Summary of Quarterly Operations (January through March)

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 first quarter 2017. 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.

Quarterly Summary

Amec Foster Wheeler submitted the final version of the CASTNET Quality Assurance Project Plan (QAPP) Revision 9.0 to EPA on January 17, 2017.

As Amec Foster Wheeler began looking for possible replacements for Pall Corporation's Nylasorb filter, which has been discontinued by Pall, Amec Foster Wheeler began developing a preventative action document to detail steps taken during the process of locating a suitable replacement filter.

The assessment required to continue International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2005 accreditation by the American Association for Laboratory Accreditation (A2LA) was scheduled for April 4–6, 2017. During first quarter, documentation was reviewed and updated as needed. Preparations were made for the assessor's site visit. Additionally, preparations continued for the meeting to discuss the annual management review report in support of ISO/IEC 17025:2005 accreditation.

In March 2017, Amec Foster Wheeler received final results for analyses submitted for proficiency test study 109 for Rain and Soft Waters to the National Laboratory of Environmental Testing, a branch of the National Water Research Institute with Environment Canada that provides quality assurance services. A data entry error for one sulfate value resulted in an "action low" flag. Conductivity was ranked as high bias at 3.9 percent. All other results were rated as "ideal." Amec Foster Wheeler's overall laboratory rating is "good." A new corrective action (CA)-0061 was implemented to add additional review steps prior to submission of data for laboratory proficiency test results.

Table 1 lists the quarters of data that were validated to Level 3 during first quarter 2017 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 laboratory filter pack measurements. These criteria apply to the QC samples listed in the following section of this report. Table 4 presents the critical criteria for ozone monitoring. Table 5 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. Table 6 presents the number of analyses in each category that were performed during first quarter 2017.

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 7 presents the relevant sample receipt statistics for first quarter 2017.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for first quarter 2017. All results were within the criteria listed in Table 3 with the exception of one Teflon calcium RP result at 23 percent. The sample and replicate values were both within 2.6 times the reporting limit. There is an observable shift in several RF recovery results in February. This coincides with the change to a new set of reference standards.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during first quarter 2017. 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 4 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 9 presents observations associated with the shaded cell results in Table 8.

Table 10 presents summary statistics of critical criteria measurements at trace-level gas monitoring sites collected during first quarter 2017. 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 11 presents observations associated with the shaded cell results in Table 10.

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 4 presents LCS analysis results for first quarter 2017. All recovery values were between 90 percent and 106 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for first quarter 2017. All first quarter results were within criteria (2 times the reporting limit) listed in Table 3 with the exception of two cellulose filter LB samples, which were both at 2.7 times the reporting limit.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during first quarter 2017 are listed in Table 12. This table also includes associated site identification and a brief description of the reason the sample was flagged. During first quarter, six filter pack samples were invalidated.

Field Problem Count

Table 13 presents counts of field problems affecting continuous data collection for more than one day for first quarter 2017. 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.

References

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler). 2016. Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 9.0. 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.

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 during First Quarter 2017

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	May 2016 – October 2016	6	Quarter 3 2016	1
SE-4/MW-6‡	July 2016 – December 2016	6	Quarter 3 2016 – Quarter 4 2016	2

Notes: * The sites contained in each calibration group are listed in Table 2.
† Contains ROM206 of the ROM406/ROM206 collocated pair
‡ Contains MCK131/231 collocated pair

Table 2 Field Calibration Schedule for 2017

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (24 Total)					
E-1 (8 Sites)	February/August	BEL116, MD[1] 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[2]	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 (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[2] ESP127, TN	
MW-7 (9 Sites)	March/September	ALH157, IL BVL130, IL[3] 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[1]	NPT006, ID CNT169, WY	PND165, WY[1] PAL190, TX	

Notes: [1] Trace-level gas calibrations are performed quarterly in February, May, August, and November.
[2] Trace-level gas calibrations are performed quarterly in January, April, July, and October.
[3] Trace-level gas calibrations are performed quarterly in March, June, September, and December.

Table 3 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 Foster Wheeler, 2016).

