Summary of Quarterly Operations (October – December) with 2012 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 2012. It also provides an annual summary that includes data from the three previous quarters. The results presented for filter pack data collection and field calibrations are generated from data extracted from the CASTNET Data Management Center database using the CASTNET Data Management System Application and Microsoft Access. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP). 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 2012

EPA issued Contract Modification 0032 to the CASTNET IV contract (EP-W-09-028) on April 6, 2012 to accept AMEC E&I, Inc.'s name change to AMEC Environment & Infrastructure, Inc. (AMEC).

Throughout 2012, AMEC worked with Bios International, Inc. (Bios), the manufacturer of the flow transfer standards used for the network, in order to resolve the measurement errors AMEC discovered in 2011. Bios identified a defect in the model used for network calibrations between 2000 and 2011, which affects all units of this model. The defect affects ambient pressure readings used to calculate flow rates scaled to standard temperature and pressure. At pressures below one atmosphere, these units read erroneously high pressure values. The magnitude of the error increases as the ambient pressure decreases. The faulty units are no longer manufactured. AMEC began using the replacement model in the field along with the older units during 2011. The differences between these models sparked the subsequent investigations. The replacement

model has been verified to accurately measure ambient pressures in the range expected for CASTNET sites, including the high-elevation sites in the network. EPA made the decision to make the documented transition to the newer, replacement standards at the beginning of 2013. In the meantime, during 2012, AMEC and Bios continued investigating to determine whether the error can be quantified and users provided a measure of uncertainty for affected data. The corrective actions implemented by AMEC included:

- Requiring documentation from the manufacturer that verifies pressure readings in the range expected at network sites. This information has been added to flow standard certification documents produced by the manufacturer for AMEC standards.
- Collecting audit data from both flow standard models during all calibrations through the end of 2012.

During 2012, AMEC participated in two proficiency test (PT) studies (0099 and 0100) 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. AMEC's laboratory received a warning flag for being biased high on two ammonia sample results for PT 0099. The laboratory identified the source of the error as inconsistent evaluation of calibration curve data prior to sample analysis and implemented corrective action during second quarter 2012. For PT study 0100, AMEC was ranked first place out of the 31 competing laboratories. Results for AMEC showed no flags and no indication of bias. An "Ideal" rating was assigned to all parameters assessed for bias. Overall, the laboratory was rated "Good" for PT 0099 analyses and "Very Good," the highest rating available, for PT 0100 analyses. AMEC's 5-year median rating remained "Very Good" for Environment Canada PT studies, which shows AMEC's consistent performance for laboratory analyses. AMEC regularly participates in laboratory intercomparison tests offered by Environment Canada and the U.S. Geological Survey.

During first and second quarter 2012, the CASTNET QA Manager completed an audit of the preparation, use, and return of the calibration and repair kits. The first phase of the audit focused on the procedures and preparation of the calibration and repair kits used by site calibrators and field technicians. Minor findings resulted in recommendations to revise the checklists used when packing the kits to provide additional details for the packers. The second phase consisted of an audit of the process and procedures for handling the kits after return to AMEC. Minor findings resulted in recommendations to revise select forms in order to provide reminders to the repair and field technicians to provide complete documentation.

The CASTNET QAPP Revision 8.0 was approved by EPA during April 2012.

During third and fourth quarters, AMEC and the National Park Service contractor, Air Resource Specialists, Inc. (ARS), evaluated the ozone monitoring systems at the ROM406/206 sites.

During third quarter, AMEC and ARS met at the sites to audit the ozone monitoring systems at each site and evaluate differences in systems and procedures. The ARS and AMEC transfer standards were compared to one another and to the site analyzers. Further comparisons were made using the different transfers at different settings with calibration lines of different inner diameter and different venting locations. Testing of Thermo PS model standards indicated that greater pressure in the calibration line results in a greater imbalance in the detector cells, affecting their performance. This pressure difference can be the result of smaller inner diameter calibration tubing (e.g., 3 millimeter), longer calibration tubing, or increased gas flow rate. The inner diameter and length of the sample tubing does not affect the performance of a transfer standard if it is not a PS model. If it is necessary to use a PS model, a minimum of 4.7 millimeter inner diameter calibration line tubing and an open vent at the back of the instrument are recommended to limit pressure imbalance in the detector cells to less than 10 millimeters of mercury. EPA, NPS, AMEC, and ARS are preparing a jointly authored paper documenting the findings that resulted from the investigation.

A technical systems audit (TSA) of AMEC's ozone facilities in Gainesville, FL and two field sites in North Carolina (CND125 and BFT142) was performed during late August and early September 2012. A TSA of the facility is required by EPA since AMEC is the monitoring organization in charge of CASTNET AQS-protocol sites. The auditor with RTI International, Inc. (RTI), the auditing organization, interviewed AMEC staff and site operators and observed activities related to various procedures. The audit report covered his visits to the two CASTNET field sites as well as the Gainesville facility audit. The audit report was complimentary with only minor findings. The auditor recommended that AMEC improve documentation of site operator training and independently confirm the status of documents stored onsite.

AMEC's analytical laboratory is pursuing International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025 accreditation by the American Association for Laboratory Accreditation (A2LA). AMEC is providing corporate funding to support this effort. During September 2012, AMEC submitted required materials and documentation to the accreditation body. The laboratory assessment by a certified assessor and final steps in the accreditation process are expected to be completed during second quarter 2013.

CASTNET sites are routinely checked for safe working conditions at each calibration (i.e., twice per year). Beginning in November 2012, AMEC began performing 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.

Quarterly/Annual Summary

Collocated filter pack precision data and completeness data for the continuous measurements are presented for data validated to Level 3 during the quarter/year. Table 1 lists the quarters of data that were validated to Level 3 during 2012 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. All EPA-sponsored CASTNET sites that monitor ozone are configured to meet EPA's AQS criteria for QA/QC procedures and are operated in accordance with Title 40 Code of Federal Regulations Part 58.

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 6 through 9 present the number of analyses in each category that were performed during each quarter of 2012.

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 10 presents the relevant sample receipt statistics for each of the four quarters of 2012 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 2012. All results were within the criteria listed in Table 4 . Table 11 presents the percent recoveries and standard deviations for RF, CCV, and RP QC sample analyses for 2012. Quarterly averages were all within criteria. There was a single CCV value for a nylon filter sulfate analysis plotted at 105.12 percent recovery. This value was within the established criterion upon application of routine rounding rules.

Table 12 presents quarterly collocated filter pack precision results for data validated to Level 3 during the year. Results for MCK131/231, KY were within criteria for all of the 11 parameters

reported. Results for ROM406/206, CO were within criteria for all of the 11 parameters. All site-parameters were within the current 20 percent criterion.

Figure 4 presents completeness statistics for continuous measurements validated to Level 3 during the year. All parameters met the 90 percent criterion with the exception of wind data. These data were affected by invalidation of data from CHE185, OK due to a calibration failure during first quarter 2012 and an equipment failure during third quarter 2012.

Table 13 presents summary statistics of critical criteria measurements at AQS-protocol ozone sites collected during fourth quarter 2012. All data associated with QC checks that fail to meet the criteria listed in Table 5 will be invalidated. Results in shaded cells either exceed documented criteria or are otherwise notable. Table 14 presents observations associated with the shaded cell results in Table 13.

