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 2019. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Wood, 2017). 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

A partial government shutdown lasted from December 22, 2018 through January 25, 2019. Task orders that were exempt at the time of the shutdown and did not require additional contact with EPA personnel continued operation if funding permitted. Some site calibrations and other activities were postponed to preserve funding for priority operations. As a result, validation of data from some sites has been delayed.

Preparations continued for the meeting to discuss the annual management review report in support of International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2005 accreditation. A presentation in support of the report was submitted to the Wood management team. A meeting to discuss the report will be held in mid-April 2019.

The assessment required to continue ISO/IEC 17025 accreditation by the American Association for Laboratory Accreditation (A2LA) was scheduled for the week of April 29, 2019. Revisions to ISO/IEC 17025 were promulgated in 2017. A2LA requested additional documentation in support of the upcoming 2019 assessment for ISO/IEC 17025:2017 accreditation. During first quarter, documentation was reviewed and updated as needed. The additional documentation was submitted to A2LA. Preparations were made for the assessor's site visit.

Comments on the CASTNET QAPP Revision 9.2 were received from EPA. Wood incorporated the comments and submitted the draft final version to all stakeholders for final review and signatures.

The final version of the "40 Code of Federal Regulations (CFR) Part 58 Technical Systems Audit (TSA) of Clean Air Status and Trends Network (CASTNET) Program Ozone Monitoring Process" that had been sent to Wood by RTI International, the TSA auditor, was sent to EPA. The CASTNET QA Manager worked with EPA and RTI on corrections and updates (e.g., EPA web addresses) to the final report.

Wood began implementing steps to ensure low-level ozone measurements are demonstrably accurate at CASTNET sites. During January 2019, the weekly multipoint challenge concentration of 40 parts per billion (ppb) was set to 30 ppb at five test sites. Data from the sites were reviewed for a few weeks to

verify accuracy prior to lowering the multipoint challenge concentration at all EPA-sponsored ozone sites. Wood will review multipoint challenge data each month prior to calibrations of the sites to determine if adjustments are needed in order to ensure the accuracy of data between zero and 30 ppb.

The internet protocol (IP) address for the KEF112, PA site was accidentally set to one being used by MKG113, PA. After polling, both sites showed MKG113 data. During February, the KEF112 data were recovered and correctly entered into the CASTNET database. To prevent this type of situation, Wood is developed a screening tool that detects duplicate data insertions that occur during polling.

Wood continued to work with MTL Corp on a pre-washed nylon filter that meets CASTNET acceptance criteria. Wood reviewed the revised standard operating procedure (SOP) from MTL for nylon filter washing and drying procedures and monitoring of the deionized water system. Wood sent the SOP with Wood's comments to Environment and Climate Change Canada personnel in order to consolidate comments from both monitoring networks regarding MTL's SOP.

Prior to the start of the partial government shutdown, Wood was contacted by EPA Region 3 and requested to assist with additional work on the West Virginia Department of Environmental Protection (WVDEP) Quality Assurance Plan (QAP). Wood was provided with a model QAP for the District of Columbia's SLAMS/NCore ambient air monitoring program to use as a guide. Wood completed revisions and submitted the document to EPA Region 3 and WVDEP on March 15, 2019.

Table 1 lists the quarters of data that were validated to Level 3 during first quarter 2019 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 2019.

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 2019.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for first quarter 2019. All results were within the criteria listed in Table 3.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during first quarter 2019. 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 2019. 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 2019. All recovery values were between 95 percent and 118 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for first quarter 2019. All first quarter results were within criteria (two times the reporting limit) listed in Table 3 with the exception of three Teflon calcium FB results at 2, 4, and 5 times the reporting limit. All other batch QC results associated with the calcium FB results were within criteria. In addition, the ambient concentration data associated with those sites were comparable to previously validated site data.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during first quarter 2019 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, five 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 2019. 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

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.

International Organization for Standardization (ISO). 2005. *Statistical Methods for the Use in Proficiency Testing by Interlaboratory Comparisons, Annex C, Robust Analysis, Section C.1: Algorithm A*. Standard 13528. ISO 13528:2005(E).

U.S. Environmental Protection Agency (EPA). 2017. Title 40 *Code of Federal Regulations* Part 58, "Appendix A to Part 58 – Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards."

Wood Environment & Infrastructure Solutions, Inc. (Wood) 2017. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan* (QAPP) Revision 9.1. 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.