Table 4 Ozone Critical Criteria*

Type of Check	Analyzer Response
Zero	Less than ± 1.5 parts per billion (ppb)
Span	Less than or equal to ± 7.1 percent between supplied and observed concentrations
Single Point QC	Less than or equal to ± 7.1 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 5 Trace-level Gas Monitoring Critical Criteria*

Parameter	Analyzer Response	
	Zero Check	Span Check / Single Point QC Check
SO_2	Less than ± 1.5 ppb	Less than or equal to ± 10.1 percent between supplied and observed concentrations
NO_y	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_2 = sulfur dioxide
NO_y = total reactive oxides of nitrogen
CO = carbon monoxide
ppb = parts per billion

Table 6 QC Analysis Count for First Quarter 2017

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-}	60	202	89	16	24	89
	NO_3^-	60	202	89	16	24	89
	NH_4^+	34	183	87	16	24	89
	Cl^-	60	202	89	16	24	89
	Ca^{2+}	35	184	88	16	24	89
	Mg^{2+}	35	184	88	16	24	89
	Na^+	35	184	88	16	24	89
	K^+	35	184	88	16	24	89
Nylon	SO_4^{2-}	56	205	87	18	24	89
	NO_3^-	56	205	87	18	24	89
Cellulose	SO_4^{2-}	58	200	80	17	24	89

Table 7 Filter Pack Receipt Summary for First Quarter 2017

Count of samples received more than 14 days after removal from tower:	12
Count of all samples received:	814
Fraction of samples received within 14 days:	0.985
Average interval in days:	4.737
First receipt date:	01/04/2017
Last receipt date:	03/31/2017

Table 8 Ozone QC Summary for First Quarter 2017 (1 of 2)

Site ID	% Span Pass[1]	Span |%D|[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	% Zero Pass[1]	Zero Average (ppb)[2]
ABT147, CT	100.00	0.34	98.89	0.48	100.00	0.23
ALC188, TX	100.00	1.21	100.00	0.86	100.00	0.19
ALH157, IL	100.00	0.40	100.00	0.49	100.00	0.18
ANA115, MI	100.00	0.92	100.00	0.86	100.00	0.12
ARE128, PA	100.00	0.95	100.00	0.86	100.00	0.25
ASH135, ME	100.00	1.51	100.00	1.77	100.00	0.20
BEL116, MD	100.00	0.89	100.00	0.75	97.53	0.21
BFT142,NC	100.00	0.85	100.00	1.00	97.65	0.32
BVL130, IL	100.00	1.07	100.00	0.94	100.00	0.22
BWR139, MD	100.00	2.07	100.00	2.59	100.00	0.40
CAD150, AR	100.00	1.89	100.00	1.45	100.00	0.28
CDR119, WV	98.77	0.96	100.00	0.88	98.77	0.28
CDZ171, KY	100.00	0.61	100.00	0.70	100.00	0.20
CKT136, KY	100.00	0.49	100.00	0.49	100.00	0.16
CND125, NC	100.00	0.95	100.00	0.89	98.75	0.24
CNT169, WY	89.36	4.52	90.43	3.92	100.00	0.31
COW137, NC	100.00	1.96	100.00	2.11	100.00	0.15
CTH110, NY	100.00	1.49	100.00	1.87	100.00	0.44
CVL151, MS	100.00	1.21	100.00	0.90	98.72	0.22
DCP114, OH	100.00	0.70	100.00	0.82	100.00	0.13
ESP127, TN	100.00	1.09	100.00	1.08	100.00	0.14
GAS153, GA	100.00	1.24	100.00	1.19	100.00	0.36
GTH161, CO	95.24	5.38	98.81	5.25	100.00	0.11
HOX148, MI	100.00	0.54	100.00	0.66	100.00	0.62
HWF187, NY	100.00	0.89	100.00	0.94	100.00	0.12
IRL141, FL	100.00	0.35	100.00	0.53	100.00	0.18

Table 8 Ozone QC Summary for First Quarter 2017 (2 of 2)

Site ID	% Span Pass[1]	Span |%D|[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	% Zero Pass[1]	Zero Average (ppb)[2]
KEF112, PA	100.00	1.33	98.72	1.90	94.87	0.53
LRL117, PA	100.00	0.58	100.00	0.89	100.00	0.21
MCK131, KY	100.00	0.74	100.00	0.66	100.00	0.40
MCK231, KY	100.00	0.66	100.00	0.67	100.00	0.39
MKG113, PA	100.00	0.60	100.00	0.68	98.86	0.36
NPT006, ID	100.00	0.55	100.00	0.48	98.81	0.18
OXF122, OH	100.00	1.58	100.00	2.28	96.63	0.98
PAL190, TX	100.00	0.76	100.00	1.19	100.00	0.49
PAR107, WV	100.00	0.67	98.86	0.99	100.00	0.19
PED108, VA	100.00	1.75	100.00	1.72	98.88	0.12
PND165, WY	100.00	1.69	100.00	2.76	100.00	0.60
PNF126, NC	100.00	0.55	100.00	0.88	100.00	0.20
PRK134, WI	100.00	1.12	100.00	0.70	100.00	0.40
PSU106, PA	100.00	0.74	100.00	0.39	100.00	0.33
QAK172, OH	100.00	2.31	100.00	2.41	92.39	0.77
ROM206, CO	100.00	1.01	100.00	0.78	100.00	0.13
SAL133, IN	100.00	0.63	100.00	1.02	100.00	0.39
SAN189, NE	95.00	1.92	89.00	4.65	94.00	1.27
SND152, AL	100.00	2.36	100.00	2.29	100.00	0.23
SPD111, TN	100.00	0.77	97.83	0.88	100.00	0.35
STK138, IL	100.00	1.36	100.00	2.03	98.84	0.84
SUM156, FL	100.00	1.22	100.00	1.41	98.85	0.35
UVL124, MI	100.00	2.33	100.00	2.17	100.00	0.14
VIN140, IN	100.00	1.05	100.00	1.05	100.00	0.26
VPI120, VA	100.00	0.80	100.00	0.80	100.00	0.34
WSP144, NJ	100.00	2.34	100.00	2.40	100.00	0.42
WST109, NH	100.00	0.23	100.00	0.33	100.00	0.12