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. The current action limits for LCS recovery are 80 percent and 120 percent. Figure 5 presents LCS analysis results for fourth quarter 2012.

Blank Results

Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for fourth quarter 2012. All results were within criteria (two times the reporting limit) listed in Table 4 with the exception of one cellulose filter FB result for sulfur dioxide that fell between two and three times the reporting limit. Table 15 summarizes the record of filter blanks for 2012.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during each of the four quarters of 2012 are listed in Table 16. This table also includes associated site identification and a brief description of the reason the sample was flagged. During fourth quarter, 15 filter pack samples were invalidated.

Field Problem Count

Table 17 presents counts of field problems affecting continuous data collection for more than one day for each quarter during quarter 2012. 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 2012 is listed in Table 18. Calibrations were performed at 21 sites during fourth quarter 2012. For fourth quarter, all sites and parameters were within the criteria listed in Table 3. The table includes several entries that were not listed in the reports published during 2012. This was due to calibration results entered in the database after publication of the reports.

Table 19 presents field accuracy results for 2012 based on instrument challenges performed in support of meteorological measurements and filter pack flow rates using independent reference standards during site calibration visits. Each parameter was within its criterion with at least 90 percent frequency except wind speed and wind direction at 88 percent and solar radiation at 89 percent.

Table 1 Data Validated to Level 3 through Fourth Quarter 2012

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
SE-4 MW-6†	July 2011 – June 2012	12	Quarter 3 2011 – Quarter 2 2012	4
E-1 SE-5	August 2011 – July 2012	12	Quarter 4 2011 – Quarter 2 2012	3
MW-7 W-9	September 2011 – August 2012	12	Quarter 4 2011 – Quarter 2 2012	3
E-2 MW-8	October 2011 – September 2012	12	Quarter 4 2011 – Quarter 3 2012	4
E-3 W-10‡	May 2011 – April 2012	12	Quarter 3 2011 – Quarter 1 2012	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 2012

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (21 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 (8 Sites)	April/October	ABT147, CT WST109, NH	ASH135, ME HOW132, ME	HOW191, ME CAT175, NY	HWF187, NY EGB181, ON
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 PNF126, NC	
SE-5 (4 Sites)	February/August	CAD150, AR CVL151, MS	IRL141, FL SUM156, FL		
Midwestern Sites (18 Total)					
MW-6 (6 Sites)	January/July	CDZ171, KY CKT136, KY	MCK131, KY MCK231, KY	ESP127, TN SPD111, TN	
MW-7 (8 Sites)	March/September	ALH157, IL BVL130, IL	STK138, IL VIN140, IN	DCP114, OH OXF122, OH	QAK172, OH PRK134, WI
MW-8 (4 Sites)	April/October	SAL133, IN HOX148, MI	ANA115, MI UVL124, MI		
Western Sites (9 Total)					
W-9 (4 Sites)	March/September	KNZ184, 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		Criteria[1]	
Parameter[2]	**Method**	**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 AQS-protocol ozone measurements.

[2] During 2012, meteorological parameters were only measured at five EPA-sponsored CASTNET sites: PAL190, TX; CHE185, OK; BVL130, IL; BEL116, MD; and BFT142, NC.

[3] Ozone is not measured at two EPA-sponsored CASTNET sites: EGB181, ON and CAT175, NY.

[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-AES	20	95 - 105	0.005	0.125
Potassium (K^+)	ICP-AES	20	95 - 105	0.006	0.15
Magnesium (Mg^{2+})	ICP-AES	20	95 - 105	0.003	0.075
Calcium (Ca^{2+})	ICP-AES	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-AES reference standards.

AC = automated colorimetry
IC = ion chromatography
ICP-AES = inductively coupled plasma-atomic 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) (Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications E 29).

For more information on analytical methods and associated precision and accuracy criteria, see the CASTNET QAPP, Revision 8.0 (AMEC, 2012)

Table 5 AQS-Protocol Ozone Critical Criteria*

Type of Check	Analyzer Response
Zero	Less than ± 10 parts per billion (ppb)
Span	Less than or equal to ± 7 percent between supplied and observed concentrations
One Point QC	Less than or equal to ± 7 percent between supplied and observed concentrations

Note: * All EPA-sponsored CASTNET sites that monitor ozone (except HOW191, ME) are configured to meet EPA's AQS criteria for QA/QC procedures and are operated in accordance with Title 40 Code of Federal Regulations Part 58.

Table 6 QC Analysis Count for First Quarter 2012

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-}	34	176	77	17	26	118
	NO_3^-	34	176	84	17	26	118
	NH_4^+	36	178	97	18	26	118
	Cl^-	34	176	84	17	26	117
	Ca^{2+}	34	175	84	17	26	117
	Mg^{2+}	34	175	84	17	26	117
	Na^+	34	175	84	17	26	117
	K^+	34	175	84	17	26	117
Nylon	SO_4^{2-}	28	153	67	14	24	81
	NO_3^-	28	153	75	14	24	81
Cellulose	SO_4^{2-}	44	166	81	21	24	81

Table 7 QC Analysis Count for Second Quarter 2012

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-}	30	156	68	15	24	44
	NO_3^-	30	156	76	15	24	44
	NH_4^+	30	157	81	15	24	44
	Cl^-	30	156	66	15	24	42
	Ca^{2+}	31	159	72	15	24	42
	Mg^{2+}	31	159	72	15	24	42
	Na^+	31	159	72	15	24	42
	K^+	31	159	72	15	24	42
Nylon	SO_4^{2-}	29	145	60	14	24	44
	NO_3^-	29	145	70	14	24	44
Cellulose	SO_4^{2-}	36	147	73	18	24	42

Table 8 QC Analysis Count for Third Quarter 2012

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-}	37	175	71	18	26	82
	NO_3^-	37	175	83	18	26	82
	NH_4^+	36	174	93	18	26	82
	Cl^-	37	175	70	18	26	81
	Ca^{2+}	36	177	82	18	26	82
	Mg^{2+}	36	177	82	18	26	82
	Na^+	36	177	82	18	26	82
	K^+	36	177	82	18	26	82
Nylon	SO_4^{2-}	34	163	68	17	26	82
	NO_3^-	34	163	80	17	26	82
Cellulose	SO_4^{2-}	32	158	77	16	26	81

Table 9 QC Analysis Count for Fourth Quarter 2012

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-}	24	115	51	16	24	42
	NO_3^-	24	115	53	16	24	42
	NH_4^+	22	112	57	15	24	42
	Cl^-	24	115	49	16	24	42
	Ca^{2+}	22	112	53	15	24	42
	Mg^{2+}	22	112	53	15	24	42
	Na^+	22	112	53	15	24	42
	K^+	22	112	53	15	24	42
Nylon	SO_4^{2-}	25	118	51	16	24	43
	NO_3^-	25	118	54	16	24	43
Cellulose	SO_4^{2-}	26	122	60	18	24	43

