Code of Federal Regulations (EPA, 2015).

<sup>2</sup> Meteorological parameters are only measured at five of the EPA-sponsored CASTNET sites: BVL130, IL; BEL116, MD; CHE185, OK; COW137, NC; and PAL190, TX.

<sup>3</sup> Ozone is not measured at 10 EPA-sponsored CASTNET sites: KIC003, KS; KNZ184, KS; RED004, MN; COW005, NC; EGB181, ON; CAT175, NY; NIC001, NY; WFM007, NY; WFM105, NY; and UND002, VT.

<sup>4</sup> For target value of 0.50 inch



**Table 4** Data Quality Indicators for CASTNET Laboratory Measurements

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

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

<sup>2</sup> 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 Foster Wheeler, 2016).

**Table 5** Ozone Critical Criteria\*

Type of Check	Analyzer Response
Zero	Less than ± 1.5 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, 2015). 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 <sub>2</sub>	Less than ± 1.5 ppb	Less than or equal to ± 10 percent between supplied and observed concentrations
NO <sub>y</sub>	Less than ± 1.5 ppb	
CO	Less than ± 30 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, 2015). 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).

SO<sub>2</sub> = sulfur dioxide

NO<sub>y</sub> = total reactive oxides of nitrogen

CO = carbon monoxide

ppb = parts per billion

**Table 7** QC Analysis Count for First Quarter 2016

Filter Type	Parameter	RF Sample Count	CCV Sample Count	RP Sample Count	MB Sample Count	LB Sample Count	FB Sample Count
Teflon	SO <sub>4</sub> <sup>2-</sup>	60	226	96	20	30	91
	NO <sub>3</sub> <sup>-</sup>	60	226	96	20	30	91
	NH <sub>4</sub> <sup>+</sup>	40	204	96	20	30	91
	Cl <sup>-</sup>	60	226	96	20	30	91
	Ca <sup>2+</sup>	40	208	96	20	30	91
	Mg <sup>2+</sup>	40	208	96	20	30	91
	Na <sup>+</sup>	40	208	96	20	30	91
	K <sup>+</sup>	40	208	96	20	30	91
Nylon	SO <sub>4</sub> <sup>2-</sup>	39	190	85	20	28	91
	NO <sub>3</sub> <sup>-</sup>	43	194	87	22	28	93
Cellulose	SO <sub>4</sub> <sup>2-</sup>	43	200	85	19	28	91

**Table 8** QC Analysis Count for Second Quarter 2016

Filter Type	Parameter	RF Sample Count	CCV Sample Count	RP Sample Count	MB Sample Count	LB Sample Count	FB Sample Count
Teflon	SO <sub>4</sub> <sup>2-</sup>	63	176	75	15	24	90
	NO <sub>3</sub> <sup>-</sup>	63	176	75	15	24	90
	NH <sub>4</sub> <sup>+</sup>	31	162	75	15	24	90
	Cl <sup>-</sup>	63	176	75	15	24	90
	Ca <sup>2+</sup>	31	166	75	15	24	90
	Mg <sup>2+</sup>	31	166	75	15	24	90
	Na <sup>+</sup>	31	166	75	15	24	90
	K <sup>+</sup>	31	166	75	15	24	90
Nylon	SO <sub>4</sub> <sup>2-</sup>	44	183	75	17	24	90
	NO <sub>3</sub> <sup>-</sup>	44	183	75	17	24	90
Cellulose	SO <sub>4</sub> <sup>2-</sup>	42	191	76	18	24	90

**Table 9** QC Analysis Count for Third Quarter 2016

Filter Type	Parameter	RF Sample Count	CCV Sample Count	RP Sample Count	MB Sample Count	LB Sample Count	FB Sample Count
Teflon	SO <sub>4</sub> <sup>2-</sup>	59	207	87	18	26	91
	NO <sub>3</sub> <sup>-</sup>	59	207	87	18	26	91
	NH <sub>4</sub> <sup>+</sup>	36	184	86	18	26	91
	Cl <sup>-</sup>	59	207	87	18	26	91
	Ca <sup>2+</sup>	38	191	87	19	26	91
	Mg <sup>2+</sup>	38	191	87	19	26	91
	Na <sup>+</sup>	38	191	87	19	26	91
	K <sup>+</sup>	38	191	87	19	26	91
Nylon	SO <sub>4</sub> <sup>2-</sup>	55	207	85	17	28	91
	NO <sub>3</sub> <sup>-</sup>	55	207	85	17	28	91
Cellulose	SO <sub>4</sub> <sup>2-</sup>	69	233	87	18	28	92

**Table 10** QC Analysis Count for Fourth Quarter 2016

Filter Type	Parameter	RF Sample Count	CCV Sample Count	RP Sample Count	MB Sample Count	LB Sample Count	FB Sample Count
Teflon	SO <sub>4</sub> <sup>2-</sup>	55	185	79	15	24	88
	NO <sub>3</sub> <sup>-</sup>	55	185	79	15	24	88
	NH <sub>4</sub> <sup>+</sup>	32	163	80	15	24	88
	Cl <sup>-</sup>	55	185	79	15	24	88
	Ca <sup>2+</sup>	34	173	79	15	24	88
	Mg <sup>2+</sup>	34	173	79	15	24	88
	Na <sup>+</sup>	34	173	79	15	24	88
	K <sup>+</sup>	34	173	79	15	24	88
Nylon	SO <sub>4</sub> <sup>2-</sup>	49	179	75	16	24	88
	NO <sub>3</sub> <sup>-</sup>	49	179	75	16	24	88
Cellulose	SO <sub>4</sub> <sup>2-</sup>	49	179	73	16	24	88

**Table 11** Filter Pack Receipt Summary for 2016

Description	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Summary
Count of samples received more than 14 days after removal from tower:	15	8	14	8	45
Count of all samples received:	837	863	817	795	3312
Fraction of samples received within 14 days:	0.982	0.991	0.983	0.990	0.986
Average interval in days:	5.373	4.388	4.416	5.186	4.841*
First receipt date:	01/04/2016	04/01/2016	07/01/2016	10/03/2016	01/04/2016
Last receipt date:	03/30/2016	06/30/2016	09/29/2016	12/30/2016	12/30/2016