Table 1 Data Validated to Level 3 during First Quarter 2019

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	May 2018 – October 2018	6	Quarter 3 2018	1
SE-4/MW-6‡	July 2018 – December 2018	6	Quarter 3 2018 – Quarter 4 2018	2

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

Table 2 Field Calibration Schedule for 2019

Calibration Group	Months Calibrated	Sites Calibrated				
Eastern Sites (23 Total)						
E-1 (8 Sites)	February/August	BEL116, MD	WSP144, NJ	ARE 128, PA	PED108, VA	
		BWR139, MD	CTH110, NY	PSU106, PA	VPI120, VA	
E-2 (10 Sites)	April/October	ABT147, CT	HOW191, ME	CAT175, NY	NIC001, NY	EGB181, ON
		ASH135, ME	WST109, NH	HWF187, NY[2]	WFM105, NY	UND002, VT
E-3 (5 Sites)	May/November	KEF112, PA	LRL117, PA	CDR119, WV		
		MKG113, PA	PAR107, WV			
Southeastern Sites (11 Total)						
SE-4 (6 Sites)	January/July	SND152, AL	BFT142, NC	COW137, NC		
		GAS153, GA	CND125, NC	SPD111, TN		
SE-5 (5 Sites)	February/August	CAD150, AR	SUM156, FL	DUK008, NC[1]		
		IRL141, FL	CVL151, MS			
Midwestern Sites (19 Total)						
MW-6 (6 Sites)	January/July	CDZ171, KY	MCK131, KY	PNF126, NC[2]		
		CKT136, KY	MCK231, KY	ESP127, TN		
MW-7 (9 Sites)	March/September	ALH157, IL	STK138, IL	RED004, MN	OXF122, OH	PRK134, WI
		BVL130, IL[3]	VIN140, IN	DCP114, OH	QAK172, OH	
MW-8 (4 Sites)	April/October	SAL133, IN	ANA115, MI			
		HOX148, MI	UVL124, MI			
Western Sites (11 Total)						
W-9 (5 Sites)	March/September	KNZ184, KS	CHE185, OK	ALC188, TX		
		KIC003, KS	SAN189, NE			
W-10 (6 Sites)	May/November	GTH161, CO	NPT006, ID	PND165, WY[1]		
		ROM206, CO[1]	CNT169, WY	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 co-located 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, (Wood, 2017).

Table 4 Ozone Critical Criteria*

Type of Check	Analyzer Response
Zero	Less than ± 3.1 parts per billion (ppb)
Span	Less than ± 7.1 percent between supplied and observed concentrations
Single Point QC	Less than ± 7.1 percent between supplied and observed concentrations

Notes: * In accordance with Part 58 of Title 40 of the *Code of Federal Regulations* (EPA, 2017). 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 ± 1.51 ppb	Less than ± 10.1 percent between supplied and observed concentrations
NO_y	Less than ± 1.51 ppb	
CO	Less than ± 30.1 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, 2017). 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).

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 2019

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-}	59	175	73	15	24	90
	NO_3^-	59	175	73	15	24	90
	NH_4^+	30	158	73	15	24	90
	Cl^-	59	175	73	15	24	90
	Ca^{2+}	30	159	73	15	24	90
	Mg^{2+}	30	159	73	15	24	90
	Na^+	30	159	73	15	24	90
	K^+	30	159	73	15	24	90
Nylon	SO_4^{2-}	42	172	69	14	24	90
	NO_3^-	42	172	69	14	24	90
Cellulose	SO_4^{2-}	43	163	72	16	24	90

Table 7 Filter Pack Receipt Summary for First Quarter 2019

Count of samples received more than 14 days after removal from tower:	41
Count of all samples received:	804
Fraction of samples received within 14 days:	0.949
Average interval in days:	6.514
First receipt date:	01/02/2019
Last receipt date:	03/29/2019

Note: Sample shipments for the Egbert, Ontario site (EGB181) are in groups of four. Samples associated with EGB181 are excluded from this statistic.

Table 8 Ozone QC Summary for First Quarter 2019 (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	1.26	100.00	1.22	100.00	0.14
ALC188, TX	100.00	1.58	100.00	0.91	100.00	0.61
ALH157, IL	100.00	0.60	100.00	0.88	100.00	0.21
ANA115, MI	100.00	0.66	100.00	0.88	100.00	0.11
ARE128, PA	100.00	2.84	100.00	2.56	100.00	0.22
ASH135, ME	100.00	1.93	100.00	2.37	100.00	0.24
BEL116, MD	100.00	1.23	100.00	1.23	100.00	0.20
BFT142, NC	100.00	3.01	100.00	2.94	100.00	0.19
BVL130, IL	100.00	2.92	100.00	2.81	100.00	0.21
BWR139, MD	100.00	2.51	100.00	2.20	100.00	0.15
CAD150, AR	100.00	0.78	100.00	0.68	100.00	0.24
CDR119, WV	100.00	1.91	100.00	1.25	100.00	0.29
CDZ171, KY	100.00	2.16	100.00	2.61	100.00	0.32
CKT136, KY	100.00	0.54	100.00	0.56	100.00	0.18
CND125, NC	100.00	0.58	100.00	0.77	100.00	0.43
CNT169, WY	100.00	0.75	100.00	0.87	100.00	0.23
COW137, NC	100.00	1.35	100.00	1.42	100.00	0.36
CTH110, NY	100.00	2.40	100.00	2.20	100.00	0.37
CVL151, MS	100.00	0.97	100.00	1.29	100.00	0.25
DCP114, OH	100.00	1.65	100.00	2.24	100.00	0.19
ESP127, TN	100.00	1.51	100.00	2.23	100.00	0.59
GAS153, GA	100.00	0.64	100.00	1.29	100.00	1.04
GTH161, CO	100.00	2.18	100.00	2.26	100.00	0.16