Notes: [1] Percentage of comparisons that pass the criteria listed in Table 4. Values falling below 90 percent are addressed in Table 9.
[2] Absolute value of the average percent differences between the on-site transfer standard and the site monitor.
%D = percent difference
ppb = parts per billion

Table 9 Ozone QC Observations for First Quarter 2017

Site ID	QC Criterion	Comments
CNT169, WY	% Span Pass	The analyzer malfunctioned in late December 2016 and was replaced January 10, 2017. Associated data were invalidated.
SAN189, NE	% Single Point QC Pass	The analyzer malfunctioned in late February 2017 and was replaced March 6, 2017. Associated data were invalidated.

Table 10 Trace-level Gas QC Summary for First Quarter 2017

Parameter	% Span Pass[1]	Span |%D|[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	% Zero Pass[1]	Zero Average (ppb)[2]
BEL116, MD						
SO_2	100.00	1.68	100.00	3.79	100.00	0.52
NO_y	100.00	0.74	100.00	0.94	100.00	0.32
BVL130, IL						
SO_2	87.50	7.94	87.50	21.11	92.50	0.87
NO_y	100.00	1.67	100.00	3.52	100.00	0.57
CO	100.00	1.55	70.00	7.80	72.50	21.04
HWF187, NY						
NO_y	100.00	0.79	100.00	1.05	100.00	0.27
PND165, WY						
NO_y	87.18	4.44	87.18	4.43	100.00	0.15
PNF126, NC						
NO_y	100.00	4.10	100.00	2.80	100.00	0.50
ROM206, CO						
NO_y	100.00	1.26	100.00	1.97	97.44	0.62

Notes: [1] Percentage of comparisons that pass the criteria listed in Table 5. Values falling below 90 percent are addressed in Table 11.
[2] Absolute value of the average percent differences between the supplied and observed concentrations. Values exceeding the criteria listed in Table 5 are addressed in Table 11.

%D = percent difference
ppb = parts per billion

Table 11 Trace-level Gas QC Observations for First Quarter 2017

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	SO_2	% Span Pass % Single Point QC Pass Single Point QC |%D|	The analyzer sample pump failed and was replaced in late January. Associated data were invalidated.
	CO	% Single Point QC Pass % Zero Pass	The analyzer drifted outside of calibration limits in late January and was recalibrated in early February. Associated data were invalidated.
PND165, WY	NO_y	% Span Pass % Single Point QC Pass	The analyzer drifted outside of calibration limits in early March and again in late March. The analyzer was recalibrated mid-March and again in late March. Associated data were invalidated.

Notes: %D = percent difference

Table 12 Filter Packs Flagged as Suspect or Invalid during First Quarter 2017

Site ID	Sample No.	Reason
ALH157, IL	1703001-02	The data logger malfunctioned during the sampling period.
JOT403, CA	1705003-12	Polled data are only available for the first day of this sampling week. The sample may be recovered if more data are received from Air Resource Specialists.
KIC003, KS	1701004-03	The flow pump was inoperative.
ROM206, CO	1704001-45	Only potassium was invalidated for a suspect value.
STK138, IL	1703001-49	Insufficient flow volume was caused by a clogged Balston filter.
YEL408, WY	1702003-24	A hole was found in the Teflon filter upon unloading the filter pack.

