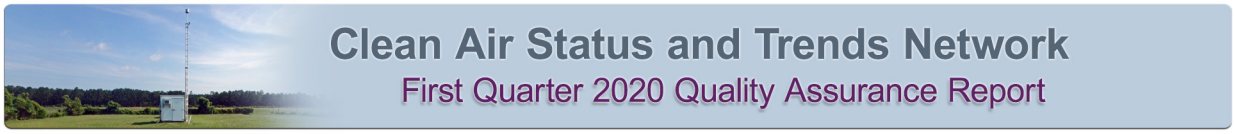

Summary of Quarterly Operations (January through March)

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 2020. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Wood, 2020). 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

During fourth quarter 2019, the CASTNET management team submitted paperwork to EPA for a change in Key Personnel for the CASTNET V contract. Ann Bernhardt, the then current Quality Assurance (QA) Supervisor, had been promoted within Wood. Wood recommended that Anne Glubis replace her as the CASTNET QA Supervisor. EPA approved Wood's request for a change in Key Personnel, and Anne Glubis formally assumed the role of the CASTNET Quality Assurance Supervisor on January 8, 2020.

During first quarter, preparations continued for the meeting to discuss the annual management review presentation in support of International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2017 accreditation.

Documentation for the annual renewal of the ISO/IEC 17025:2017 accreditation by the American Association for Laboratory Accreditation (A2LA) was completed and submitted to A2LA. A2LA accepted Wood's annual submittal. Wood's 17025:2017 ISO/IEC accreditation is current through May 2021.

Wood began a new procedure designed to identify site operators needing training. When site operator contact information is added or updated, a "ticket" is now generated to alert field personnel of a potential need for training. The ticket remains open and active until field personnel verify the site operator is up-to-date with training. The CASTNET QA Manager developed a review draft of a team-accessible matrix that includes technical training and quality management system training. Once it has been finalized, it will be uploaded to SharePoint for access by all team members.

Wood's analytical laboratory uses a simulated rainwater standard reference material (SRM) designed for CASTNET target analytes as part of its QC checks. High Purity Standards supplies the SRM. Wood noted that its results did not match the SRM certificate of analysis while solutions provided by AccuStandard matched their provided certificates. The CASTNET Laboratory Operations Manager (LOM) contacted the laboratories associated with ECCC and NADP and learned those laboratories were also having problems with the High Purity Standards SRM. The LOM contacted High Purity Standards who agreed to send a reformulation of the SRM. In the meantime, Wood's CASTNET LOM is looking for another SRM source.

MTL Corp ran out of nylon filters from Lot 709 and did not notify Wood of the impending change to Lot 710. Wood learned of the change from ECCC and ordered additional filters from Lot 710 to begin acceptance tests. The filters passed laboratory acceptance tests. The filters from Lot 710 were deployed at the MCK231, KY co-located site for comparison with Lot 709 filters. Field testing ran from March 3, 2020 through April 7, 2020. Preliminary results show the two lots are comparable. Wood has an approximately 1-year supply of nylon filters remaining from Lot 709.

The CASTNET QAPP Revision 9.3 was approved by EPA during March 2020.

During March 2020, Wood received final results of sample analyses for proficiency test study 0115 for Rain and Soft Waters to the National Laboratory of Environmental Testing (NLET), a branch of the National Water Research Institute with Environment Canada that provides QA services. All results passed with no flags.

Providing a safe working environment is one of Wood's goals. During March, Wood responded to the COVID-19 crisis by providing equipment and IT support for Wood personnel to work from home. Laboratory and field personnel are staggering hours in the respective laboratories to promote social distancing. Additional cleaning is being done for frequently touched surfaces. If site visits are required, field technicians plan to drive rather than fly. Calibrations for April and May were rescheduled to adhere to stay-at-home safety precautions.

Table 1 lists the quarters of data that were validated to Level 3 during first quarter 2020 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 2020.

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 2020.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for first quarter 2020. All results were within the criteria listed in Table 3. A Teflon calcium RP result came in at 36 percent.

This sample concentration was less than twice the reporting limit with an absolute difference of 0.09 μg from the replicate.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during first quarter 2020. 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 2020. 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 2020. All recovery values were between 94 percent and 104 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for first quarter 2020. All first quarter results were within criteria (two times the reporting limit) listed in Table 3.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during first quarter 2020 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, nine 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 2020. 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.

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) 2020. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan* (QAPP) Revision 9.3. 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.