Table 10 Filter Pack Receipt Summary for 2012

Description	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Summary
Count of samples received more than 14 days after removal from tower:	10	10	3	10	33
Count of all samples received:	783	1083	1059	737	3662
Fraction of samples received within 14 days:	0.987	0.991	0.997	0.986	0.991
Average interval in days:	4.58	3.37	3.34	4.81	4.03*
First receipt date:	01/03/2012	04/02/2012	07/02/2012	10/01/2012	01/03/2012
Last receipt date:	03/30/2012	06/29/2012	09/28/2012	12/28/2012	12/28/2012

Note: *annual average

Table 11 Filter Pack QC Summary for 2012

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-}	99.07	1.48	129	100.80	1.38	644	0.52	0.69	276
	NO_3^-	101.09	1.43	129	100.75	1.32	644	1.29	1.51	306
	NH_4^+	101.92	1.75	128	100.30	1.42	642	0.57	0.64	338
	Ca^{2+}	99.13	1.97	129	100.57	0.93	647	0.88	0.88	300
	Mg^{2+}	102.91	1.52	129	100.01	0.84	647	1.47	1.52	300
	Na^+	100.32	1.29	129	100.01	0.81	647	1.11	1.21	300
	K^+	100.77	2.03	129	100.00	0.66	647	1.76	2.12	300
	Cl^-	102.09	1.56	129	101.90	1.30	644	1.29	1.41	270
Nylon	SO_4^{2-}	99.48	1.25	122	100.65	1.42	609	1.57	1.65	259
	NO_3^-	101.13	1.25	122	100.42	1.25	609	1.23	1.20	293
Cellulose	SO_4^{2-}	98.18	1.19	144	98.85	1.42	623	2.10	2.90	305

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 12 Precision (MARPD) Results for Third Quarter 2011 through Second Quarter 2012

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											
2011 Q3	3.91	10.68	3.92	6.80	5.51	4.81	7.72	1.78	5.57	4.28	5.70
2011 Q4	6.29	10.22	7.34	9.85	10.24	7.88	8.89	8.35	5.99	3.86	6.55
2012 Q1	3.25	5.80	2.88	9.68	8.52	5.26	4.86	4.70	3.82	3.63	3.35
2012 Q2	3.49	8.45	3.68	7.74	7.90	4.28	5.21	1.06	3.00	3.86	3.68
Average	4.24	8.79	4.46	8.52	8.04	5.56	6.67	3.97	4.60	3.91	4.82
ROM406/206, CO											
2011 Q3	3.30	11.21	3.47	3.57	4.83	4.01	10.71	3.35	12.64	4.46	11.11
2011 Q4	6.75	19.90	6.41	11.31	10.47	10.37	13.51	17.53	11.63	9.03	9.18
2012 Q1	5.95	6.73	4.73	6.05	8.12	8.03	5.88	9.67	10.16	5.38	7.85
2012 Q2	4.67	6.47	3.40	2.26	5.88	3.19	6.77	10.62	10.10	4.90	7.11
Average	5.17	11.08	4.50	5.80	7.33	6.40	9.22	10.29	11.13	5.94	8.81

Note: All 88 site-quarter-parameters were within criterion
MARPD = mean absolute relative percent difference

Table 13 AQS-Protocol Ozone QC Summary for Fourth Quarter 2012 (1 of 2)

Site ID	% Span Pass[1]	Span |%D |[2]	% Single Point QC Pass	Single Point QC |%D|	Single Point QC CL[3]	% Zero Pass	Zero Average (ppb)
ABT147, CT	100.00	0.56	100.00	0.75	0.10	100.00	0.37
ALC188, TX	92.13	8.82	92.13	7.65	3.53	85.56	4.35
ALH157, IL	97.70	12.79	97.70	32.79	39.31	100.00	1.95
ANA115, MI	96.77	2.65	96.77	2.75	2.12	100.00	0.50
ARE128, PA	93.41	6.54	93.41	5.21	2.93	93.41	2.45
ASH135, ME	95.79	7.86	95.79	13.20	8.98	100.00	0.25
BEL116, MD	98.89	2.19	97.78	2.02	1.61	98.89	0.90
BFT142, NC	98.92	0.98	100.00	1.07	0.18	100.00	1.67
BVL130, IL	100.00	1.95	100.00	2.20	0.26	100.00	3.34
BWR139, MD	94.62	6.84	94.62	6.58	3.63	100.00	0.87
CAD150, AR	100.00	1.73	100.00	2.02	0.13	100.00	0.67
CDR119, WV	98.92	0.91	98.92	0.94	0.19	100.00	0.80
CDZ171, KY	100.00	0.35	100.00	0.27	0.04	100.00	0.76
CKT136, KY	100.00	1.44	100.00	1.61	0.05	100.00	0.62
CND125, NC	100.00	0.75	100.00	0.79	0.11	100.00	1.03
CNT169, WY	73.33	24.01	73.33	19.28	8.33	76.67	11.27
COW137, NC	100.00	1.00	100.00	0.60	0.08	100.00	0.94
CTH110, NY	100.00	1.94	100.00	1.35	0.12	100.00	0.45
CVL151, MS	100.00	3.74	98.92	3.89	0.20	100.00	1.43
DCP114, OH	100.00	0.43	100.00	0.80	0.08	100.00	0.40
ESP127, TN	100.00	0.44	100.00	0.55	0.13	100.00	3.14
GAS153, GA	100.00	0.77	97.87	1.38	0.24	98.94	2.93
GTH161, CO	97.83	3.31	97.83	2.73	1.36	97.83	1.06
HOW132, ME	100.00	1.62	100.00	2.40	0.37	100.00	0.56
HOX148, MI	100.00	0.51	100.00	0.76	0.14	100.00	0.61
HWF187, NY	69.15	4.73	69.15	4.89	0.50	97.87	4.26
IRL141, FL	98.91	1.35	98.91	0.92	0.60	97.83	6.25
KEF112, PA	100.00	1.45	100.00	1.27	0.11	100.00	0.34
KNZ184, KS	100.00	0.23	100.00	0.41	0.06	100.00	0.41
LRL117, PA	93.02	8.02	95.52	5.12	4.16	100.00	0.22
MCK131, KY	100.00	3.10	100.00	3.26	0.08	100.00	0.41
MCK231, KY	97.89	2.59	97.89	2.61	0.58	100.00	1.47

