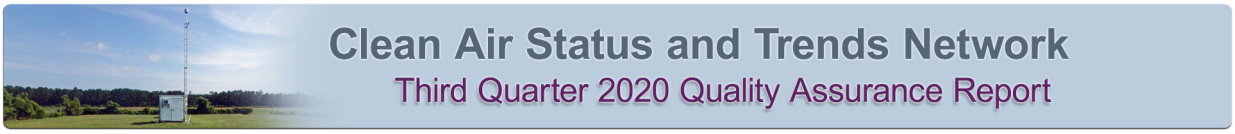

Summary of Quarterly Operations (July through September)

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 third 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

Wood continued updating the iCASTNET data management system and moving to electronic forms. iCASTNET is used by field, data, and QA personnel to manage field activities and data collection and validation. Data review and validation were moved to iCASTNET after verifying accuracy by using duplicate Excel spreadsheets and QA review. Electronic data review, validation summary, and data submittal forms were incorporated into the review process.

The SUM156, FL site was identified as violating siting criteria during a recent audit. Wood worked with the site operator at the SUM156, FL to flag the trees identified as violating or potentially violating siting criteria. The U S Department of Agriculture agreed to remove the trees.

Review of the CASTNET QAPP continued during third quarter. One of the updates included changing the P-flag criterion from 100 ppb to 130 ppb for nine western sites based on a 5-year average of the daily maximum 8-hour average concentration. A list of these sites will be included in the upcoming revision of the CASTNET QAPP. Updates to the QAPP will be submitted to EPA on November 1, 2020.

Wood field, data, and QA personnel discussed the handling of flagging for zero/span/precision (zsp) QC checks invalidated or not invalidated due to moisture. The majority of the zsp checks are stabilizing after a sufficient zero air purge. Comments included in iCASTNET problem tickets will clearly indicate which ones are stabilizing versus failed checks that indicate problems with ambient concentrations.

The co-located comparison of the MTL nylon filters from Lots 709 and 710 ended. The last filter pack for the study was installed on the tower on September 29, 2020. Preliminary results show the two lots of filters are comparable.

Table 1 lists the quarters of data that were validated to Level 3 during third 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 third 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 third quarter 2020. Eighty-eight percent of field samples were received within 14 days during third quarter. Package handling changes by shipping carriers and an increased volume of shipping nationally due to the COVID-19 pandemic resulted in delays in the receipt of exposed filter packs. The average number of days for filter pack receipt during third quarter 2020 was 9.359 days.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for third quarter 2020. All results were within the criteria listed in Table 3. The single RP value for nylon sulfate in Figure 4 that plots at 26 percent difference has a concentration value less than five times the reporting limit and meets the established criterion of plus or minus the reporting limit.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during third 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 third 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 third quarter 2020. All recovery values were between 95 percent and 107 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for third quarter 2020. All third 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 third 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 third quarter, 12 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 third 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 Third Quarter 2020

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	November 2019 – April 2020	6	Quarter 1 2020	1
SE-4/MW-6‡	January 2020 – June 2020	6	Quarter 1 2020 – Quarter 2 2020	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 (22 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 (9 Sites)	April/October	ABT147, CT	WST109, NH	HWF187, NY[1]	WFM105, NY	
		ASH135, ME	CAT175, NY	NIC001, NY	EGB181, ON	UND002, VT
E-3 (5 Sites)	May/November	KEF112, PA	LRL117, PA	CDR119, WV		
		MKG113, PA	PAR107, WV			
Southeastern Sites (11 Total)						
SE-4 (7 Sites)	January/July	SND152, AL	BFT142, NC	COW137, NC	DUK008, NC[1]	
		GAS153, GA	CND125, NC	SPD111, TN		
SE-5 (4 Sites)	February/August	CAD150, AR	SUM156, FL			
		IRL141, FL	CVL151, MS			
Midwestern Sites (19 Total)						
MW-6 (6 Sites)	January/July	CDZ171, KY	MCK131, KY	PNF126, NC[1]		
		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[2]		
		ROM206, CO[2]	CNT169, WY	PAL190, TX		