Table 8 Ozone QC Summary for First Quarter 2019 (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]
HOX148, MI	100.00	3.18	100.00	2.39	100.00	0.50
HWF187, NY	100.00	0.26	100.00	0.41	100.00	0.13
IRL141, FL	100.00	0.63	100.00	0.72	100.00	0.75
KEF112, PA	100.00	1.72	100.00	1.95	100.00	0.38
LRL117, PA	100.00	1.10	100.00	1.41	100.00	0.22
MCK131, KY	100.00	1.06	98.80	1.19	100.00	0.37
MCK231, KY	100.00	0.73	100.00	1.18	100.00	0.16
MKG113, PA	100.00	1.46	100.00	1.38	100.00	0.23
NPT006, ID	100.00	1.82	100.00	0.80	100.00	0.29
OXF122, OH	100.00	0.79	100.00	0.79	100.00	0.37
PAL190, TX	100.00	0.44	100.00	0.77	100.00	0.57
PAR107, WV	100.00	0.72	100.00	0.81	100.00	0.21
PED108, VA	100.00	0.35	100.00	0.71	100.00	0.14
PND165, WY	100.00	0.73	100.00	1.69	100.00	0.49
PNF126, NC	100.00	0.30	100.00	0.73	100.00	0.71
PRK134, WI	100.00	0.66	100.00	0.73	100.00	0.20
PSU106, PA	100.00	2.33	100.00	2.17	100.00	0.18
QAK172, OH	100.00	1.10	100.00	1.42	100.00	0.37
ROM206, CO	100.00	1.64	100.00	1.88	100.00	0.16
SAL133, IN	100.00	3.42	100.00	3.11	100.00	0.63
SAN189, NE	100.00	1.13	100.00	1.14	100.00	0.41
SND152, AL	100.00	1.36	100.00	1.91	100.00	0.54
SPD111, TN	100.00	0.89	100.00	0.71	100.00	0.24
STK138, IL	100.00	2.55	100.00	1.45	100.00	0.75
SUM156, FL	90.00	11.32	90.00	10.76	100.00	0.75
UVL124, MI	100.00	0.86	100.00	1.16	100.00	0.14
VIN140, IN	100.00	1.45	100.00	1.23	100.00	0.43
VPI120, VA	100.00	2.42	100.00	2.36	100.00	0.42
WSP144, NJ	100.00	1.36	100.00	1.89	100.00	0.15
WST109, NH	100.00	0.59	100.00	0.59	100.00	0.10

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. Values exceeding the criteria listed in Table 4 are addressed in Table 9.

%D = percent difference

ppb = parts per billion

Table 9 Ozone QC Observations for First Quarter 2019

Site ID	QC Criterion	Comments
SUM156, FL	Span |%D| Single Point QC |%D|	The analyzer sample pump failed 3/16/19 and was replaced 3/20/19. Associated data were invalidated.

Note: %D = percent difference

Table 10 Trace-level Gas QC Summary for First Quarter 2019

Parameter	% Span Pass[1]	Span |%D|[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	% Zero Pass[1]	Zero Average (ppb)[2]
BVL130, IL						
SO_2	100.00	1.71	100.00	1.61	100.00	0.22
NO_y	100.00	3.09	100.00	2.52	100.00	0.28
CO	NA	NA	NA	NA	NA	NA
DUK008, NC						
NO_y	100.00	1.83	100.00	3.79	100.00	0.64
HWF187, NY						
NO_y	100.00	1.82	100.00	1.95	97.83	0.26
PND165, WY						
NO_y	100.00	3.09	95.65	4.39	100.00	0.09
PNF126, NC						
NO_y	100.00	0.73	100.00	2.32	100.00	0.36
ROM206, CO						
NO_y	97.83	2.94	97.83	2.33	100.00	0.06

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 2019

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	CO	NA – analyzer not present	The malfunctioning CO analyzer was removed from the site for troubleshooting and repair during first quarter 2019.

Table 12 Filter Packs Flagged as Suspect or Invalid during First Quarter 2019

Site ID	Sample No.	Reason
ANA115, MI	1902001-03	Calcium and magnesium values were invalidated as suspect.
JOT403, CA	1905003-12	Possible polling issue: flow data were null.
LAV410, CA	1907003-13	Insufficient flow volume due to intermittent power failures
UND002, VT	1910001-52	Insufficient flow volume due to a power failure
YEL408, WY	1901003-24	Data were invalidated as suspect. The sample was installed and left on the tower for four weeks due to the government shutdown.