**Note:** \*annual average

**Table 12** Filter Pack QC Summary for 2016

Filter Type	Parameter	Reference Sample <sup>1</sup> Recovery (%R)			Continuing Calibration Verification Samples (%R)			In-Run Replicate <sup>2</sup> (RPD)		
		Mean	Std. Dev.	Count <sup>3</sup>	Mean	Std. Dev.	Count <sup>3</sup>	Mean	Std. Dev.	Count <sup>3</sup>
Teflon	SO <sub>4</sub> <sup>2-</sup>	99.19	2.27	241	100.80	1.43	806	1.28	1.73	342
	NO <sub>3</sub> <sup>-</sup>	99.79	1.96	241	98.93	1.55	806	2.05	2.07	342
	NH <sub>4</sub> <sup>+</sup>	100.48	2.54	141	100.84	2.06	724	0.70	1.19	342
	Ca <sup>2+</sup>	102.07	2.52	145	100.27	1.04	750	1.02	1.25	342
	Mg <sup>2+</sup>	99.91	1.48	145	99.99	0.89	750	1.03	1.10	342
	Na <sup>+</sup>	99.13	1.48	145	100.00	1.11	750	1.01	1.03	342
	K <sup>+</sup>	98.50	1.83	145	100.00	0.92	750	1.85	2.14	342
	Cl <sup>-</sup>	100.62	1.95	241	103.07	1.27	806	2.34	2.64	342
Nylon	SO <sub>4</sub> <sup>2-</sup>	101.03	2.01	190	100.74	1.78	770	5.29	4.75	325
	NO <sub>3</sub> <sup>-</sup>	99.97	1.86	194	98.20	1.80	774	2.81	2.93	327
Cellulose	SO <sub>4</sub> <sup>2-</sup>	101.38	1.43	206	101.13	1.34	808	8.43	5.78	323

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

<sup>1</sup> Results of reference sample analyses provide accuracy estimates

<sup>2</sup> Results of replicate analyses provide precision estimates

<sup>3</sup> Number of QC Samples

**Table 13** Precision Results for Third Quarter 2015 through Second Quarter 2016

Quarter	SO <sub>4</sub> <sup>2-</sup>	NO <sub>3</sub> <sup>-</sup>	NH <sub>4</sub> <sup>+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	Na <sup>+</sup>	K <sup>+</sup>	Cl <sup>-</sup>	HNO <sub>3</sub>	SO <sub>2</sub>	Total NO <sub>3</sub> <sup>-</sup>
MCK131/231, KY											
2015 Q3	2.61	8.20	3.30	2.18	5.92	4.40	5.54	1.77	4.52	6.32	4.35
2015 Q4	1.61	3.74	2.08	8.07	9.25	3.35	4.35	2.08	5.67	5.13	4.22
2016 Q1	1.86	3.62	1.73	7.55	5.81	3.45	5.37	7.21	5.69	3.45	3.00
2016 Q2	2.99	5.54	0.94	6.86	6.54	2.58	4.02	1.42	6.16	6.42	4.29
Average	2.27	5.28	2.01	6.17	6.88	3.45	4.82	3.12	5.51	5.33	3.97
ROM406/206, CO											
2015 Q3	2.44	13.21	4.94	5.35	4.04	6.14	5.52	3.17	5.19	12.39	6.60
2015 Q4	6.05	14.62	6.18	8.34	7.89	5.46	20.19	13.58	10.14	12.73	7.00
2016 Q1	6.81	15.88	9.67	8.05	5.01	7.46	9.06	9.79	10.14	20.14	10.88
2016 Q2	4.94	10.55	5.33	5.01	4.99	8.25	6.29	6.87	12.64	17.30	11.25
Average	5.06	13.57	6.53	6.69	5.48	6.83	10.27	8.35	9.53	15.64	8.93

**Notes:** 0 of 88 site-quarter-parameters were outside criterion  
MARPD = mean absolute relative percent difference

**Table 14** Ozone QC Summary for Fourth Quarter 2016 (1 of 2)

Site ID	% Span Pass <sup>1</sup>	Span  %D  <sup>2</sup>	% Single Point QC Pass <sup>1</sup>	Single Point QC  %D  <sup>2</sup>	% Zero Pass <sup>1</sup>	Zero Average (ppb) <sup>2</sup>
ABT147, CT	100.00	0.46	100.00	0.53	100.00	0.19
ALC188, TX	97.92	3.18	95.83	2.76	94.79	0.87
ALH157, IL	100.00	0.44	100.00	0.50	98.89	0.22
ANA115, MI	100.00	0.83	100.00	0.72	100.00	0.10
ARE128, PA	97.92	1.09	97.92	1.13	100.00	0.30
ASH135, ME	100.00	1.44	100.00	1.62	98.92	0.20
BEL116, MD	100.00	0.87	100.00	0.73	98.86	0.19
BFT142, NC	100.00	1.26	98.92	1.43	93.55	0.47
BVL130, IL	100.00	1.01	100.00	1.15	98.86	0.24
BWR139, MD	100.00	1.95	100.00	2.68	100.00	0.46
CAD150, AR	100.00	1.54	100.00	1.52	100.00	0.25
CDR119, WV	100.00	1.31	100.00	1.58	100.00	0.31
CDZ171, KY	100.00	0.45	100.00	0.64	100.00	0.14
CKT136, KY	100.00	0.53	100.00	0.53	100.00	0.14
CND125, NC	100.00	1.43	100.00	1.31	96.34	0.54
CNT169, WY	75.41	4.14	79.03	3.01	100.00	0.80
COW137, NC	100.00	1.06	98.95	1.67	90.53	0.46
CTH110, NY	100.00	0.90	100.00	1.04	100.00	0.45
CVL151, MS	100.00	1.66	100.00	1.00	98.94	0.24
DCP114, OH	100.00	0.63	100.00	0.93	100.00	0.13
ESP127, TN	100.00	0.86	100.00	1.08	95.74	0.22
GAS153, GA	100.00	0.79	100.00	0.78	100.00	0.19
GTH161, CO	100.00	5.40	98.97	5.49	100.00	0.16
HOX148, MI	100.00	0.66	100.00	0.77	100.00	0.67
HWF187, NY	100.00	0.94	100.00	1.11	100.00	0.14
IRL141, FL	100.00	1.63	100.00	1.68	98.70	0.31
KEF112, PA	100.00	1.20	100.00	1.80	91.76	0.53
LRL117, PA	100.00	0.58	98.94	0.84	97.87	0.27
MCK131, KY	100.00	0.64	100.00	0.57	98.91	0.25
MCK231, KY	100.00	0.61	100.00	0.64	98.94	0.27
MKG113, PA	100.00	0.82	100.00	0.71	98.94	0.19
NPT006, ID	100.00	0.94	98.96	0.94	98.96	0.16