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	427
60	15
90	3
Unresolved by End of Quarter	19

Figure 1 Reference Standard Results for First Quarter 2017 (percent recovery)

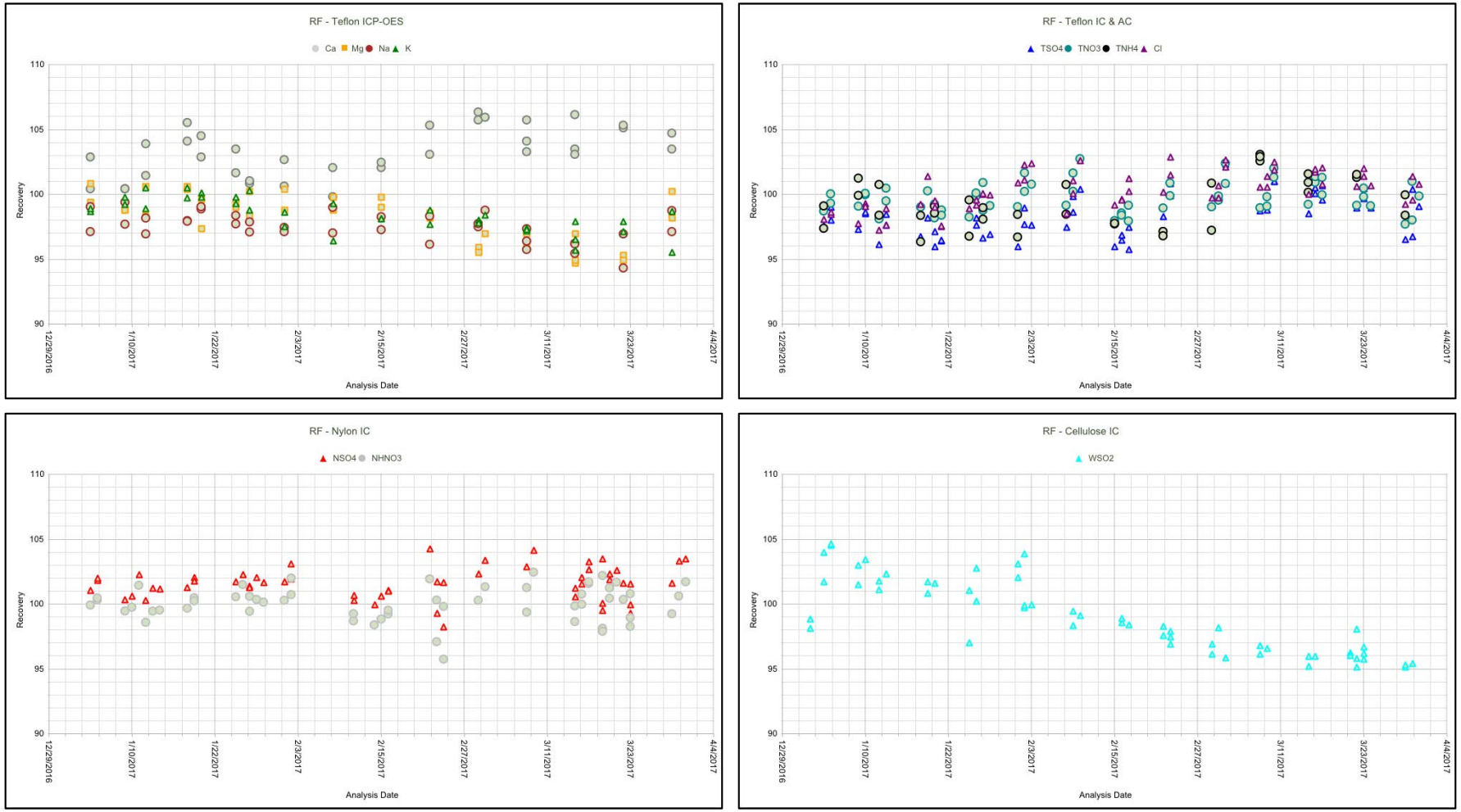

Figure 2 Continuing Calibration Spike Results for First Quarter 2017 (percent recovery)