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	365
60	13
90	2
Unresolved by End of Quarter	14

Figure 1 Reference Standard Results for First Quarter 2019 (percent recovery)

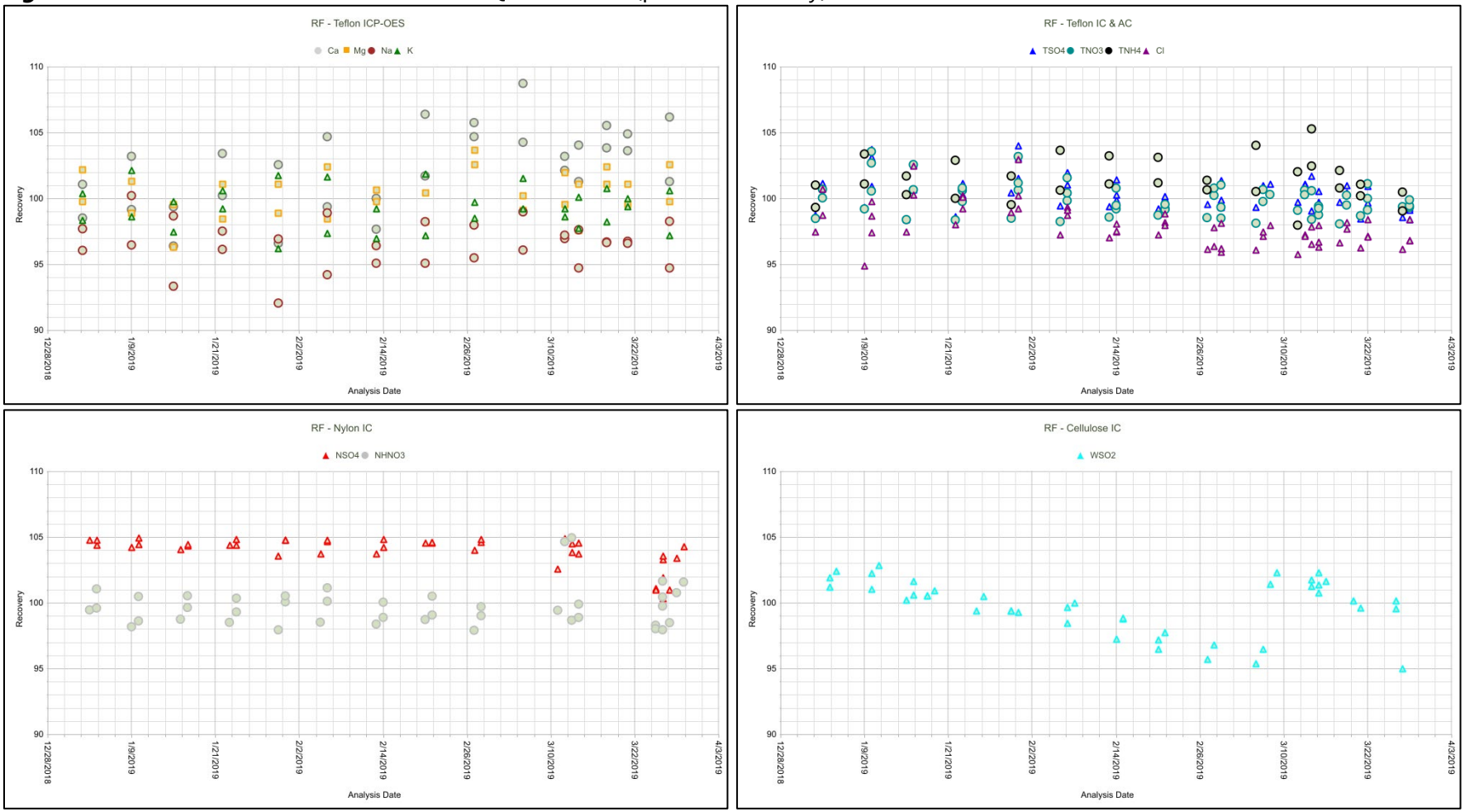

Figure 2 Continuing Calibration Spike Results for First Quarter 2019 (percent recovery)