**Table 14** Ozone QC Summary for Fourth Quarter 2016 (2 of 2)

Site ID	% Span Pass <sup>1</sup>	Span  %D  <sup>2</sup>	% Single Point QC Pass <sup>1</sup>	Single Point QC  %D  <sup>2</sup>	% Zero Pass <sup>1</sup>	Zero Average (ppb) <sup>2</sup>
OXF122, OH	100.00	1.25	98.90	1.89	93.41	1.03
PAL190, TX	100.00	0.86	100.00	1.10	100.00	0.49
PAR107, WV	100.00	0.85	97.89	1.11	94.74	0.34
PED108, VA	100.00	1.42	100.00	1.56	100.00	0.14
PND165, WY	100.00	1.42	100.00	2.62	100.00	0.62
PNF126, NC	86.87	6.97	86.87	6.88	95.96	0.40
PRK134, WI	100.00	1.39	100.00	0.79	100.00	0.44
PSU106, PA	100.00	0.59	100.00	0.55	98.82	0.42
QAK172, OH	100.00	1.25	98.55	1.04	100.00	0.29
ROM206, CO	100.00	0.90	100.00	0.93	100.00	0.15
SAL133, IN	100.00	0.67	100.00	0.75	96.81	0.40
SAN189, NE	100.00	0.51	100.00	1.02	100.00	0.13
SND152, AL	100.00	0.74	100.00	0.84	98.55	0.25
SPD111, TN	100.00	0.94	100.00	0.50	100.00	0.24
STK138, IL	100.00	1.26	100.00	2.22	98.67	1.06
SUM156, FL	100.00	0.74	98.95	1.09	91.58	0.65
UVL124, MI	98.92	2.26	100.00	1.33	100.00	0.17
VIN140, IN	100.00	0.91	100.00	1.16	97.80	0.33
VPI120, VA	100.00	0.66	100.00	0.77	100.00	0.36
WSP144, NJ	100.00	3.48	100.00	3.90	97.92	0.72
WST109, NH	100.00	0.37	100.00	0.43	98.94	0.12

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

<sup>2</sup> 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.

%D = percent difference  
ppb = parts per billion

**Table 15** Ozone QC Observations for Fourth Quarter 2016

Site ID	QC Criterion	Comments
CNT169, WY	% Span Pass % Single Point QC Pass	The site analyzer malfunctioned at the end of December. Associated data were invalidated.
PNF126, NC	% Span Pass % Single Point QC Pass	There was a leak in the sample line at the end of December. Associated data were invalidated.

**Note:** %D = percent difference

**Table 16** Trace-level Gas QC Summary for Fourth Quarter 2016

Parameter	% Span Pass <sup>1</sup>	Span  %D  <sup>2</sup>	% Single Point QC Pass <sup>1</sup>	Single Point QC  %D  <sup>2</sup>	% Zero Pass <sup>1</sup>	Zero Average (ppb) <sup>2</sup>
BEL116, MD						
SO <sub>2</sub>	100.00	2.38	100.00	2.81	100.00	0.85
NO <sub>y</sub>	100.00	1.12	100.00	1.61	100.00	0.35
BVL130, IL						
SO <sub>2</sub>	100.00	0.90	100.00	2.10	100.00	0.26
NO <sub>y</sub>	100.00	1.74	100.00	2.10	100.00	0.43
CO	97.92	2.48	95.83	4.59	93.88	11.47
HWF187, NY						
NO <sub>y</sub>	100.00	0.76	100.00	1.30	100.00	0.17
PND165, WY						
NO <sub>y</sub>	100.00	3.19	95.00	3.53	100.00	0.14
PNF126, NC						
NO <sub>y</sub>	100.00	1.33	100.00	1.36	100.00	0.26
ROM206, CO						
NO <sub>y</sub>	100.00	1.30	100.00	1.93	100.00	0.32

**Notes:** <sup>1</sup> Percentage of comparisons that pass the criteria listed in Table 6. No values were below 90 percent.

<sup>2</sup> Absolute value of the average percent differences between the supplied and observed concentrations. No values exceeded the criteria listed in Table 6.

%D = percent difference

ppb = parts per billion



**Table 17** Summary of Filter Blanks for 2016 (1 of 2)

Parameter Name	Detection Limit Total µg	Total Number	Number > Detection Limit	Average Total µg	Average Absolute Deviation	Maximum Total µg
<b>FIELD BLANKS</b>						
Teflon-NH <sub>4</sub> <sup>+</sup> -N	0.500	361	0	0.500	0.000	0.500
Teflon- NO <sub>3</sub> <sup>-</sup> -N	0.200	361	8	0.205	0.010	1.322
Teflon- SO <sub>4</sub> <sup>2-</sup>	1.000	361	0	1.000	0.000	1.000
Cl <sup>-</sup>	0.500	361	0	0.500	0.000	0.500
Ca <sup>2+</sup>	0.150	361	5	0.151	0.003	0.390
Mg <sup>2+</sup>	0.075	361	0	0.075	0.000	0.075
Na <sup>+</sup>	0.125	361	1	0.125	0.000	0.130
K <sup>+</sup>	0.150	361	4	0.164	0.028	4.855
Nylon- NO <sub>3</sub> <sup>-</sup> -N	0.200	363	1	0.200	0.000	0.253
Nylon - SO <sub>4</sub> <sup>2-</sup>	1.000	361	0	1.000	0.000	1.000
Cellulose - SO <sub>4</sub> <sup>2-</sup>	2.000	361	26	2.025	0.046	3.760
<b>LABORATORY BLANKS</b>						
Teflon-NH <sub>4</sub> <sup>+</sup> -N	0.500	106	0	0.500	0.000	0.500
Teflon- NO <sub>3</sub> <sup>-</sup> -N	0.200	106	0	0.200	0.000	0.200
Teflon- SO <sub>4</sub> <sup>2-</sup>	1.000	106	0	1.000	0.000	1.000
Cl <sup>-</sup>	0.500	106	0	0.500	0.000	0.500
Ca <sup>2+</sup>	0.150	106	1	0.150	0.001	0.203
Mg <sup>2+</sup>	0.075	106	0	0.075	0.000	0.075
Na <sup>+</sup>	0.125	106	0	0.125	0.000	0.125
K <sup>+</sup>	0.150	106	0	0.150	0.000	0.150
Nylon- NO <sub>3</sub> <sup>-</sup> -N	0.200	104	0	0.200	0.000	0.200
Nylon -SO <sub>4</sub> <sup>2-</sup>	1.000	104	0	1.000	0.000	1.000
Cellulose -SO <sub>4</sub> <sup>2-</sup>	2.000	104	4	2.011	0.022	2.385
<b>METHOD BLANKS</b>						
Teflon-NH <sub>4</sub> <sup>+</sup> -N	0.500	69	0	0.500	0.000	0.500
Teflon- NO <sub>3</sub> <sup>-</sup> -N	0.200	69	0	0.200	0.000	0.200
Teflon- SO <sub>4</sub> <sup>2-</sup>	1.000	69	0	1.000	0.000	1.000
Cl <sup>-</sup>	0.500	69	0	0.500	0.000	0.500
Ca <sup>2+</sup>	0.150	70	0	0.150	0.000	0.150
Mg <sup>2+</sup>	0.075	70	0	0.075	0.000	0.075
Na <sup>+</sup>	0.125	70	0	0.125	0.000	0.125
K <sup>+</sup>	0.150	70	0	0.150	0.000	0.150
Nylon- NO <sub>3</sub> <sup>-</sup> -N	0.200	74	0	0.200	0.000	0.200
Nylon -SO <sub>4</sub> <sup>2-</sup>	1.000	72	0	1.000	0.000	1.000
Cellulose -SO <sub>4</sub> <sup>2-</sup>	2.000	73	0	2.000	0.000	2.000