Table 1 Data Validated to Level 3 during First Quarter 2020

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	May 2019 – October 2019	6	Quarter 3 2019	1
SE-4/MW-6‡	July 2019 – December 2019	6	Quarter 3 2019 – Quarter 4 2019	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 2020

Calibration Group	Months Calibrated	Sites Calibrated				
Eastern Sites (23 Total)						
E-1 (8 Sites)	February/August	BEL116, MD BWR139, MD	WSP144, NJ CTH110, NY	ARE 128, PA PSU106, PA	PED108, VA VPI120, VA	
E-2 (10 Sites)	April/October	ABT147, CT ASH135, ME	CAT175, NY HWF187, NY[2]	NIC001, NY WFM105, NY	WST109, NH 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 (6 Sites)	January/July	SND152, AL GAS153, GA	BFT142, NC CND125, NC	COW137, NC SPD111, TN		
SE-5 (5 Sites)	February/August	CAD150, AR IRL141, FL	SUM156, FL CVL151, MS	DUK008, NC[1]		
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 co-located filter samples and laboratory precision based on replicate samples for samples >5 times the reporting limit. The criterion is ± the reporting limit if the sample is ≤ five times the reporting limit.

[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, 2020).

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: * 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).

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 2020

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-}	75	211	89	18	28	93
	NO_3^-	75	211	89	18	28	93
	NH_4^+	36	184	86	18	26	93
	Cl^-	75	211	89	18	28	93
	Ca^{2+}	36	185	86	18	26	93
	Mg^{2+}	36	185	86	18	26	93
	Na^+	36	185	86	18	26	93
	K^+	36	185	86	18	26	93
Nylon	SO_4^{2-}	60	214	90	18	28	93
	NO_3^-	60	214	90	18	28	93
Cellulose	SO_4^{2-}	51	184	84	17	26	93

Table 7 Filter Pack Receipt Summary for First Quarter 2020

Count of samples received more than 14 days after removal from tower:	17
Count of all samples received:	820
Fraction of samples received within 14 days:	0.979
Average interval in days:	6.937
First receipt date:	01/03/2020
Last receipt date:	03/31/2020

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 2020 (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	1.37	100.00	1.32	100.00	0.14
ALC188, TX	100.00	0.62	100.00	0.69	100.00	0.36
ALH157, IL	100.00	0.43	100.00	0.64	100.00	0.27
ANA115, MI	100.00	1.94	100.00	0.97	100.00	0.33
ARE128, PA	100.00	3.80	100.00	3.82	100.00	0.23
ASH135, ME	100.00	0.90	100.00	0.99	100.00	0.44
BEL116, MD	100.00	0.85	100.00	1.49	100.00	0.36
BFT142, NC	100.00	0.42	100.00	0.61	100.00	0.15
BVL130, IL	100.00	2.63	100.00	2.81	100.00	0.14
BWR139, MD	100.00	0.77	100.00	1.13	100.00	0.24
CAD150, AR	100.00	1.52	100.00	1.79	100.00	0.39
CDR119, WV	96.84	1.93	98.95	1.55	100.00	0.29
CDZ171, KY	100.00	1.94	100.00	1.33	100.00	0.64
CKT136, KY	100.00	0.75	100.00	0.74	100.00	0.15
CND125, NC	100.00	0.68	98.91	0.85	100.00	0.36
CNT169, WY	100.00	0.58	100.00	0.78	100.00	0.21
COW137, NC	100.00	0.49	100.00	1.39	100.00	1.28
CTH110, NY	100.00	0.83	100.00	1.04	100.00	0.20
CVL151, MS	100.00	1.11	100.00	1.63	100.00	0.47
DCP114, OH	100.00	1.13	97.67	1.78	100.00	0.46
DUK008, NC	100.00	1.32	100.00	1.41	100.00	0.36
ESP127, TN	100.00	1.73	100.00	2.33	100.00	0.27
GAS153, GA	100.00	1.85	100.00	2.60	100.00	0.64
GTH161, CO	100.00	1.69	100.00	1.42	100.00	0.26
HOX148, MI	100.00	0.34	100.00	0.44	100.00	0.21