Table 13 AQS-Protocol Ozone QC Summary for Fourth Quarter 2012 (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]
MKG113, PA	100.00	0.56	100.00	0.75	0.09	100.00	0.26
OXF122, OH	100.00	1.68	100.00	1.62	0.09	100.00	0.68
PAL190, TX	84.54	42.84	84.54	39.12	22.48	100.00	0.84
PAR107, WV	100.00	0.50	100.00	0.51	0.09	100.00	0.56
PED108, VA	100.00	0.40	100.00	0.63	0.07	100.00	0.57
PND165, WY	100.00	0.82	100.00	0.89	0.13	100.00	0.87
PNF126, NC	100.00	0.59	100.00	0.46	0.05	100.00	0.37
PRK134, WI	100.00	0.44	100.00	0.44	0.08	100.00	1.12
PSU106, PA	100.00	0.75	100.00	0.90	0.06	100.00	0.19
QAK172, OH	93.48	6.75	93.48	6.82	2.57	93.48	2.18
ROM206, CO	100.00	1.97	100.00	2.68	0.10	100.00	0.36
SAL133, IN	100.00	1.19	100.00	1.35	0.08	100.00	0.39
SAN189, NE	94.51	5.92	94.51	6.06	3.93	100.00	0.18
SND152, AL	100.00	1.73	100.00	1.60	0.08	100.00	0.46
SPD111, TN	92.39	2.03	93.48	1.87	0.43	100.00	0.33
STK138, IL	95.70	1.90	95.70	1.73	0.40	100.00	0.55
SUM156, FL	83.52	85.49	85.71	63.36	81.85	100.00	0.43
UVL124, MI	100.00	1.30	100.00	1.35	0.08	100.00	0.19
VIN140, IN	100.00	0.96	100.00	1.07	0.08	100.00	0.13
VPI120, VA	98.82	2.14	98.82	2.05	1.08	98.85	1.13
WSP144, NJ	100.00	1.15	100.00	0.70	0.09	100.00	0.37
WST109, NH	100.00	2.43	100.00	2.81	0.08	100.00	0.29

Notes: [1] Percentage of comparisons that pass the criteria listed in Table 5. Values falling below 90 percent are addressed in Table 14.

[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 14.

[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 14.

%D = percent difference
CL = confidence limit
ppb = parts per billion

Table 14 AQS-Protocol Ozone QC Observations for Fourth Quarter 2012

Site ID	QC Criterion	Comments
ALC188, TX	Span |%D | Single Point QC |%D| % Zero Pass	The zero air compressor was off for two weeks. Ambient data were not affected.
ALH157, IL	Span |%D | Single Point QC |%D| Single Point QC CL	There was a flow leak in one of the zero air canisters. Ambient data were not affected.
ASH135, ME	Span |%D | Single Point QC |%D| Single Point QC CL	Transfer standard flow rates were low. Ambient data were not affected.
CNT169, WY	% Span Pass % Single Point QC Pass Single Point QC |%D| Single Point QC CL % Zero Pass Zero Average	Ice formed in the sample and calibration gas lines.
HWF187, NY	% Span Pass % Single Point QC Pass	The ozone generation system malfunctioned in October and again in November. Ambient data were not affected.
LRL117, PA	Span |%D |	The Ethernet cable was not connected to the site analyzer.
PAL190, TX	% Span Pass Span |%D | % Single Point QC Pass Single Point QC |%D| Single Point QC CL	The pressure transducer in the site analyzer malfunctioned.
SUM156, FL	% Span Span |%D | % Single Point QC Pass Single Point QC |%D| Single Point QC CL	The zero air system was not connected properly. Ambient data were not affected.

Notes: %D = percent difference
CL = confidence limit
ppb = parts per billion

Table 15 Summary of Filter Blanks for 2012 (page 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	325	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.200	325	1	0.200	0.000	0.250
Teflon- SO_4^{2-}	1.000	325	0	1.000	0.000	1.000
Cl^-	0.500	325	0	0.500	0.000	0.500
Ca^{2+}	0.150	325	4	0.151	0.002	0.281
Mg^{2+}	0.075	325	0	0.075	0.000	0.075
Na^+	0.125	325	0	0.125	0.000	0.125
K^+	0.150	325	3	0.150	0.001	0.223
Nylon- NO_3^--N	0.200	289	0	0.200	0.000	0.200
Nylon - SO_4^{2-}	1.000	289	0	1.000	0.000	1.000
Cellulose - SO_4^{2-}	2.000	289	6	2.020	0.039	4.540
LABORATORY BLANKS						
Teflon-NH_4^+-N	0.500	104	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.200	104	0	0.200	0.000	0.200
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	1	0.150	0.001	0.195
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	1	0.151	0.002	0.235
Nylon- NO_3^--N	0.200	102	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.000	102	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.000	102	2	2.011	0.022	2.820
METHOD BLANKS						
Teflon-NH_4^+-N	0.500	68	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.200	68	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.000	68	0	1.000	0.000	1.000
Cl^-	0.500	68	0	0.500	0.000	0.500
Ca^{2+}	0.150	68	0	0.150	0.000	0.150
Mg^{2+}	0.075	68	0	0.075	0.000	0.075
Na^+	0.125	68	0	0.125	0.000	0.125
K^+	0.150	68	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.200	64	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.000	64	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.000	76	0	2.000	0.000	2.000

Table 15 Summary of Filter Blanks for 2012 (page 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	216	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.200	216	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.000	216	0	1.000	0.000	1.000
Cl^-	0.500	216	0	0.500	0.000	0.500
Ca^{2+}	0.150	216	0	0.150	0.000	0.150
Mg^{2+}	0.075	216	0	0.075	0.000	0.075
Na^+	0.125	216	0	0.125	0.000	0.125
K^+	0.150	216	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.200	204	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.000	204	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 NO_3^-. The blank results are used only for QC.

Table 16 Filter Packs Flagged as Suspect or Invalid

Site ID	Sample	Reason
First Quarter 2012		
BFT142, NC	1202001-10	Polling problems
	1203001-10	Polling problems
	1206001-10	Polling problems
	1207001-10	Polling problems
CKT136, KY	1208001-20	Insufficient flow volume
CNT169, WY	1203001-22	Polling problems
GAS153, GA	1201001-31	Polling problems
Second Quarter 2012		
CAT175, NY	1217001-15	"Calibrator Onsite" data logger status left as true for the latter half of the week
CHE185, OK	1215001-19	Polling problems
GRB411, NV	1214001-33	Invalidated: suspect data
	1215001-33	Invalidated: suspect data
	1216001-33	Invalidated: suspect data
HOW132, ME	1217001-37	Power failure
	1220001-37	Power failure
WNC429, SD	1222001-80	Data logger channel down
Third Quarter 2012		
BBE401, TX	1229001-08	Insufficient valid flow
BFT142, NC	1228001-10	Insufficient valid flow
BVL130, IL	1230001-11	Insufficient valid flow

Site ID	Sample	Reason
Third Quarter 2012 (continued)		
GLR468, MT	1227001-32	Insufficient valid flow
PRK134, WI	1231001-62	Insufficient valid flow
	1232001-62	Insufficient valid flow
UVL124, MI	1232001-76	Insufficient valid flow
VPI120, VA	1227001-79	Insufficient valid flow
WNC429, SD	1230001-80	Insufficient valid flow
Fourth Quarter 2012		
ARE128, PA	1243001-06	Invalidated (K^+) only: suspect data
CNT169, WY	1242001-22	Insufficient valid flow
HWF187, NY	1248001-41	Insufficient valid flow
JOT403, CA	1244001-43	Insufficient valid flow
LAV410, CA	1248001-46	Insufficient valid flow
LRL117, PA	1244001-47	Insufficient valid flow
SHN418, VA	1243001-70	Insufficient valid flow
THR422, ND	1242001-75	Insufficient valid flow
WSP144, NJ	1245001-81	Insufficient valid flow
YEL408, WY	1242001-83	Insufficient valid flow
	1247001-83	Insufficient valid flow
	1248001-83	Insufficient valid flow
YOS404, CA	1243001-84	Insufficient valid flow
	1244001-84	Insufficient valid flow
	1245001-84	Insufficient valid flow