**Table 17** Summary of Filter Blanks for 2016 (2 of 2)

Parameter Name	Detection Limit Total $\mu\text{g}$	Total Number	Number > Detection Limit	Average Total $\mu\text{g}$	Average Absolute Deviation	Maximum Total $\mu\text{g}$
<b>ACCEPTANCE TEST VALUES<sup>1</sup></b>						
Teflon-NH <sub>4</sub> <sup>+</sup> -N	0.500	240	0	0.500	0.000	0.500
Teflon- NO <sub>3</sub> <sup>-</sup> -N	0.200	240	1	0.201	0.002	0.393
Teflon- SO <sub>4</sub> <sup>2-</sup>	1.000	240	0	1.000	0.000	1.000
Cl <sup>-</sup>	0.500	240	1	0.502	0.003	0.870
Ca <sup>2+</sup>	0.150	240	0	0.150	0.000	0.150
Mg <sup>2+</sup>	0.075	240	0	0.075	0.000	0.075
Na <sup>+</sup>	0.125	240	1	0.125	0.000	0.168
K <sup>+</sup>	0.150	240	2	0.150	0.001	0.210
Nylon- NO <sub>3</sub> <sup>-</sup> -N	0.200	240	0	0.200	0.000	0.200
Nylon -SO <sub>4</sub> <sup>2-</sup>	1.000	240	0	1.000	0.000	1.000
Cellulose -SO <sub>4</sub> <sup>2-</sup>	2.000	298	11	2.031	0.060	4.535

**Note:** <sup>1</sup>Only filter batches passing QC requirements are used for sampling and analysis.

**Table 18** Filter Packs Flagged as Suspect or Invalid (1 of 2)

Site ID	Sample	Reason
<b>First Quarter 2016</b>		
BEL116, MD	1609001-06	Insufficient flow data due to problems with telemetry
BFT142, NC	1605001-07	Insufficient flow volume
CHE185, OK	1611004-02	Insufficient flow data due to problems with telemetry
COW005, NC	1602003-01	Insufficient flow volume
CTH110, NY	1602001-24	Insufficient flow volume due to power failure
DCP114, OH	1611001-21 1612001-21	Insufficient flow data due to problems with telemetry
DIN431, UT	1602001-28 1604003-06 1605003-06	Insufficient flow volume due to a leak in the flow system
GAS153, GA	1602001-32 1608001-24	“Calibrator onsite” flags were applied in error for 1602001-32. Flow data should be recoverable for this sample.  Insufficient flow data due to problems with telemetry for sample 1608001-24
NIC001, NY	1602001-53	Insufficient flow volume due to power failure
PRK134, WI	1612001-43	Insufficient flow volume
ROM406, CO	1602001-67	Insufficient flow volume due to a leak in the flow system
SPD111, TN	1603001-49 1611001-49	Insufficient flow volume for both samples Problems with telemetry for sample 1611001-49
WNC429, SD	1604003-23	Insufficient flow volume
YOS404, CA	1604003-25 1609003-25 1611003-25	Insufficient flow volume due to a malfunctioning flow pump.
<b>Second Quarter 2016</b>		
ALC188, TX	1618004-01	Data logger malfunction
BFT142, NC	1615001-07	Improper installation of the filter pack
CAN407, UT	1619003-03	Insufficient valid flow volume
ESP127, TN	1619001-23	Insufficient valid flow volume
JOT403, CA	1618003-12	Insufficient valid flow volume
MAC426, KY	1615003-14	Insufficient valid flow volume
NIC001, NY	1617001-36	Insufficient valid flow volume
SND152, AL	1619001-48	Data acquisition system router malfunction
SUM156, FL	1616001-51 1617001-51 1618001-51	Suspect potassium values were invalidated. Other parameters were reported as valid.
WNC429, SD	1615003-23	Insufficient valid flow volume

**Table 18** Filter Packs Flagged as Suspect or Invalid (2 of 2)

Site ID	Sample	Reason
Third Quarter 2016		
BAS601, WY	1628005-01 1630008-01	Insufficient flow volume
BBE401, TX	1635004-02	The mass flow controller malfunctioned and was replaced.
BEL116, MD	1635003-06	Power failure
BUF603, WY	1629006-02	Power failure
CAN407, UT	1636005-03	Insufficient flow volume
CDR119, WV	1628001-12 1630005-12	Data logger malfunction
CHA467, AZ	1629004-04	Insufficient flow volume
CHE185, OK	1629005-02 1631005-02 1633005-02 1634005-02	There were telemetry and data logger issues. Data recovery is underway.
CNT169, WY	1638003-16	Flow data are missing due to a polling error.
DIN431, UT	1634004-06	Insufficient flow volume
KIC003, KS	1629005-03 1630007-03 1631005-03 1632005-03	Leaks in the flow system and a malfunctioning flow pump
MEV405, CO	1636005-15	Flow system malfunction
PAL190, TX	1628001-38	Data logger malfunction
PED108, VA	1635003-40	Flow data are missing due to a polling error.
UND002, VT	1630005-52 1637003-52	Intermittent power fluctuations resulted in problems with site telemetry.
Fourth Quarter 2016		
ANA115, MI	1642004-03 1643003-03	Mass flow controller malfunction
CNT169, WY	1642004-16 1644003-16 1645003-16	Insufficient flow volume
FOR605, WY	1641006-03	Power failure
GLR468, MT	1643004-08	Blockage in the sample line
GRB411, NV	1650004-09	Flow pump was left off following a third party site audit.
JOT403, CA	1649004-12	Insufficient flow volume
NEC602, WY	1648007-04	Insufficient flow volume
PND165, WY	1645003-41	Insufficient flow volume
PNF126, NC	1645003-42	Leak in the sample line
UND002, VT	1643003-52 1645003-52 1646003-52	Intermittent power failures
VOY413, MN	1644004-22	Suspect* potassium value was invalidated. Other parameters were reported as valid.

**Note:** \*Determined to be suspect during routine review of filter pack concentrations.

**Table 19** Field Problems Affecting Data Collection

Days to Resolution	Problem Count
First Quarter 2016	
30	244
60	3
90	0
Unresolved by End of Quarter	5
Second Quarter 2016	
30	244
60	4
90	0
Unresolved by End of Quarter	1
Third Quarter 2016	
30	544
60	14
90	0
Unresolved by End of Quarter	20
Fourth Quarter 2016	
30	652
60	7
90	0
Unresolved by Date of Publication	29

**Table 20** Field Calibration Failures by Parameter for 2016

Site ID	Parameter(s)
First Quarter 2016	
ABT147, CT	Temperature
ALC188, TX	Temperature
BWR139, MD	Flow Rate
CDZ171, KY	Flow Rate, Temperature
CKT136, KY	Temperature
VIN140, IN	Temperature
Second Quarter 2016	
NPT006, ID	Flow Rate
Third Quarter 2016	
BVL130, IL	Solar Radiation
COW137, NC	Solar Radiation
IRL141, FL	Solar Radiation
PNF126, NC	Temperature
Fourth Quarter 2016	
No failures	

**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 Foster Wheeler, 2016). Please refer to Table 14 for documentation of the QC failures affecting the validity of ozone data.