Table 8 Ozone QC Summary for First Quarter 2020 (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]
HWF187, NY	100.00	1.00	95.88	1.71	92.78	0.86
IRL141, FL	100.00	0.97	100.00	1.73	100.00	0.50
KEF112, PA	100.00	1.34	100.00	1.56	100.00	0.23
LRL117, PA	100.00	0.93	100.00	1.06	100.00	0.24
MCK131, KY	100.00	0.75	100.00	0.59	100.00	0.31
MCK231, KY	100.00	0.73	100.00	1.06	100.00	0.24
MKG113, PA	100.00	0.23	100.00	0.83	98.92	0.25
NPT006, ID	94.32	7.53	94.32	5.14	100.00	0.29
OXF122, OH	100.00	0.24	100.00	0.52	100.00	0.33
PAL190, TX	100.00	0.26	100.00	0.51	100.00	0.34
PAR107, WV	89.69	10.86	89.69	11.06	100.00	0.25
PED108, VA	100.00	0.81	100.00	0.60	100.00	0.15
PND165, WY	100.00	0.72	100.00	1.10	100.00	0.16
PNF126, NC	100.00	0.91	100.00	1.41	100.00	0.40
PRK134, WI	100.00	0.98	100.00	0.54	100.00	0.12
PSU106, PA	100.00	0.31	100.00	0.29	100.00	0.14
QAK172, OH	100.00	0.57	100.00	1.20	98.91	0.82
ROM206, CO	100.00	1.64	100.00	1.94	100.00	0.21
SAL133, IN	100.00	0.32	100.00	0.49	100.00	0.11
SAN189, NE	100.00	0.89	98.91	1.25	100.00	0.42
SND152, AL	100.00	0.87	100.00	1.24	100.00	0.35
SPD111, TN	94.25	4.79	94.25	5.36	95.40	0.95
STK138, IL	100.00	1.49	100.00	0.87	100.00	0.50
SUM156, FL	100.00	2.52	100.00	2.15	100.00	0.27
UVL124, MI	96.77	4.75	98.92	2.17	98.92	0.61
VIN140, IN	100.00	0.93	100.00	1.14	98.91	0.23
VPI120, VA	100.00	1.08	100.00	0.73	100.00	0.15
WSP144, NJ	87.50	4.90	96.12	4.66	100.00	0.20
WST109, NH	100.00	0.44	100.00	0.62	100.00	0.19

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 2020

Site ID	QC Criterion	Comments
NPT006, ID	Span |%D|	The sample pump failed and was replaced on 1/02/2020
PAR107, WV	Span |%D| Single Point QC |%D|	The sample pump failed and was replaced on 1/27/2020
WSP144, NJ	% Span Pass	The analyzer solenoid malfunctioned starting 2/10/2020. It was replaced on 02/26/2020.

Note: %D = percent difference

Table 10 Trace-level Gas QC Summary for First Quarter 2020

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	0.88	100.00	4.77	100.00	0.30
NO_y	100.00	1.03	100.00	1.53	100.00	0.34
CO	100.00	1.68	75.00	9.34	80.00	23.14
DUK008, NC						
NO_y	84.21	5.69	78.95	6.51	100.00	0.64
HWF187, NY						
NO_y	100.00	1.21	100.00	2.22	100.00	0.12
PND165, WY						
NO_y	100.00	3.08	100.00	3.06	100.00	0.16
PNF126, NC						
NO_y	100.00	0.62	100.00	3.89	100.00	0.24
ROM206, CO						
NO_y	100.00	1.18	100.00	1.26	100.00	0.26

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 2020

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	CO	% Single Point QC Pass % Zero Pass	Analyzer was unstable during January. It was serviced and recalibrated on 1/28/2020.
DUK008, NC	NO_y	% Span Pass % Single Point QC Pass	Cold temperatures (< 5° C) were affecting concentration readings. Actions were taken to better control shelter temperatures between the end of January and early February 2020. Subsequent QC checks were in control.

Table 12 Filter Packs Flagged as Suspect or Invalid during First Quarter 2020

Site ID	Sample No.	Reason
BEL116, MD	2007001-06	Insufficient flow volume was due to a power failure.
BVL130, IL	2005001-08	Calibration flags were left in place. Data may be recovered.
CAT175, NY	2002001-11	Insufficient flow volume was due to a power failure.
ESP127, TN	2007001-23	Insufficient flow volume was due to a power failure.
FOR605, WY	2005005-03	Possible polling issue: flow data were null.
JOT403, CA	2005003-12	Possible polling issue: flow data were null.
NEC602, WY	2004005-04 2005005-04	The mass flow controller malfunctioned resulting in invalid flow rates for these samples.
NPT006, ID	2004004-04	Insufficient flow volume was due to a power failure.

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	308
60	13
90	0
Unresolved by End of Quarter	15

Figure 1 Reference Standard Results for First Quarter 2020 (percent recovery)