Table 17 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
First Quarter 2012	
30	162
60	9
90	0
Unresolved by End of Quarter	4
Second Quarter 2012	
30	100
60	10
90	0
Unresolved by End of Quarter	7
Third Quarter 2012	
30	139
60	9
90	8
Unresolved by End of Quarter	7
Fourth Quarter 2012	
30	167
60	2
90	0
Unresolved by Date of Publication	6

Table 18 Field Calibration Failures by Parameter for 2012

Site ID	Parameter(s)
First Quarter 2012	
BVL130, IL	Solar Radiation
CHE185, OK	Wind Speed Wind Direction
COW137, NC	Flow Rate
KNZ184, KS	Flow Rate
PRK134, WI	Flow Rate
Second Quarter 2012	
CNT169, WY	Temperature
Third Quarter 2012	
BFT142, NC	Solar Radiation*
Fourth Quarter 2012	
There were no failures observed for the fourth quarter.	

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 that its magnitude (i.e., if within 2x the criterion). If flow calibrations fall within 2x the criteria, these data are adjusted per approved protocol described in the CASTNET QAPP, Revision 8.0 (AMEC, 2012). Please refer to Table 13 for documentation of the QC failures affecting the validity of AQS-protocol ozone data.

*Subsequent testing of this solar radiation sensor revealed its calibration to be within the established criterion. Root cause investigation found that the error was caused by faulty wiring connecting the transfer standard to the data logger.

Table 19 Accuracy Results for 2012 Field Measurements

Parameter	Percent Within Criterion
Flow Rate	97.3
Wind Speed < 5 m/s	87.5
Wind Speed ≥ 5 m/s	87.5
Wind Direction North	100.0
Wind Direction South	88.9
Temperature (0°C)	99.1
Temperature (ambient)	99.1
Delta Temperature (0°C)	100.0
Delta Temperature (ambient)	100.0
Relative Humidity > 85%	100.0
Precipitation	100.0
Solar Radiation	88.9
Wetness (w/in 0.5 volts)	100.0

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 for 2012 indicated by this table were within 2x the criterion with the exception of wind speed, wind direction, and solar radiation.

Figure 1 Reference Standard Results for Fourth Quarter 2012 (percent recovery)

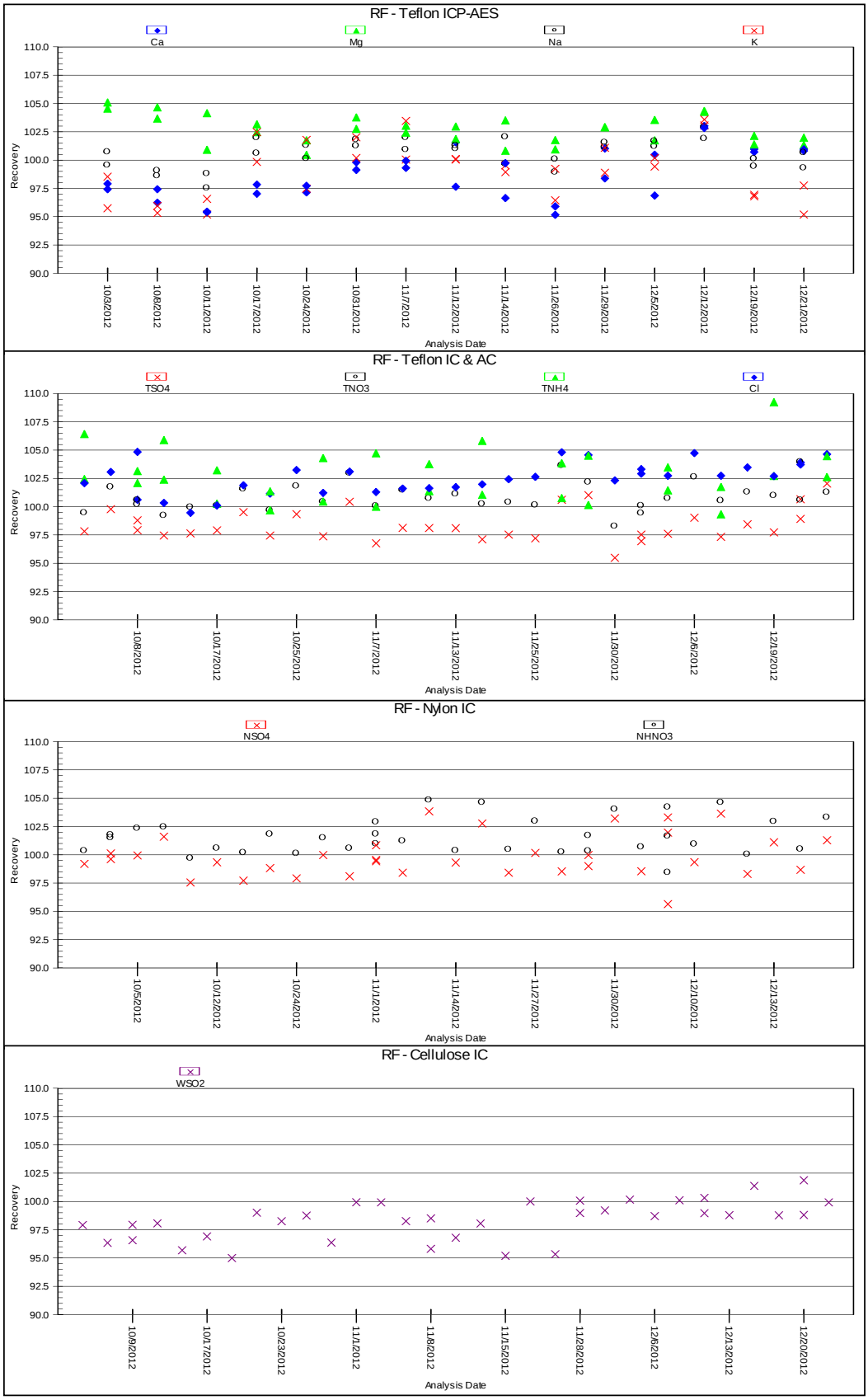


Figure 2 Continuing Calibration Spike Results for Fourth Quarter 2012 (percent recovery)