**Table 21** Accuracy Results for 2016 Field Measurements

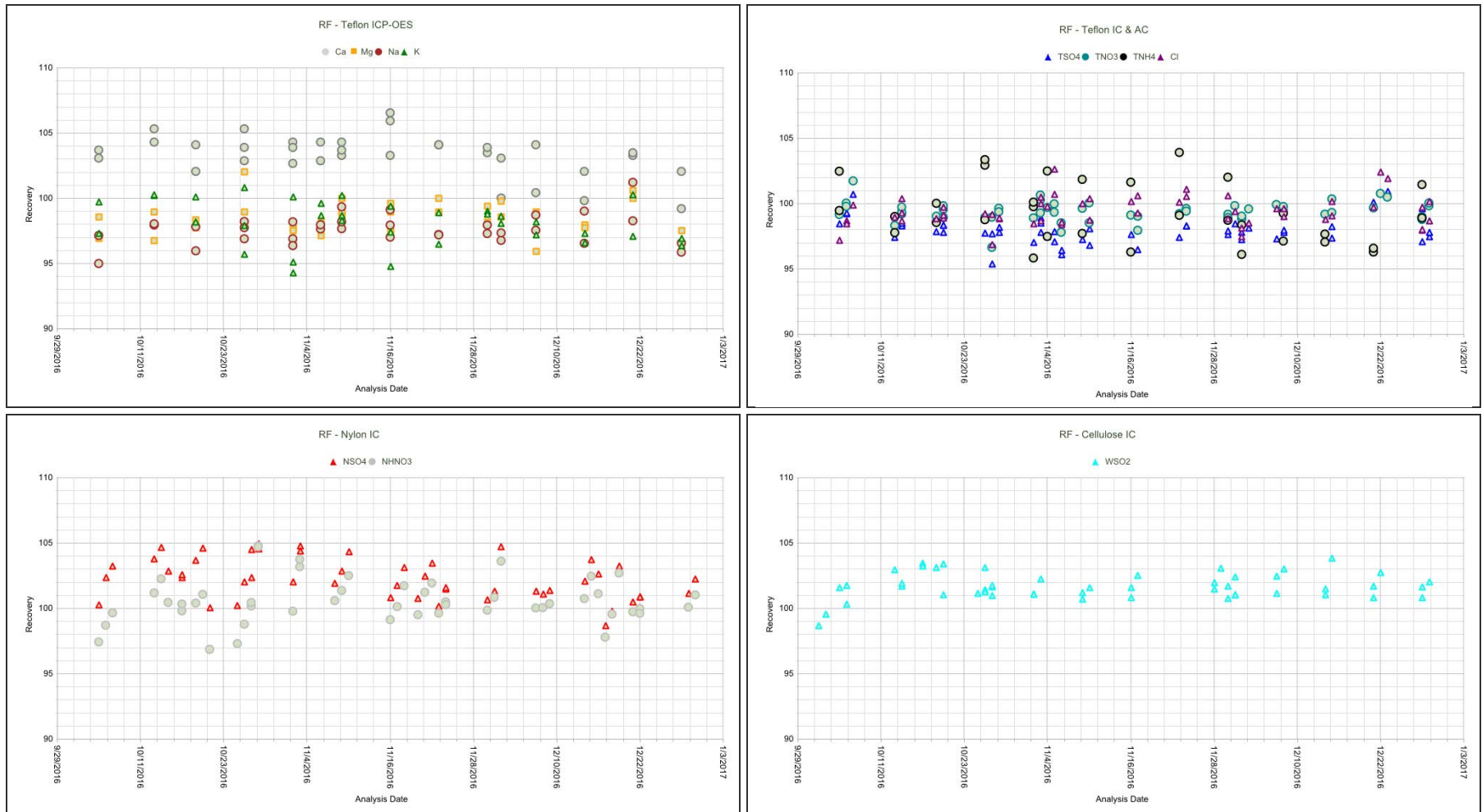
Parameter	Percent Within Criterion	Parameter	Percent Within Criterion
Flow Rate	97.5	Delta Temperature (0°C)	100.0
Wind Speed < 5 m/s	100.0	Delta Temperature (ambient)	100.0
Wind Speed ≥ 5 m/s	100.0	Relative Humidity	100.0
Wind Direction North	100.0	Precipitation	100.0
Wind Direction South	100.0	Solar Radiation	72.7*
Temperature (0°C)	95.8	Wetness (w/in 0.5 volts)	100.0
Temperature (ambient)	96.6		