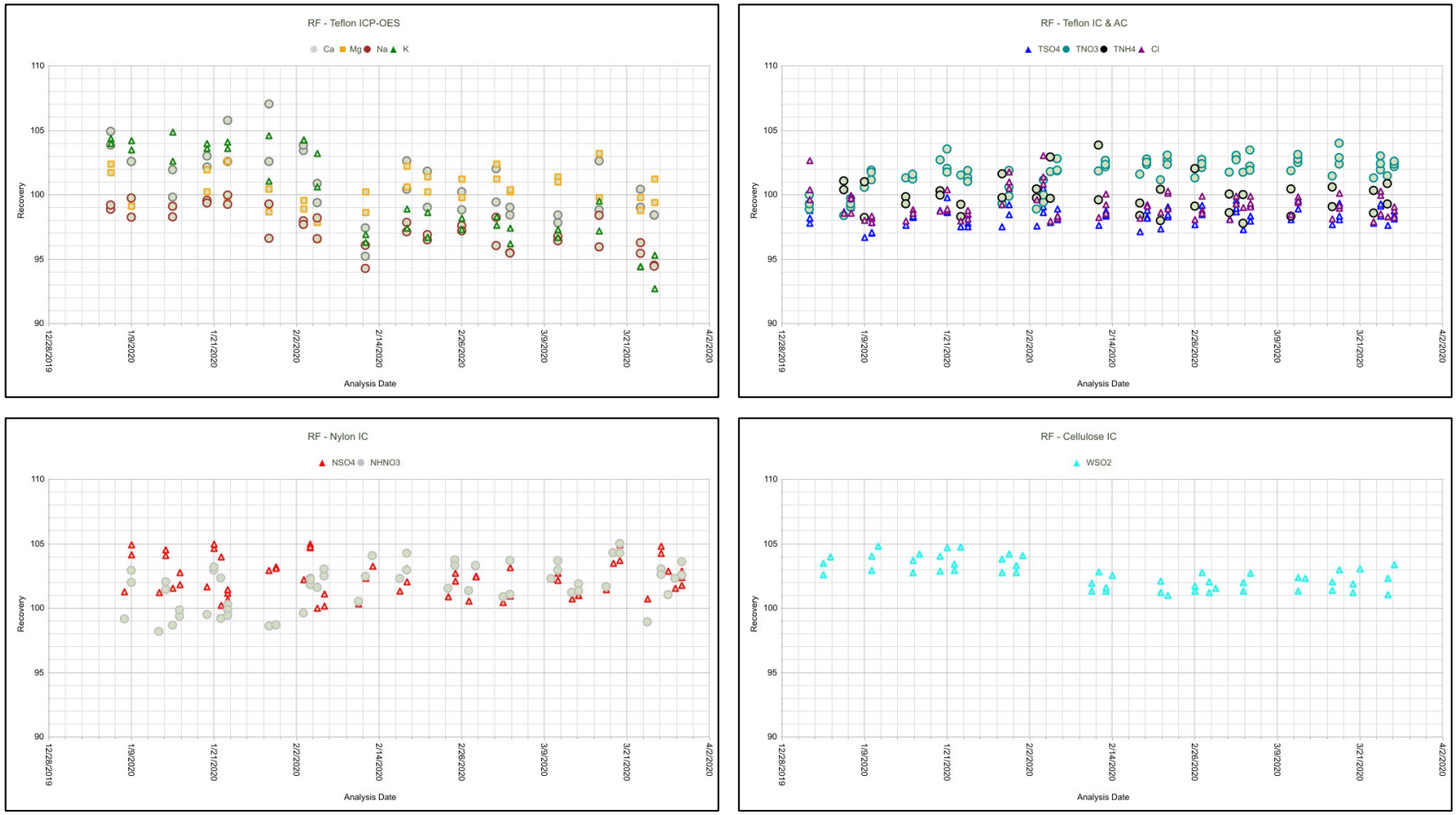

Figure 2 Continuing Calibration Spike Results for First Quarter 2020 (percent recovery)