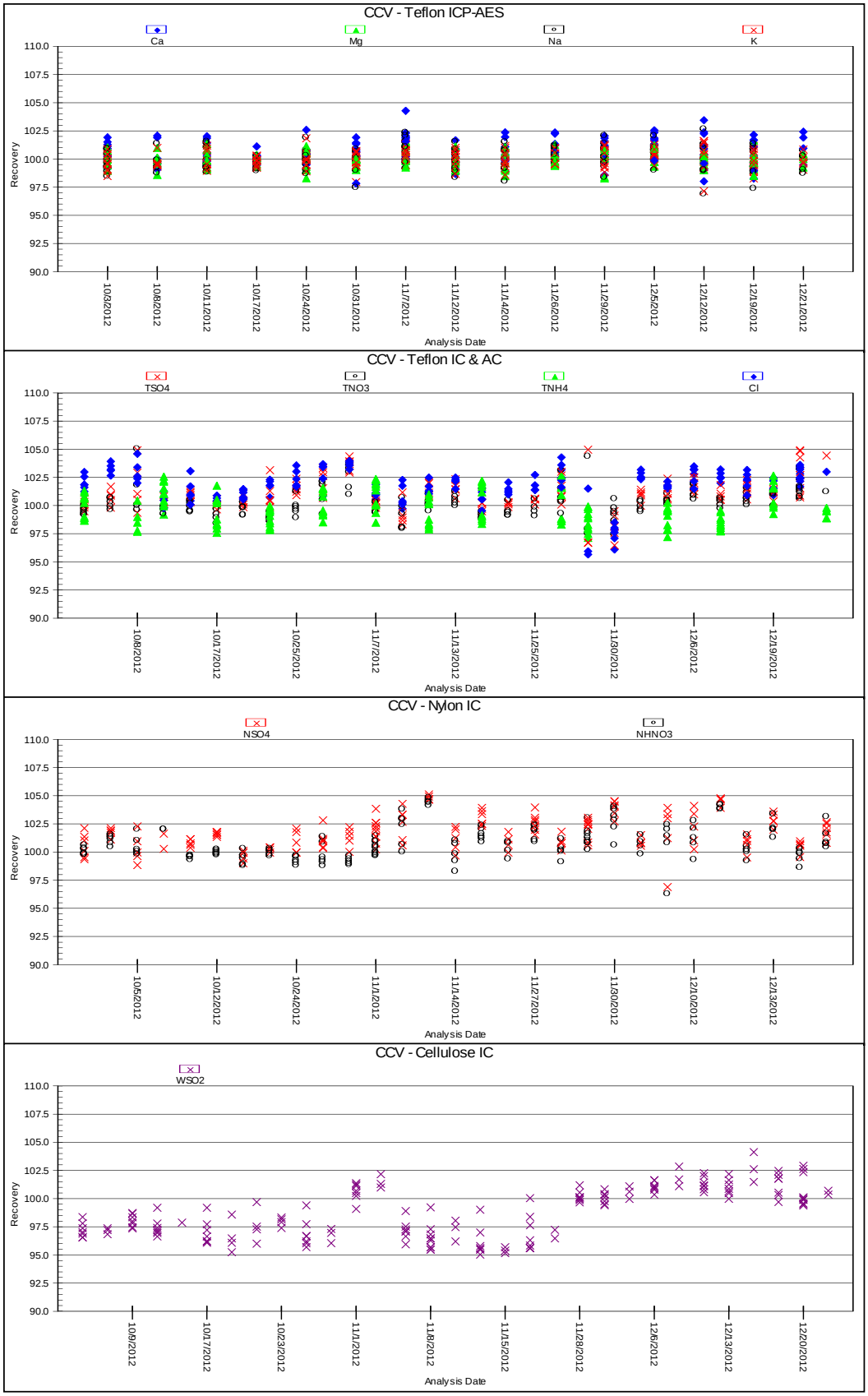


Figure 3 Replicate Sample Analysis Results for Fourth Quarter 2012 (percent difference)

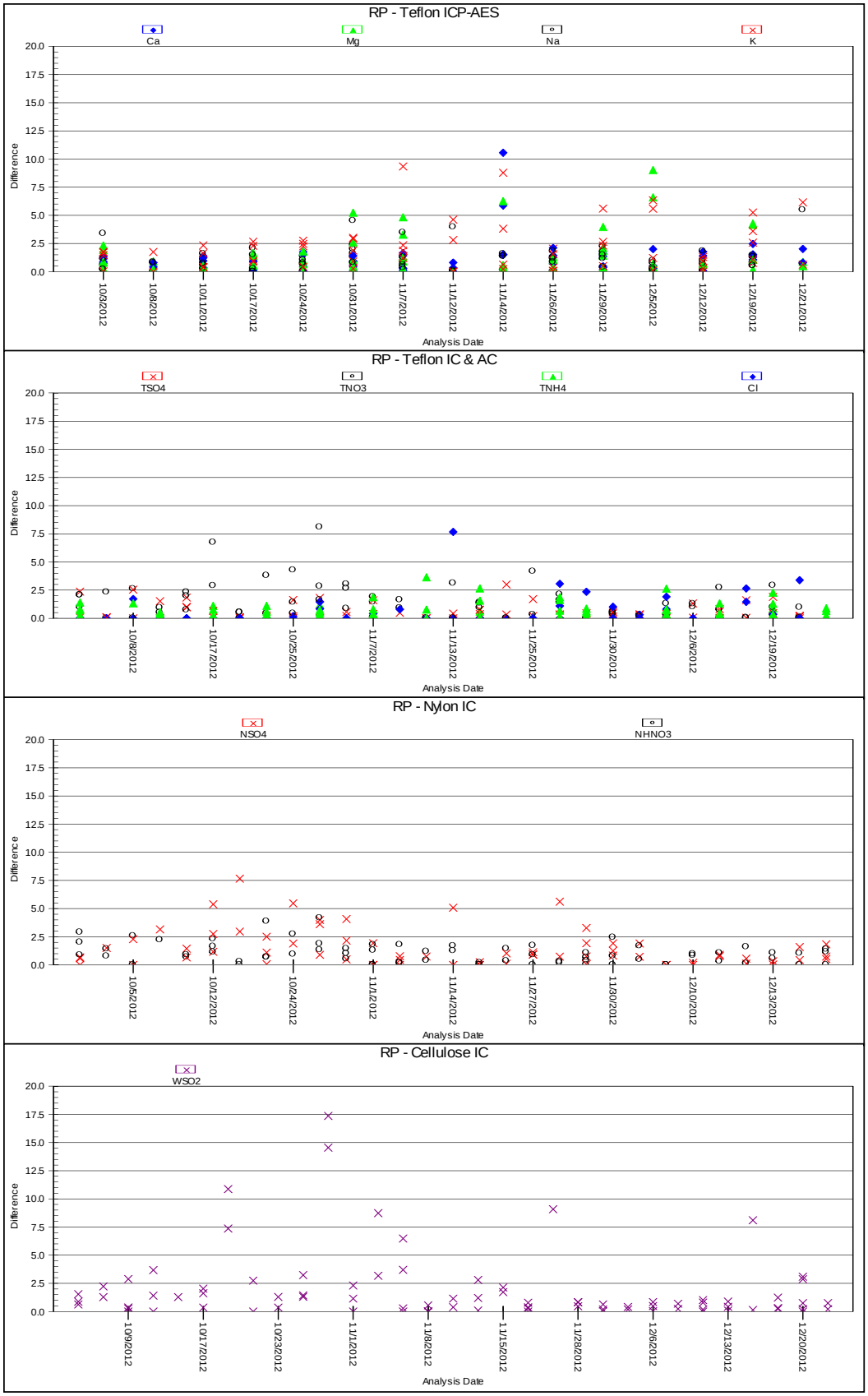
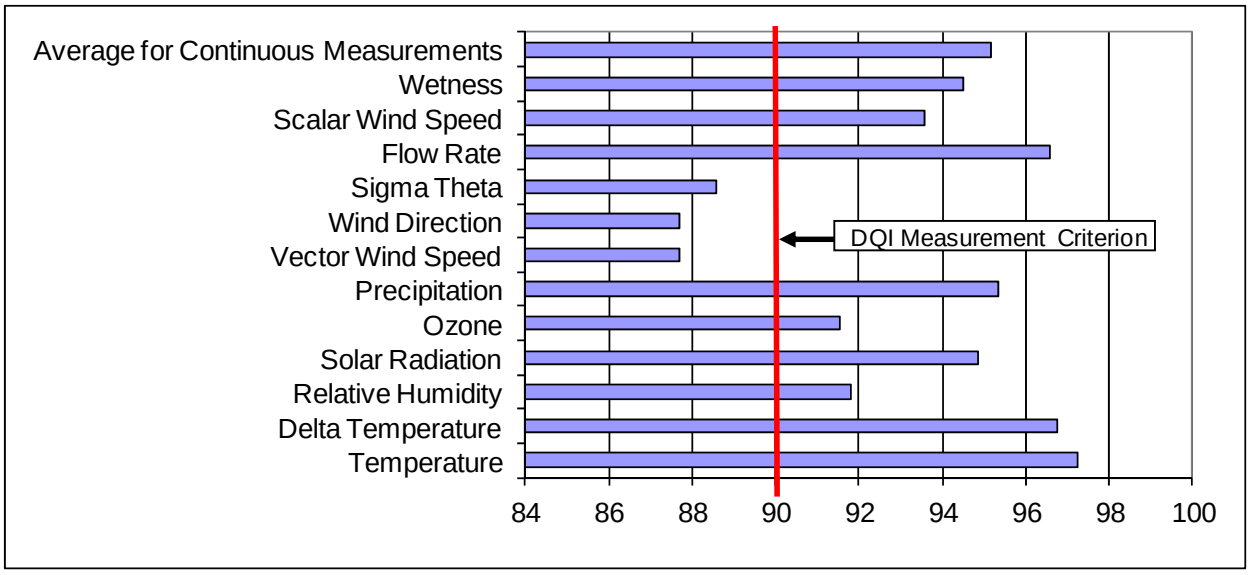