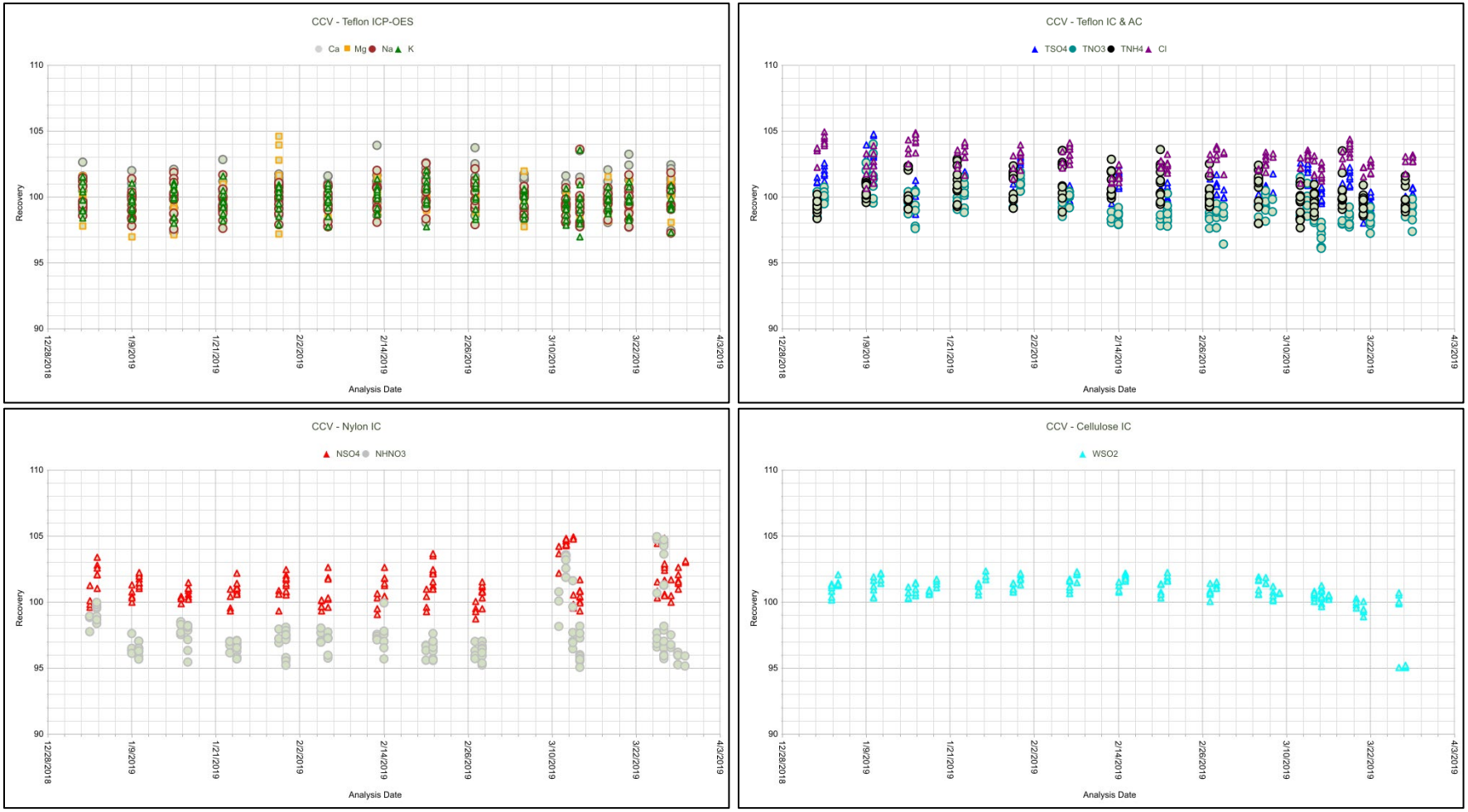

Figure 3 Replicate Sample Analysis Results for First Quarter 2019 (percent difference)