**Notes:** °C = degrees Celsius

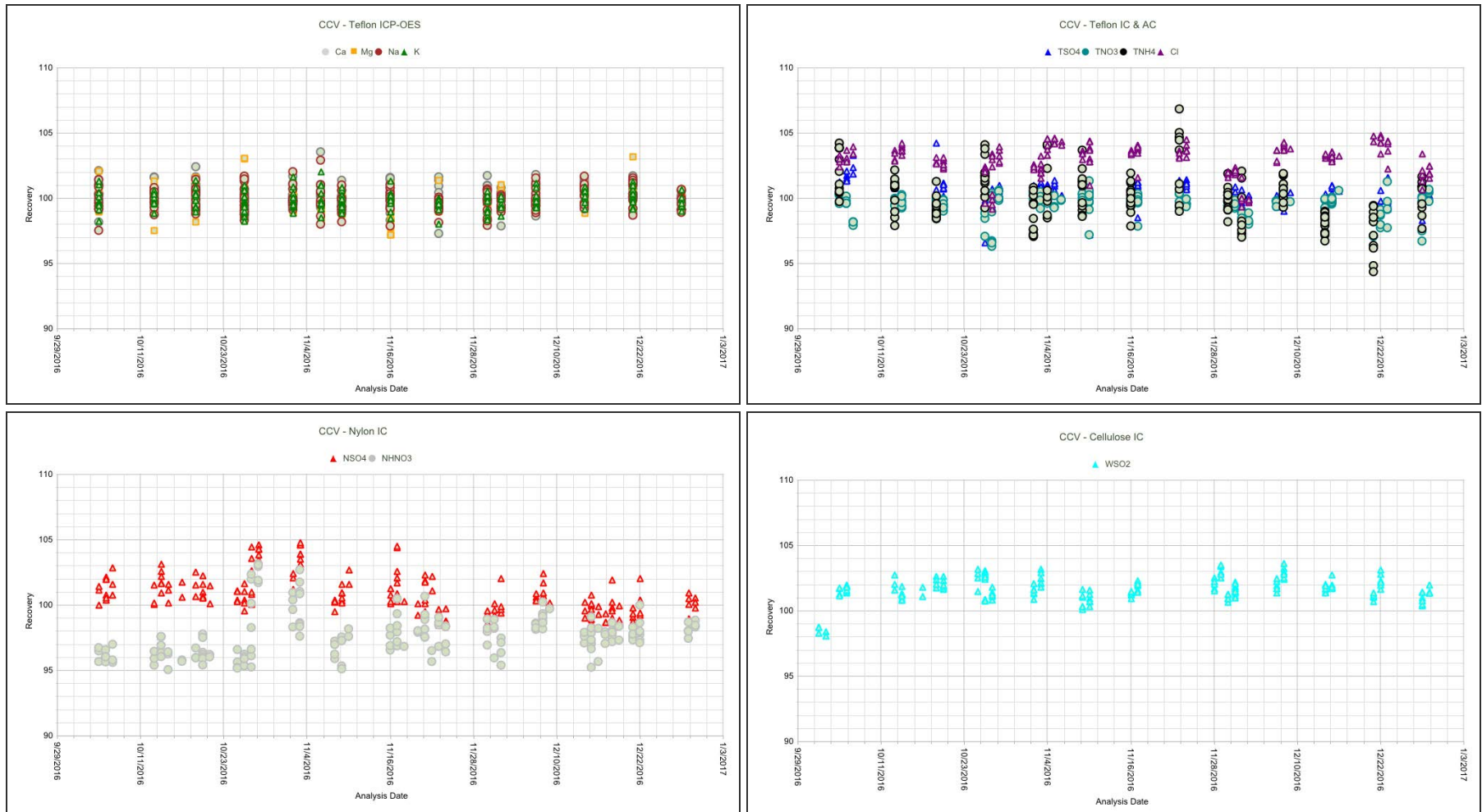
m/s = meters per second

\* = 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 2016 for the indicated parameters were within 2x the criterion with the exception of flow rate at NPT006, ID; and temperature at ALC188, TX; CKT136, KY; and VIN140, IN. Associated temperature data were invalidated. Associated flow rate data were adjusted as per EPA direction.