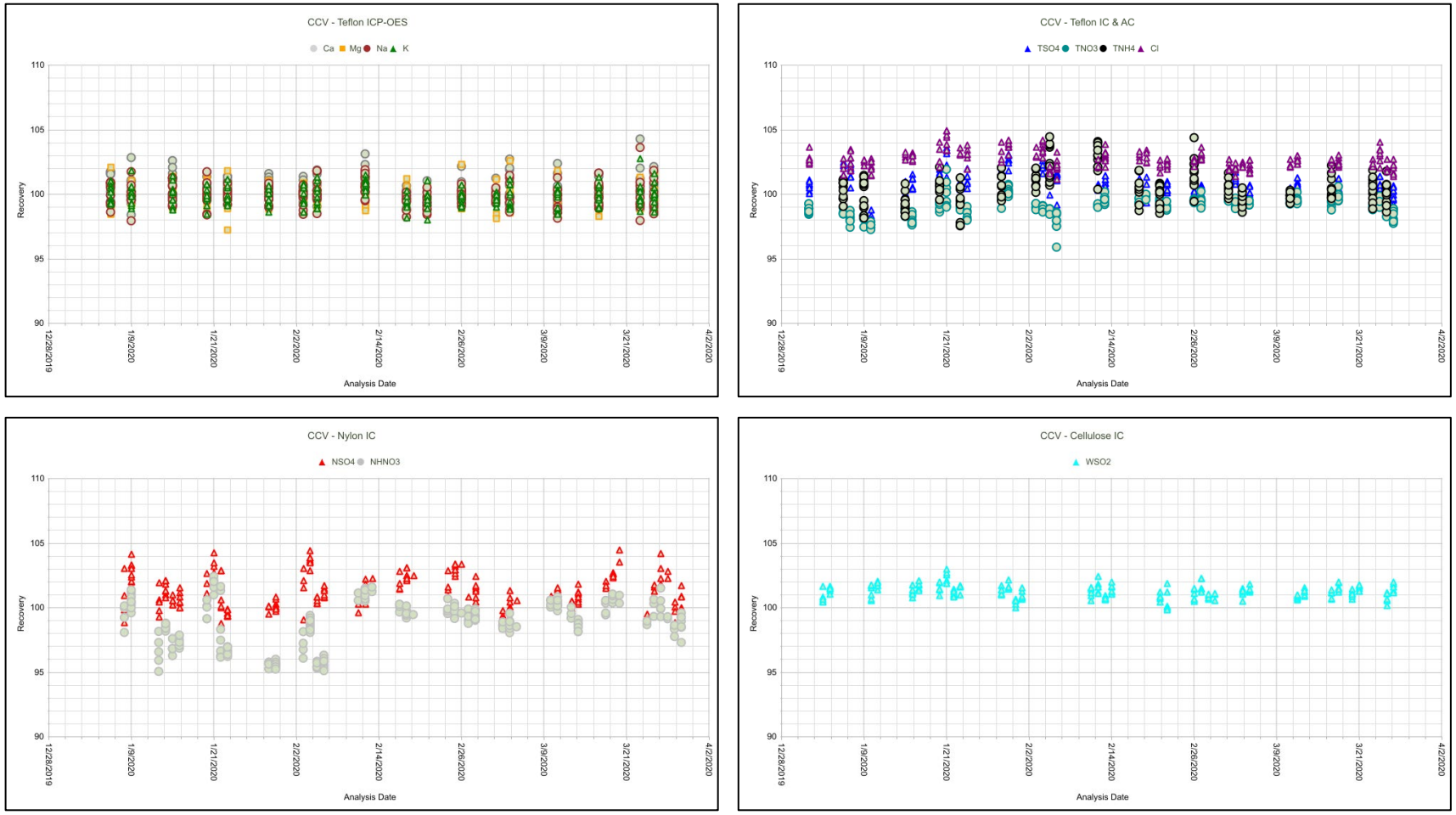

Figure 3 Replicate Sample Analysis Results for First Quarter 2020 (percent difference)