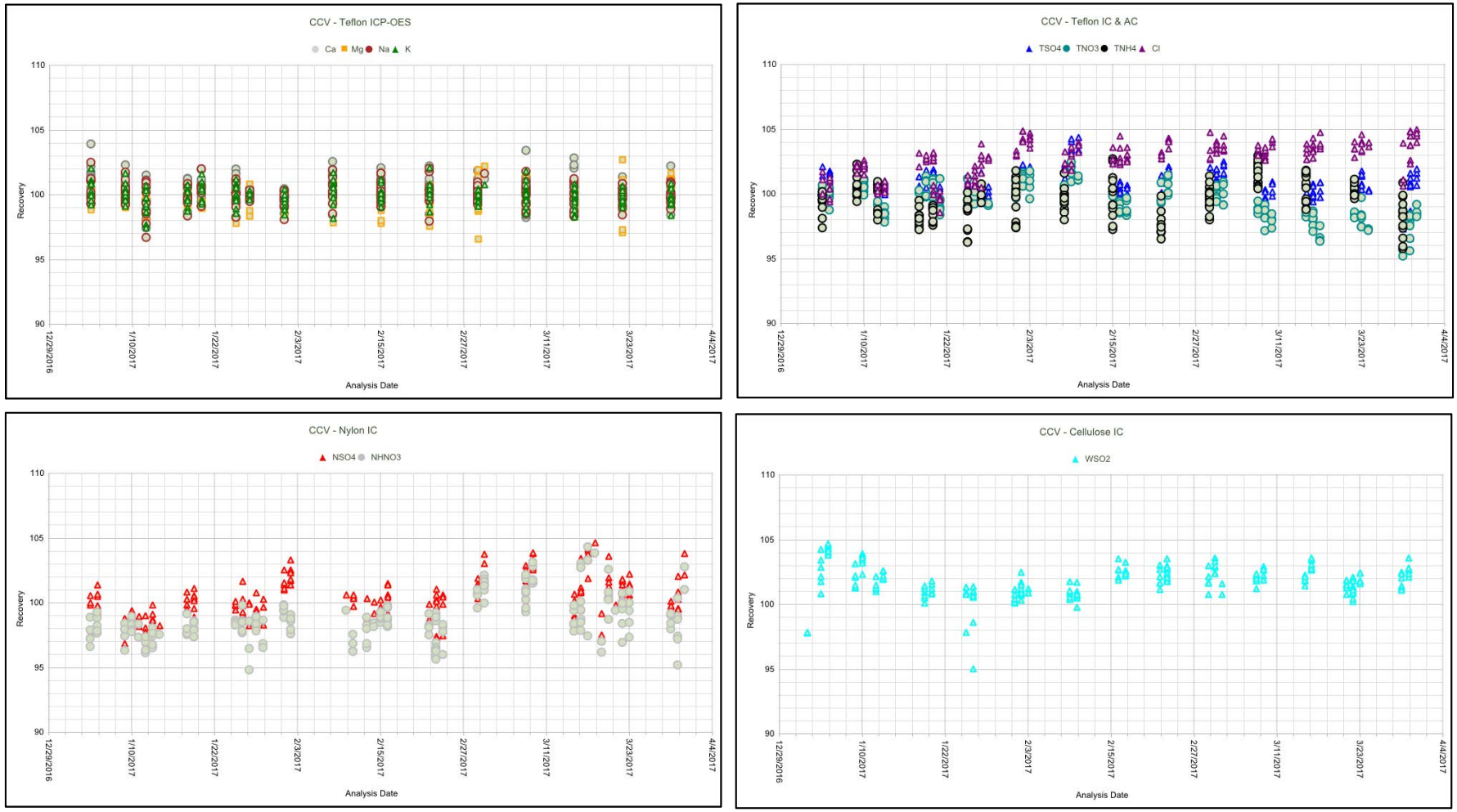

Figure 3 Replicate Sample Analysis Results for First Quarter 2017 (percent difference)