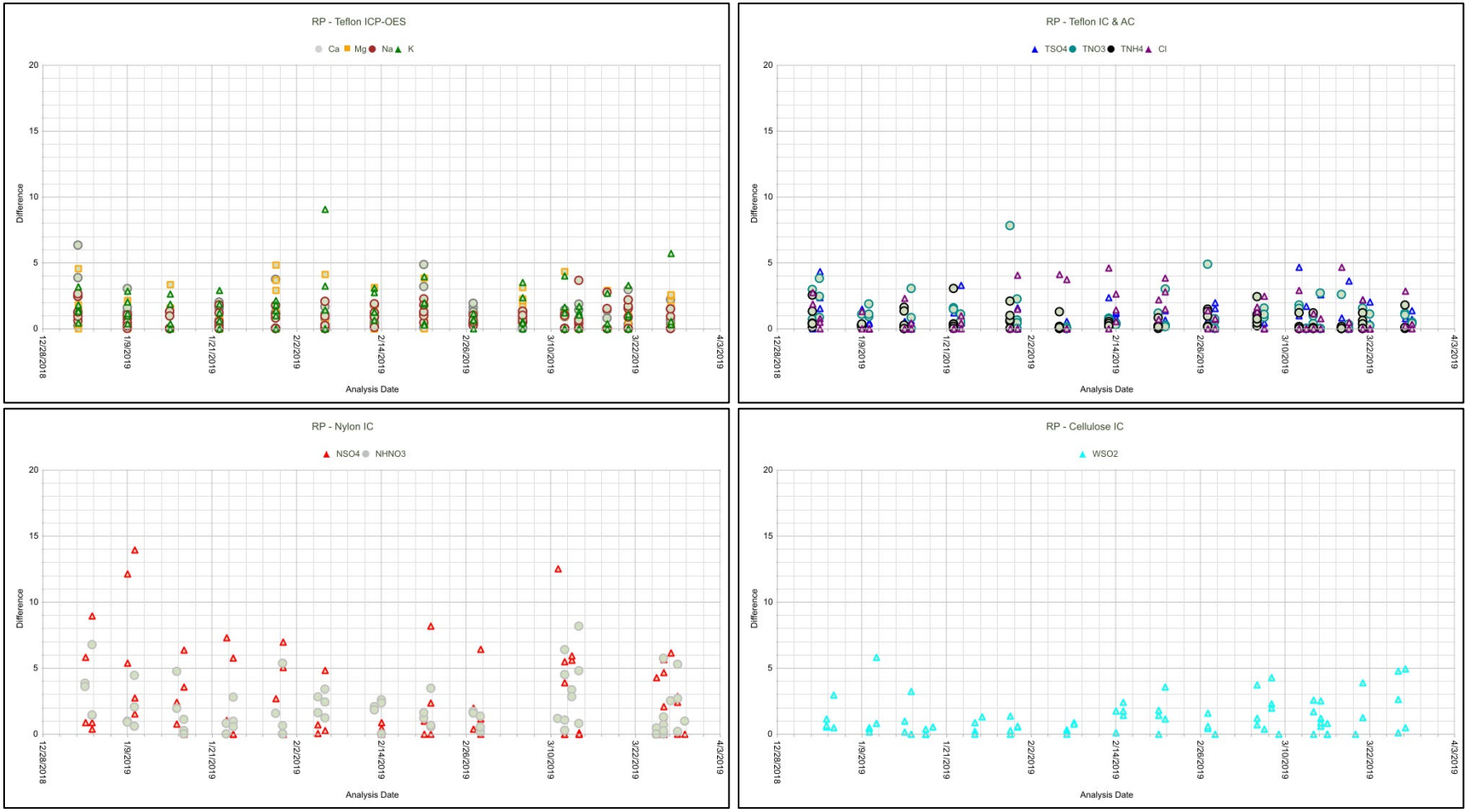

Figure 4 Laboratory Control Sample Results for First Quarter 2019 (percent recovery)