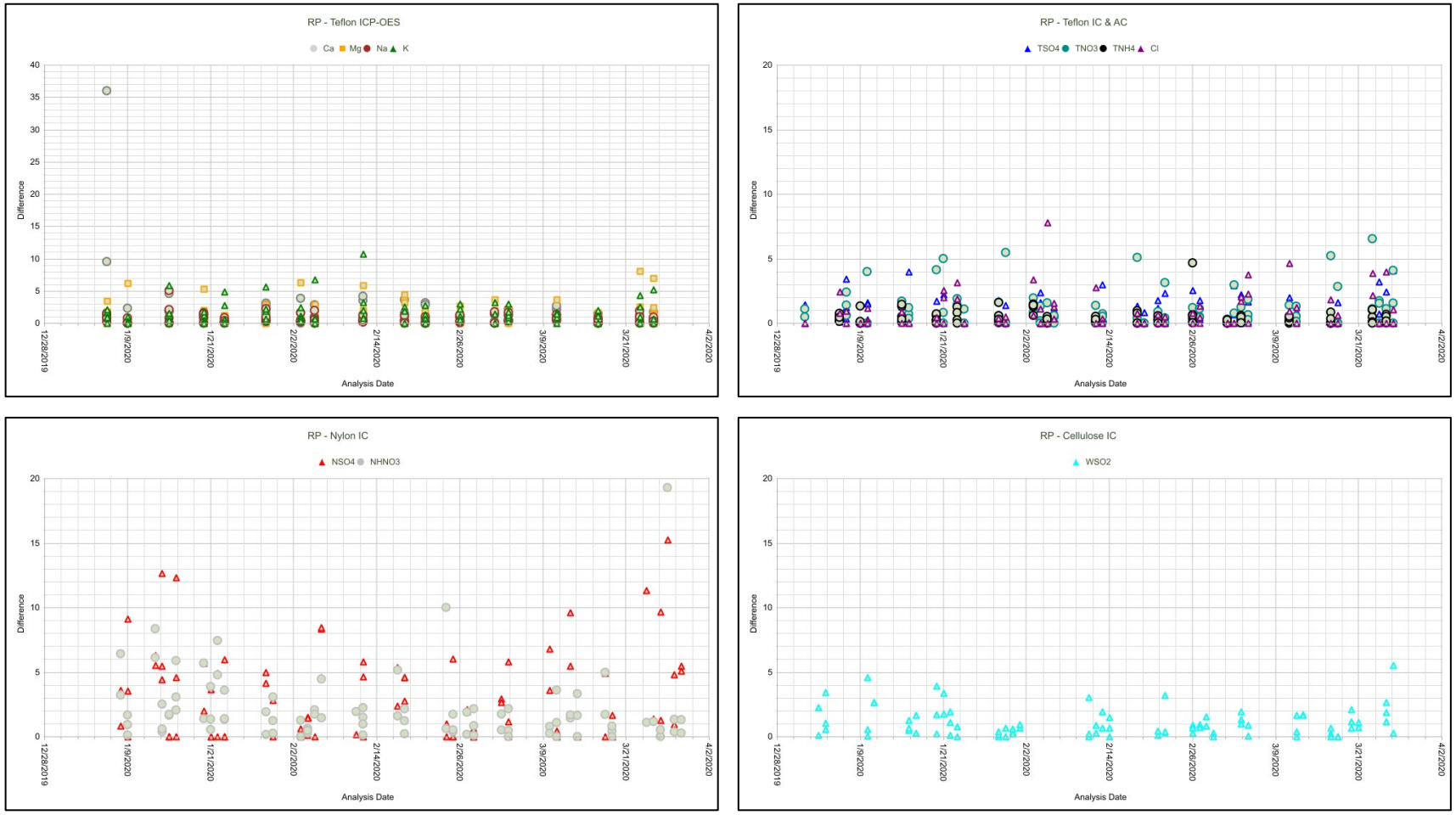

Figure 4 Laboratory Control Sample Results for First Quarter 2020 (percent recovery)