Figure 4 Percent Completeness of Measurements for Second Quarter 2011 through Third Quarter 2012*



Note: *Presents Level 3 data available during the fourth quarter of 2012

Figure 5 Laboratory Control Sample Results for Fourth Quarter 2012 (percent recovery)

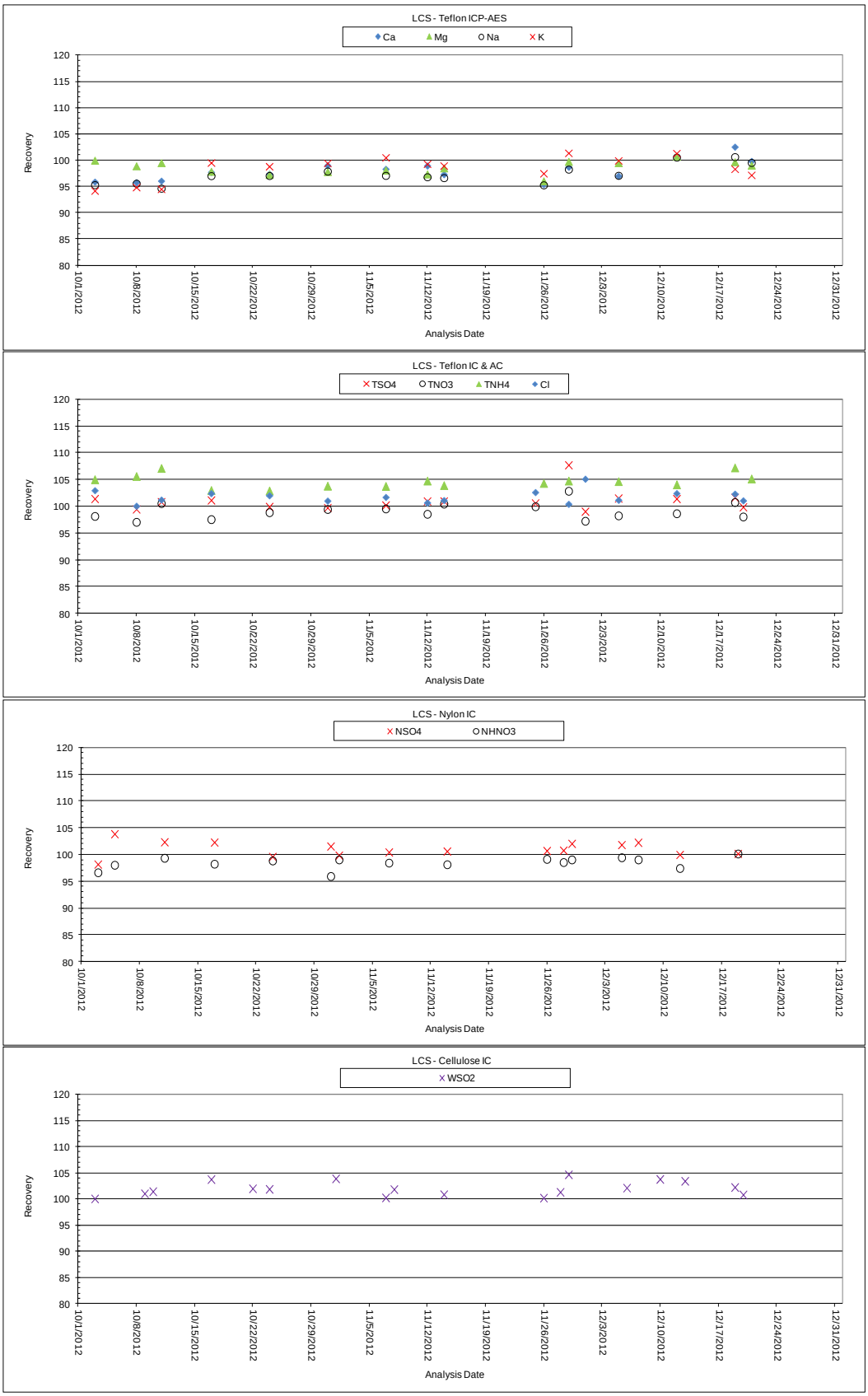


Figure 6 Method Blank Analysis Results for Fourth Quarter 2012 (total micrograms)