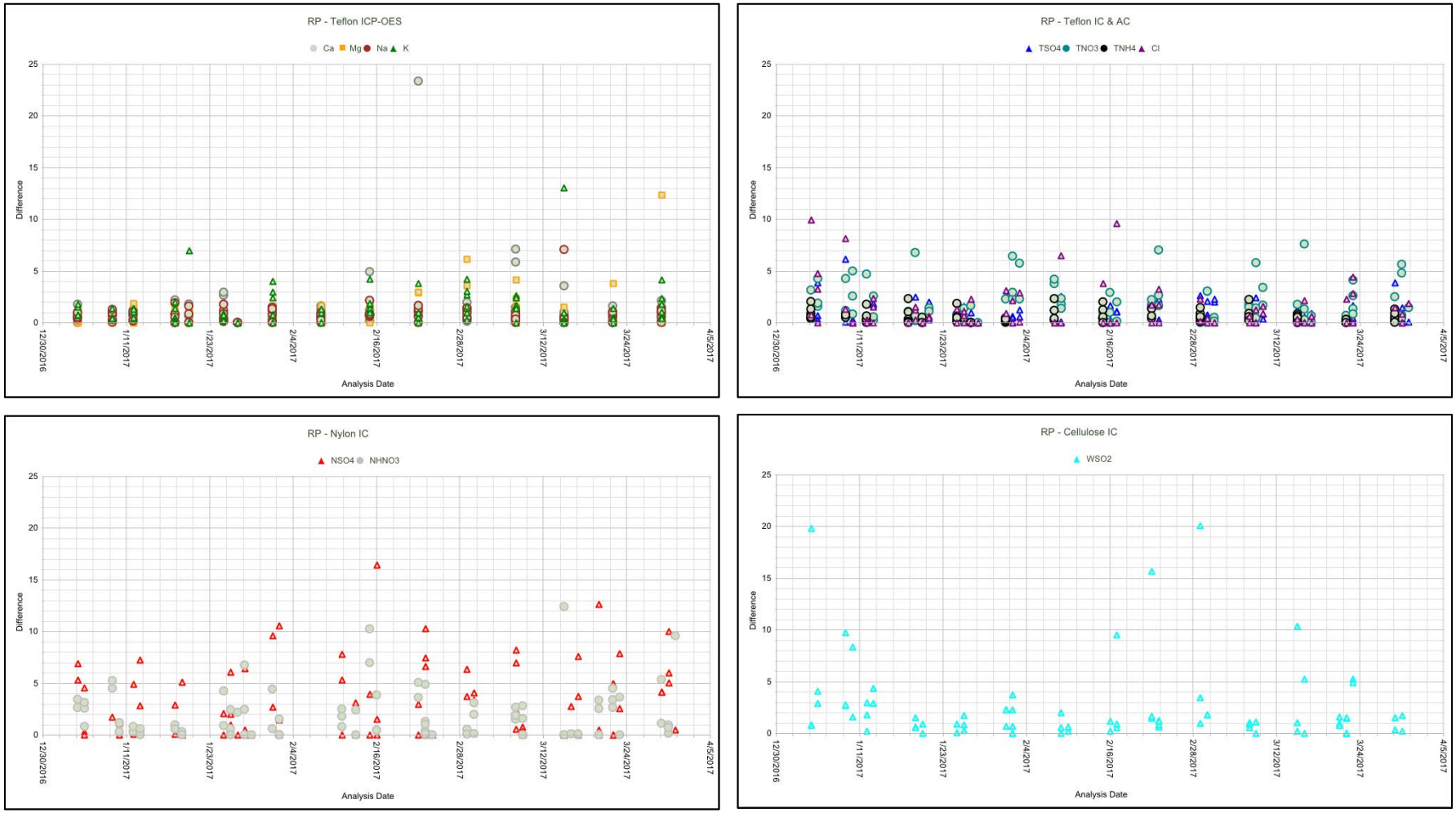

Figure 4 Laboratory Control Sample Results for First Quarter 2017 (percent recovery)