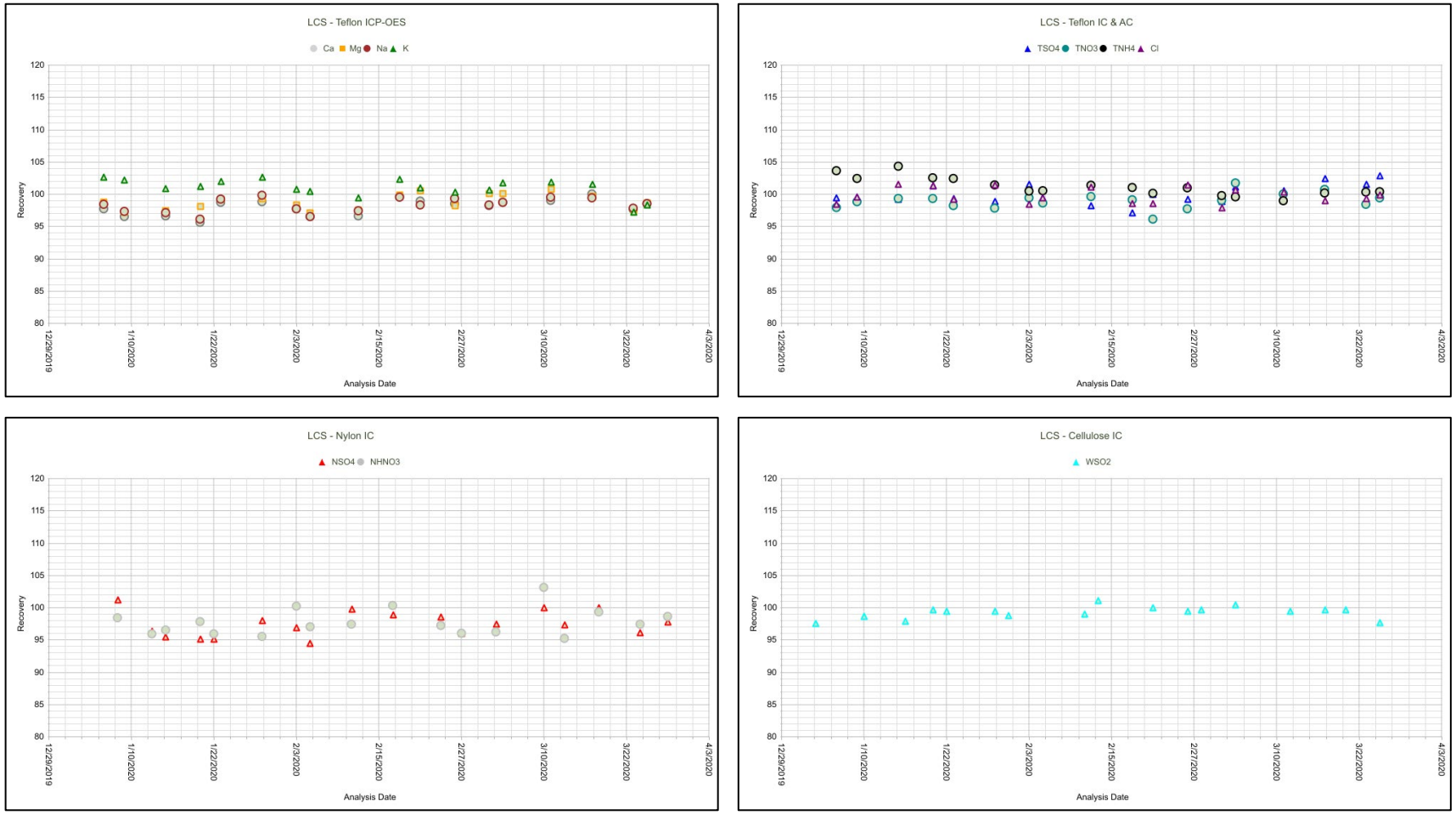

Figure 5 Method Blank Analysis Results for First Quarter 2020 (total micrograms)

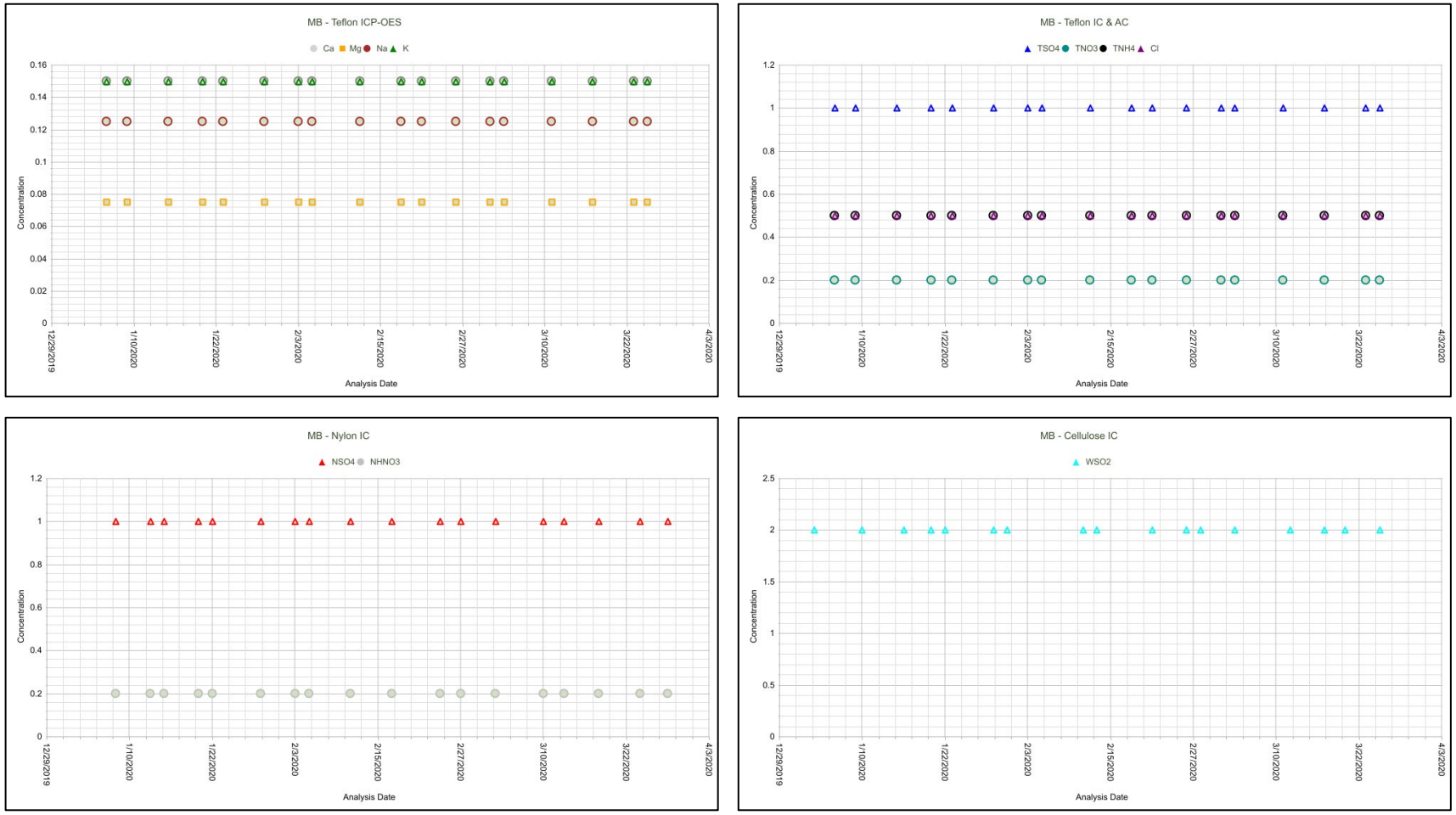

Figure 6 Laboratory Blank Analysis Results for First Quarter 2020 (total micrograms)