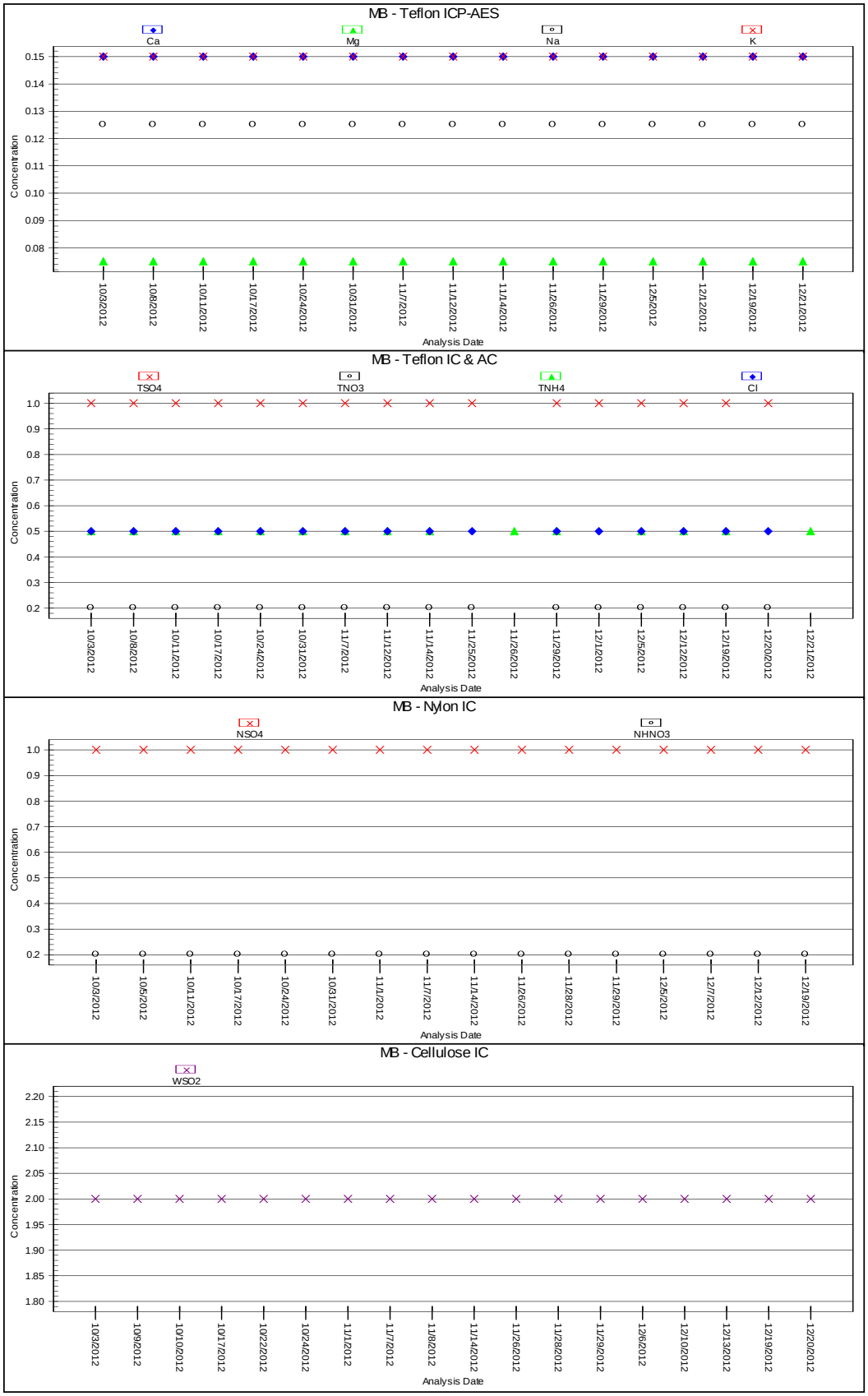


Figure 7 Laboratory Blank Analysis Results for Fourth Quarter 2012 (total micrograms)

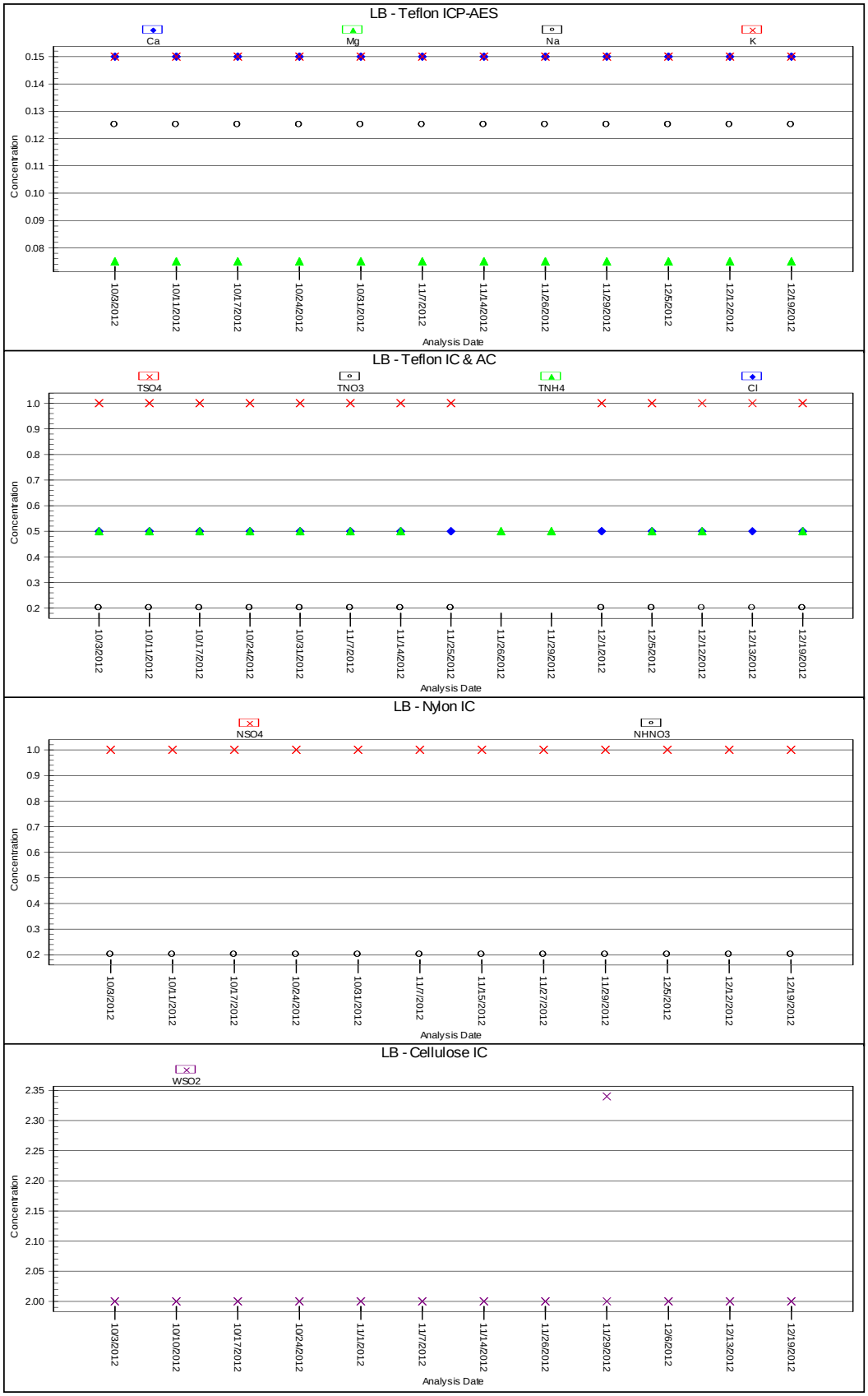


Figure 8 Field Blank Analysis Results for Fourth Quarter 2012 (total micrograms)