**Figure 1** Reference Standard Results for Fourth Quarter 2016 (percent recovery)

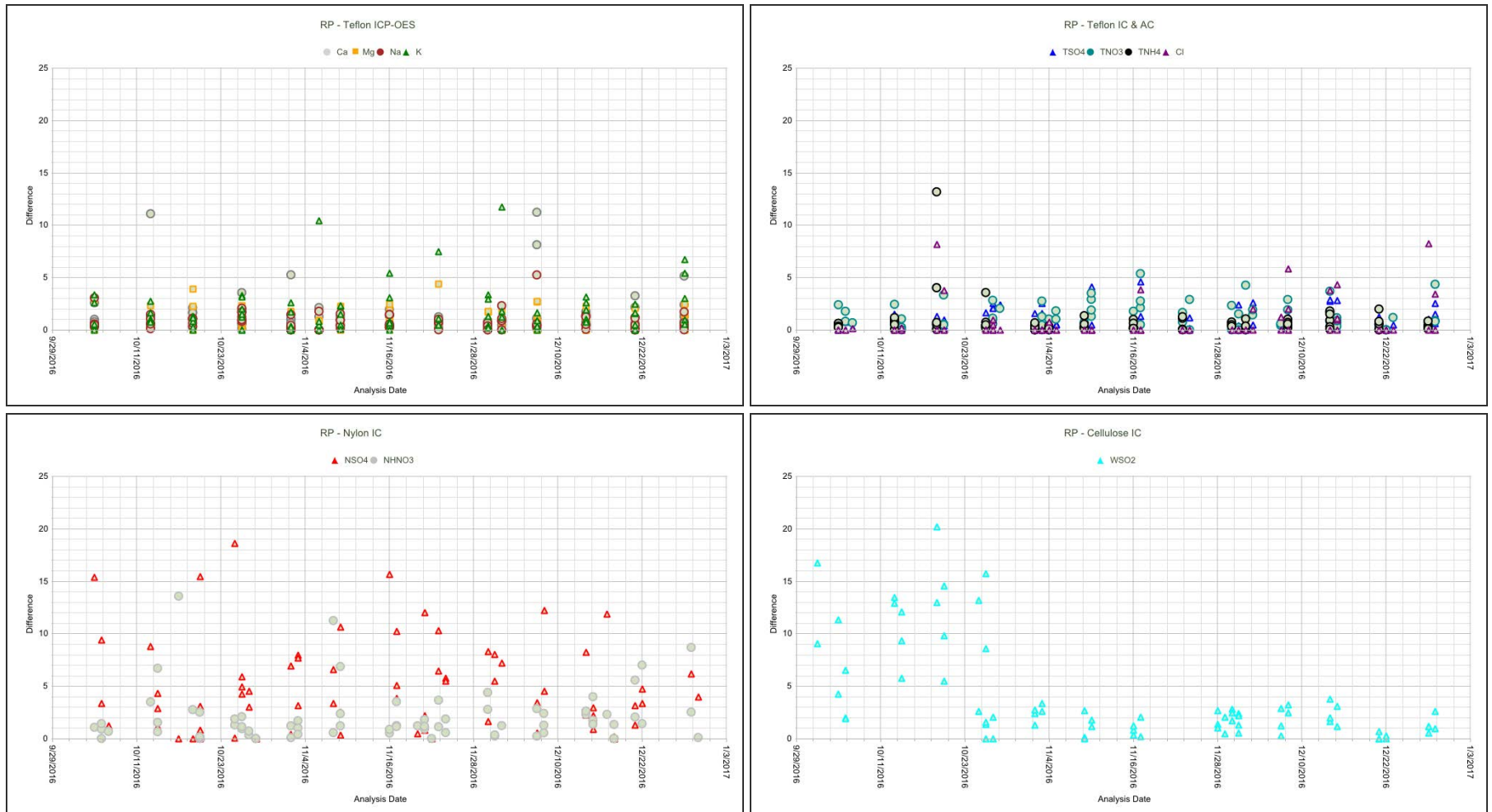


**Figure 2** Continuing Calibration Spike Results for Fourth Quarter 2016 (percent recovery)

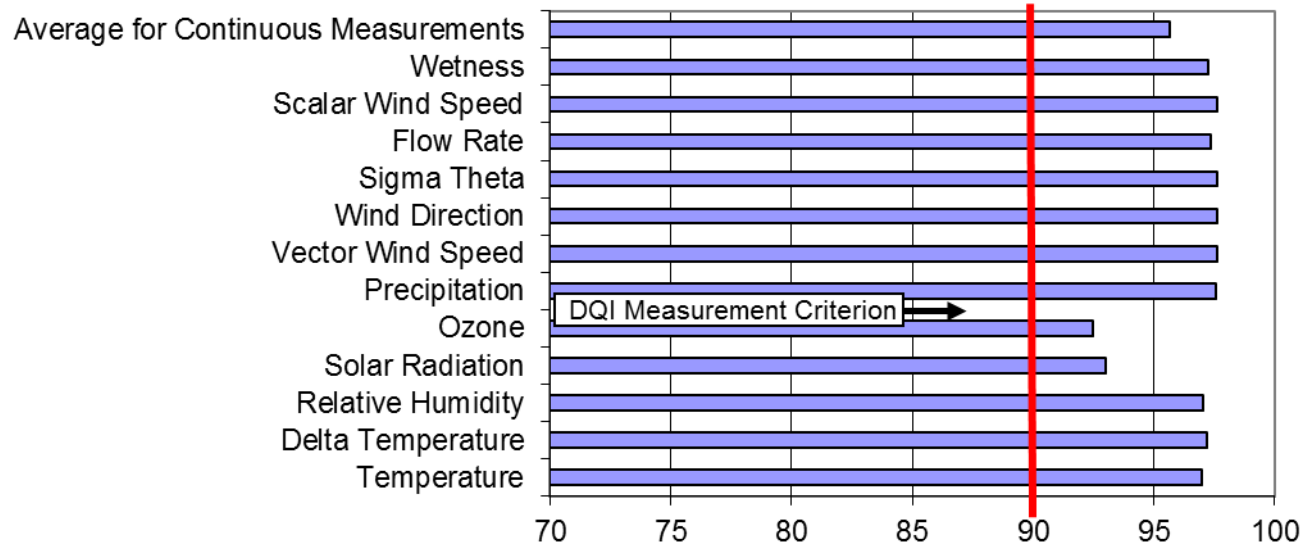




**Figure 3** Replicate Sample Analysis Results for Fourth Quarter 2016 (percent difference)

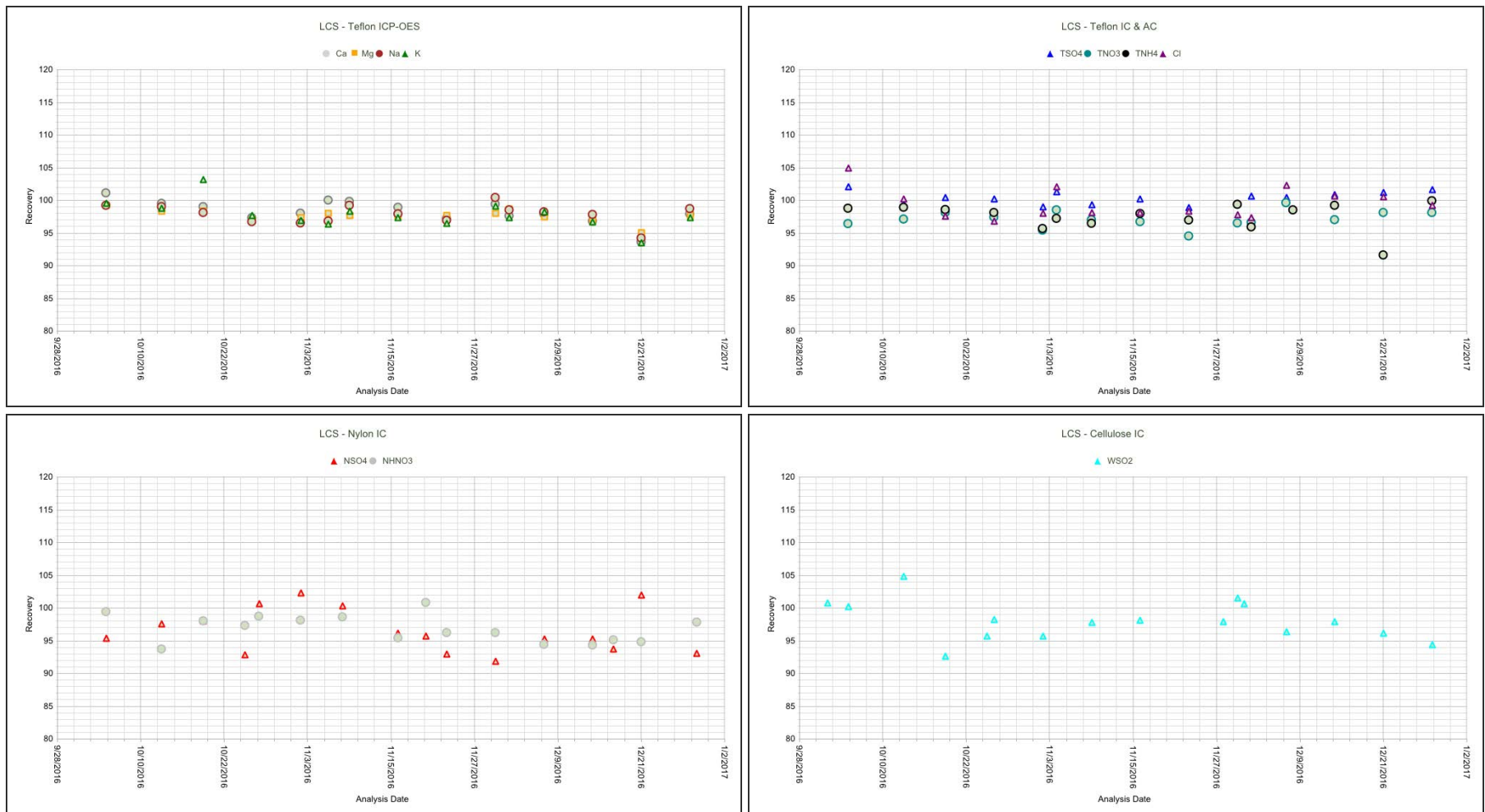


**Figure 4** Percent Completeness of Measurements for Second Quarter 2015 through Third Quarter 2016\*

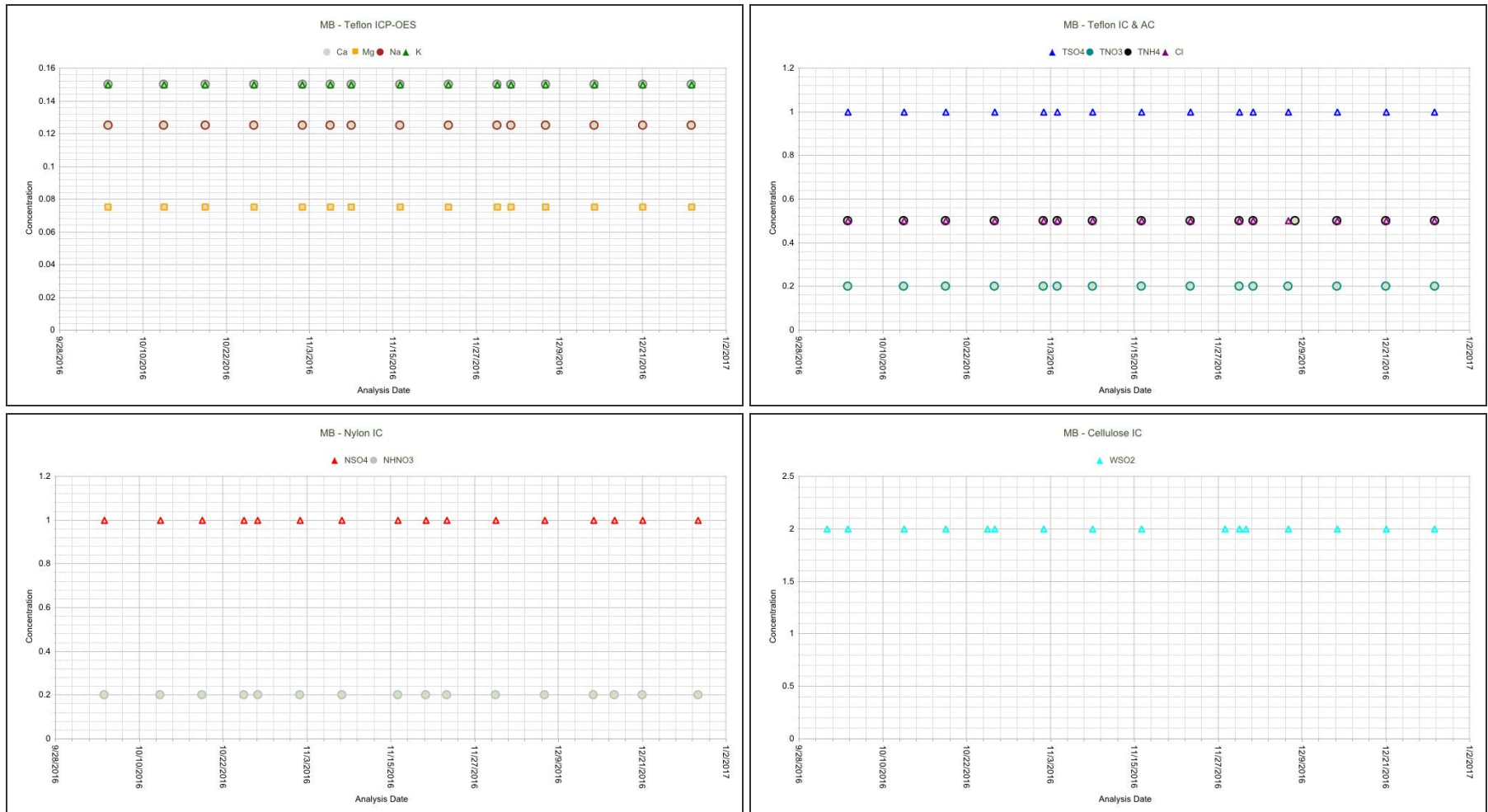