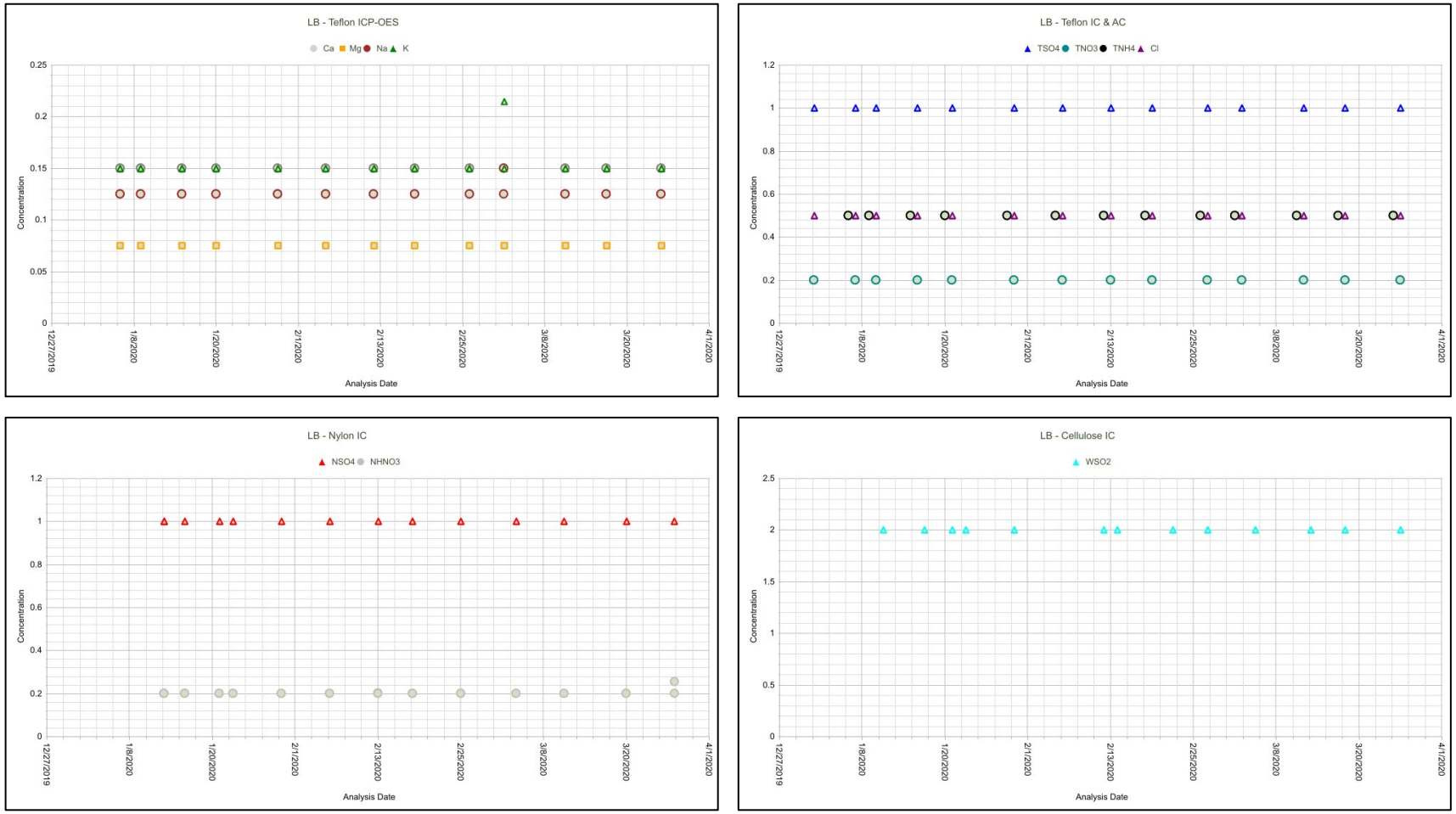

Figure 7 Field Blank Analysis Results for First Quarter 2020 (total micrograms)