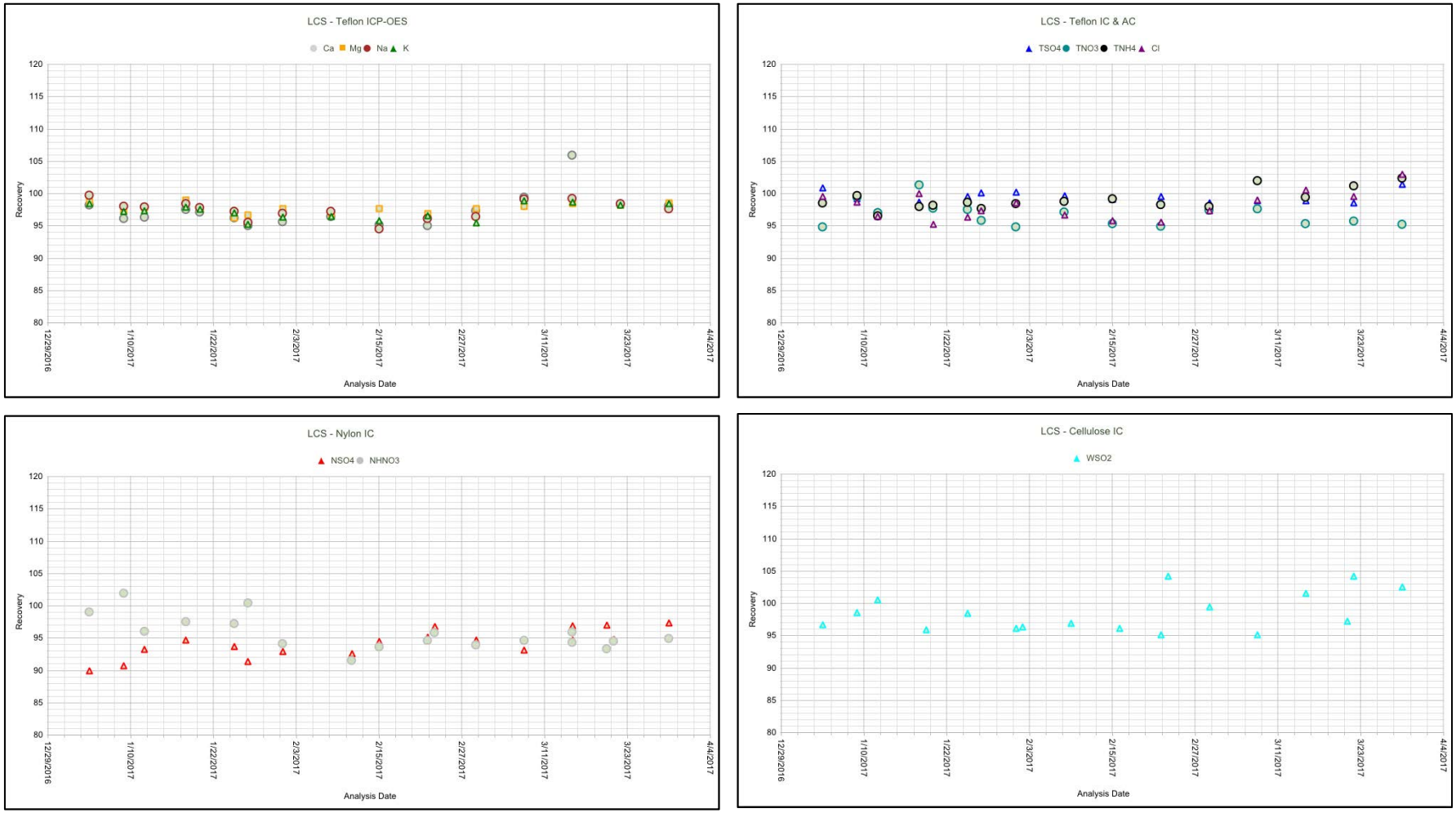

Figure 5 Method Blank Analysis Results for First Quarter 2017 (total micrograms)

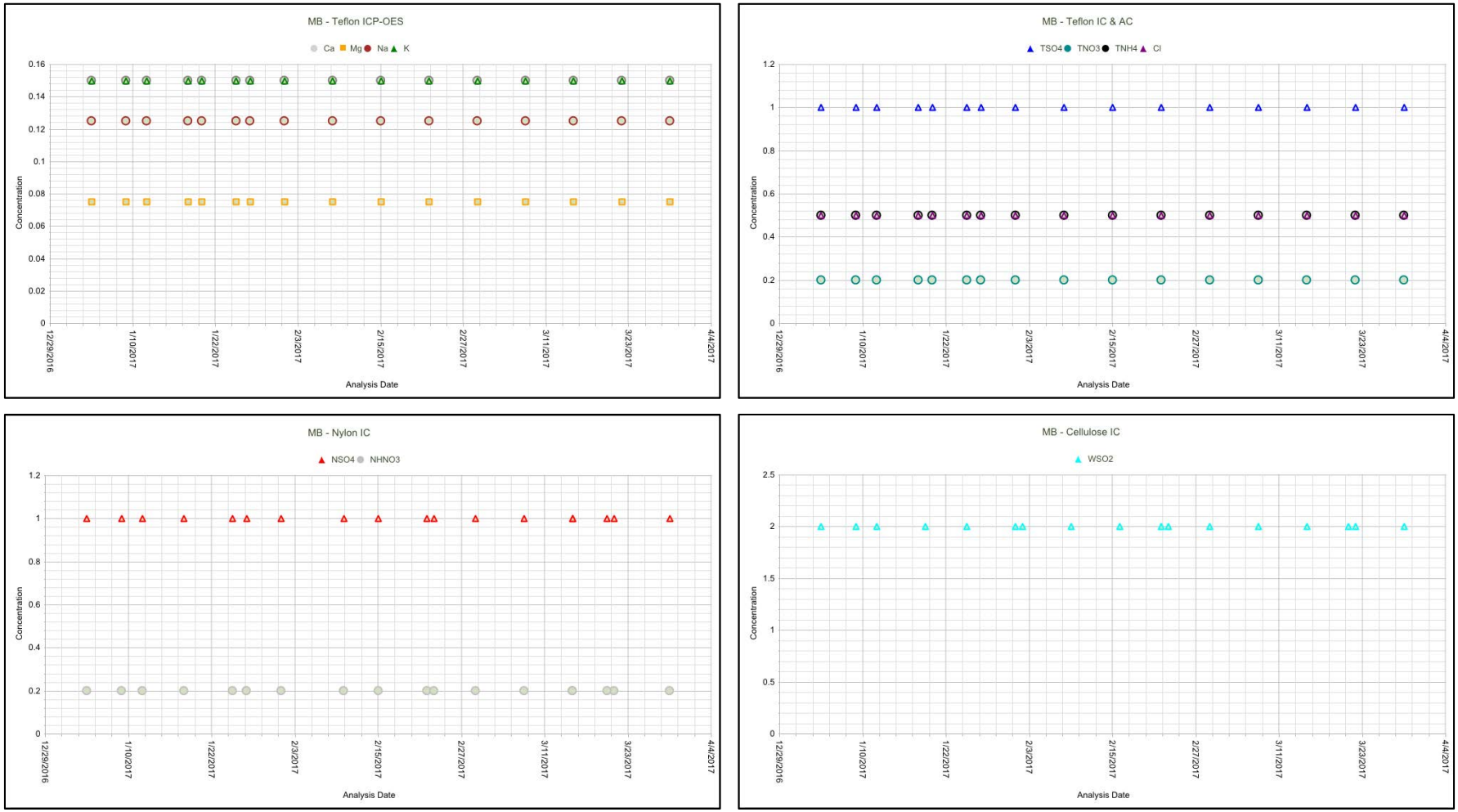

Figure 6 Laboratory Blank Analysis Results for First Quarter 2017 (total micrograms)