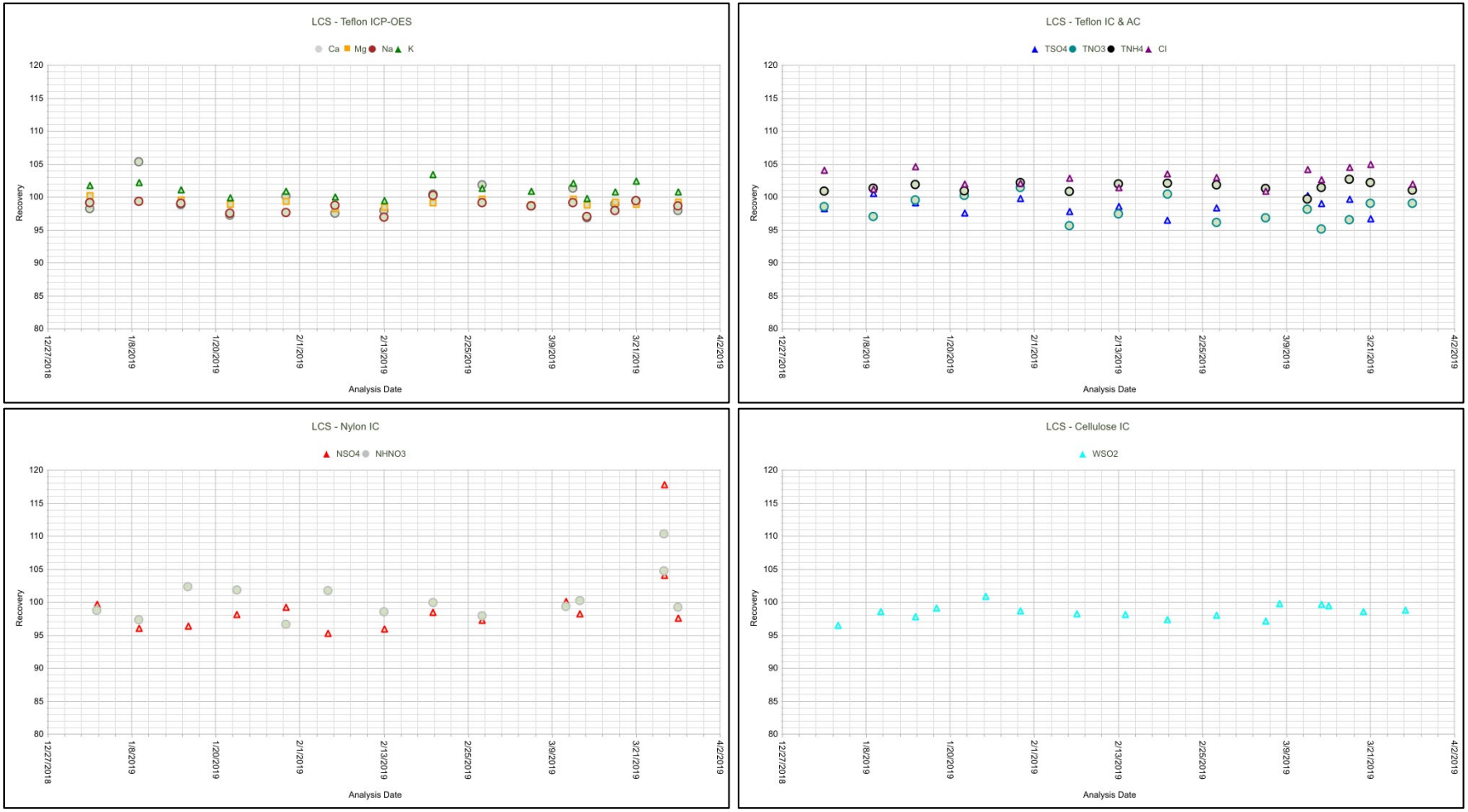

Figure 5 Method Blank Analysis Results for First Quarter 2019 (total micrograms)