Note: \*Presents Level 3 data available during the fourth quarter of 2016

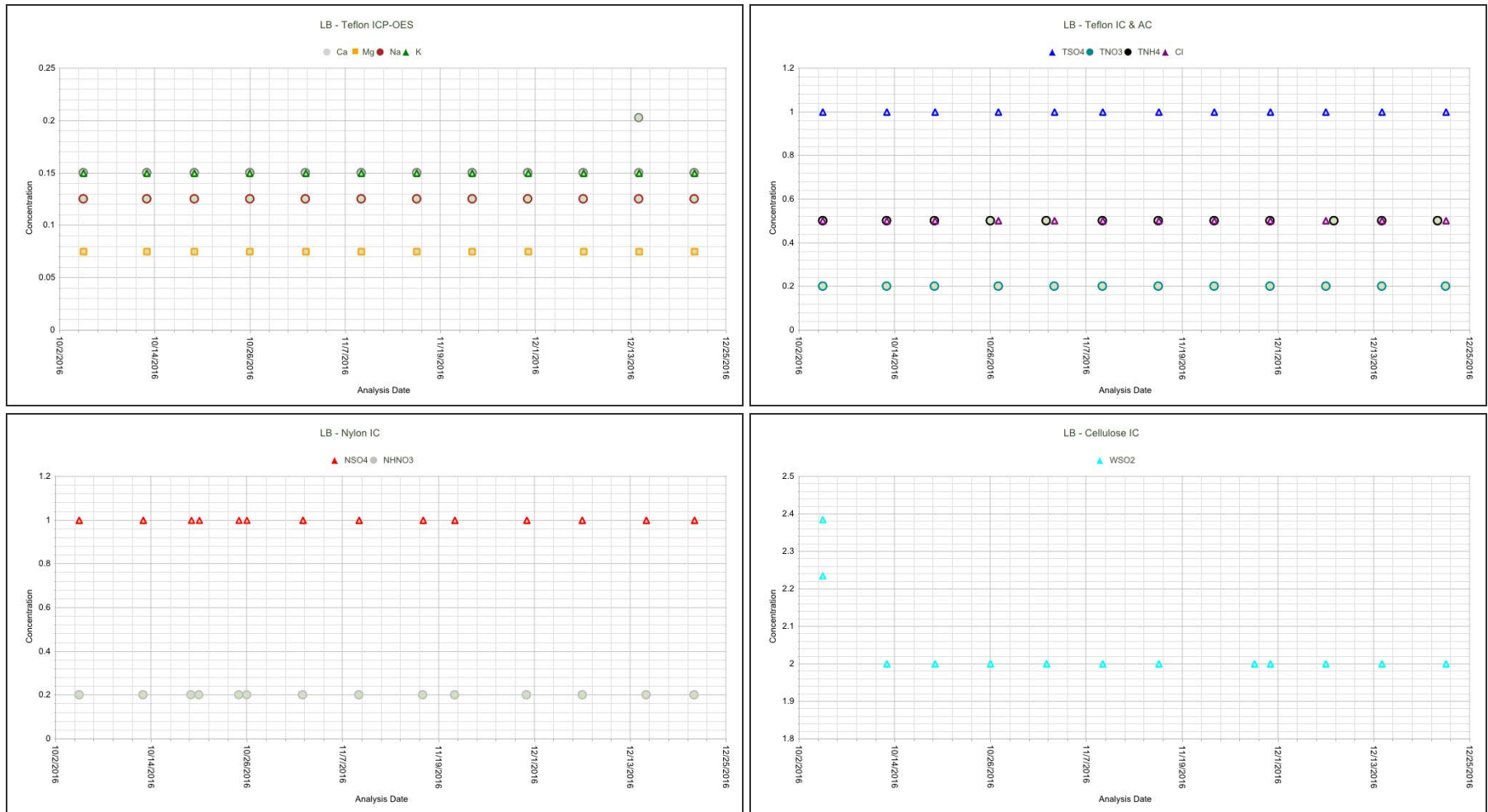
**Figure 5** Laboratory Control Sample Results for Fourth Quarter 2016 (percent recovery)



**Figure 6** Method Blank Analysis Results for Fourth Quarter 2016 (total micrograms)



**Figure 7** Laboratory Blank Analysis Results for Fourth Quarter 2016 (total micrograms)



**Figure 8** Field Blank Analysis Results for Fourth Quarter 2016 (total micrograms)