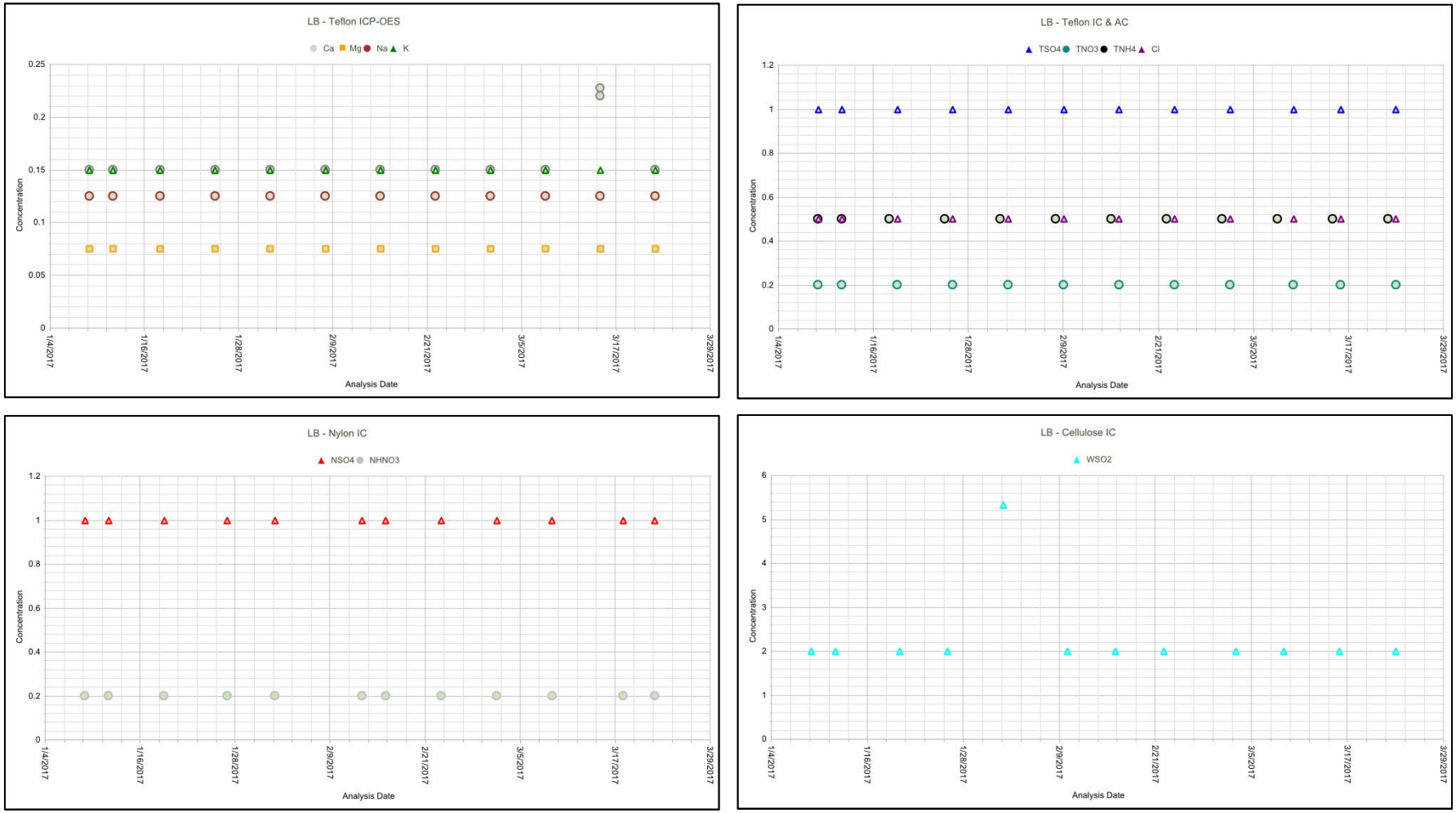

Figure 7 Field Blank Analysis Results for First Quarter 2017 (total micrograms)