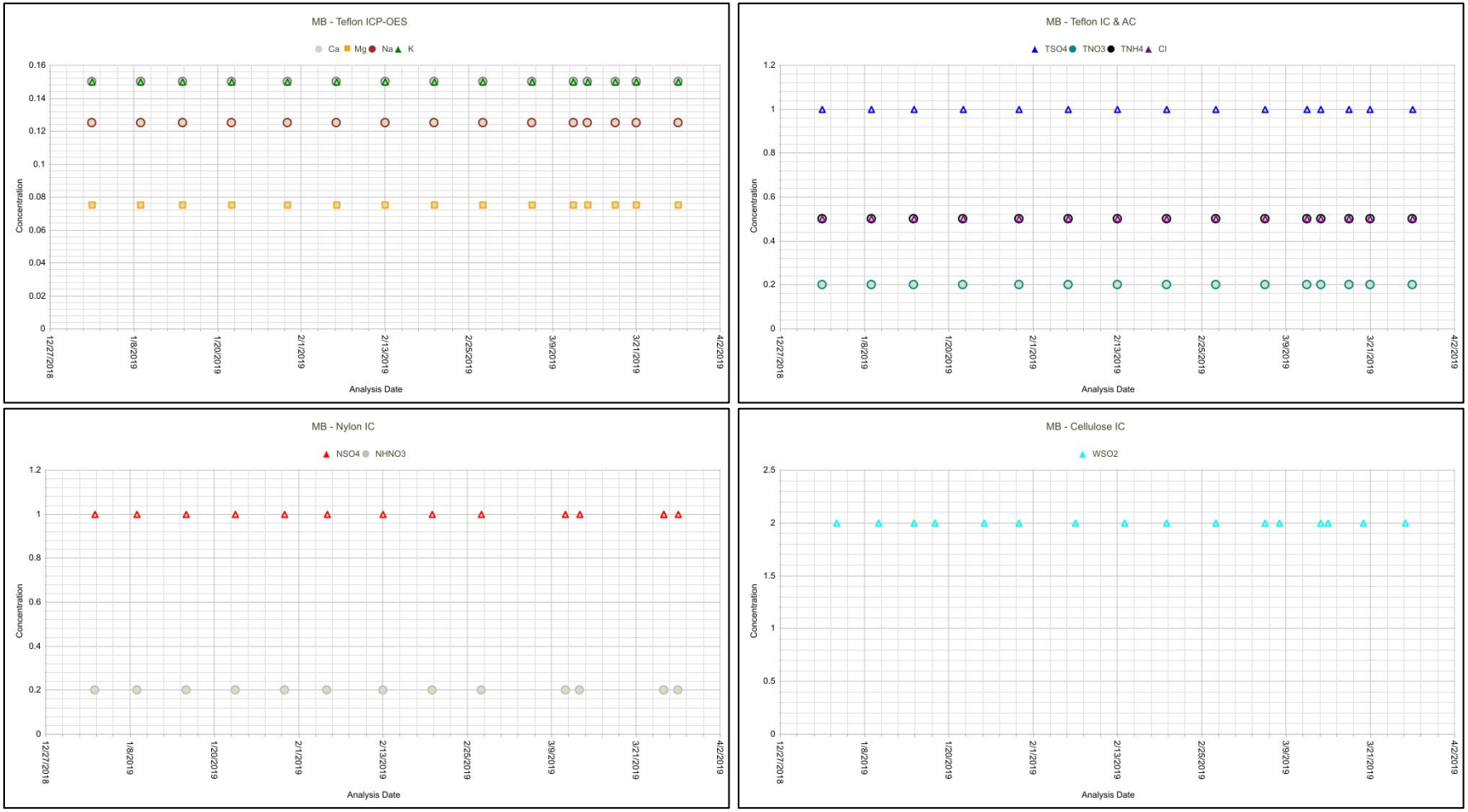

Figure 6 Laboratory Blank Analysis Results for First Quarter 2019 (total micrograms)

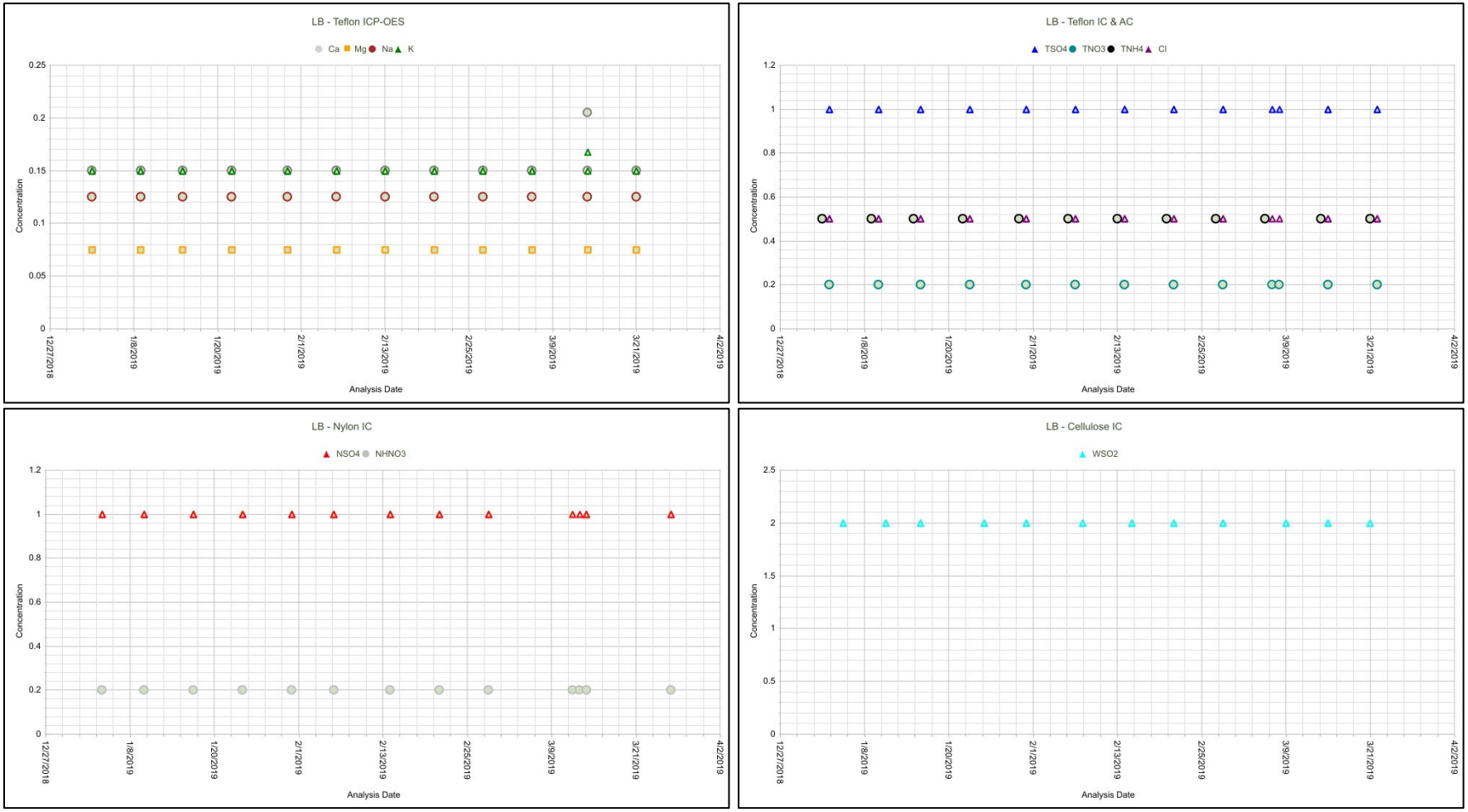

Figure 7 Field Blank Analysis Results for First Quarter 2019 (total micrograms)