Notes: [1] Trace-level gas calibrations are performed quarterly in January, April, July, and October.
[2] Trace-level gas calibrations are performed quarterly in February, May, August, and November.
[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 > five 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 Third 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-}	68	197	81	18	26	92
	NO_3^-	68	197	81	18	26	92
	NH_4^+	34	179	81	17	26	92
	Cl^-	68	197	81	18	26	92
	Ca^{2+}	34	180	81	17	26	92
	Mg^{2+}	34	180	81	17	26	92
	Na^+	34	180	81	17	26	92
	K^+	34	180	81	17	26	92
Nylon	SO_4^{2-}	49	188	78	16	26	92
	NO_3^-	49	188	78	16	26	92
Cellulose	SO_4^{2-}	47	172	79	16	26	92

Table 7 Filter Pack Receipt Summary for Third Quarter 2020

Count of samples received more than 14 days after removal from tower:	88
Count of all samples received:	730
Fraction of samples received within 14 days:	0.879
Average interval in days:	9.359
First receipt date:	07-01-2020
Last receipt date:	09-18-2020

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 Third 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	1.58	100.00	1.70	100.00	0.23
ALC188, TX	100.00	2.11	100.00	1.36	100.00	0.36
ALH157, IL	100.00	2.01	98.94	2.13	100.00	0.29
ANA115, MI	100.00	2.61	100.00	1.78	100.00	0.50
ARE128, PA	91.14	10.33	92.41	8.49	94.94	0.57
ASH135, ME	100.00	0.55	100.00	0.71	100.00	0.25
BEL116, MD	100.00	0.81	100.00	1.37	98.88	0.63
BFT142, NC	100.00	1.53	100.00	1.45	100.00	0.53
BVL130, IL	100.00	1.04	100.00	1.18	98.89	0.36
BWR139, MD	100.00	1.18	100.00	1.76	100.00	0.50
CAD150, AR	100.00	2.59	100.00	2.37	100.00	0.29
CDR119, WV	100.00	2.14	100.00	2.33	100.00	0.27
CDZ171, KY	100.00	0.78	100.00	0.81	100.00	0.36
CKT136, KY	100.00	0.59	100.00	0.59	100.00	0.12
CND125, NC	100.00	1.25	100.00	1.36	100.00	0.99
CNT169, WY	100.00	0.43	100.00	0.57	100.00	0.27
COW137, NC	100.00	0.93	100.00	1.43	100.00	0.75
CTH110, NY	100.00	1.93	100.00	2.25	100.00	0.21
CVL151, MX	100.00	0.62	100.00	0.90	100.00	0.32
DCP114, OH	87.76	14.01	87.76	14.21	100.00	0.52
DUK008, NC	100.00	2.40	98.85	2.47	97.70	0.47
ESP127, TN	100.00	1.07	100.00	0.63	100.00	0.23
GAS153, GA	100.00	1.03	100.00	1.60	100.00	0.80
GTH161, CO	100.00	0.84	100.00	0.93	100.00	0.19

Table 8 Ozone QC Summary for Third 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]
HOX148, MI	100.00	1.42	100.00	1.59	100.00	0.28
HWF187, NY	97.56	2.63	93.90	2.79	100.00	0.26
IRL141, FL	98.89	0.80	98.89	0.97	100.00	0.42
KEF112, PA	100.00	1.59	100.00	1.40	100.00	0.17
LRL117, PA	100.00	0.96	100.00	0.93	100.00	0.18
MCK131, KY	100.00	1.76	97.89	1.91	98.95	0.28
MCK231, KY	100.00	0.82	98.94	0.82	100.00	0.17
MKG113, PA	100.00	1.39	100.00	1.30	100.00	0.43
NPT006, ID	98.57	4.85	98.57	6.68	100.00	0.19
OXF122, OH	100.00	1.64	100.00	1.86	100.00	0.40
PAL190, TX	100.00	0.34	100.00	1.04	100.00	0.36
PAR107, WV	100.00	1.48	98.92	1.05	100.00	0.16
PED108, VA	100.00	1.98	100.00	1.98	100.00	0.36
PND165, WY	100.00	0.68	100.00	0.92	100.00	0.22
PNF126, NC	100.00	0.22	100.00	0.66	100.00	0.36
PRK134, WI	100.00	1.91	100.00	1.70	100.00	0.29
PSU106, PA	98.91	0.59	100.00	0.62	100.00	0.20
QAK172, OH	100.00	2.14	97.83	3.80	100.00	0.88
ROM206, CO	100.00	0.78	100.00	0.66	100.00	0.23
SAL133, IN	100.00	1.79	100.00	1.57	100.00	0.29
SAN189, NE	100.00	3.08	100.00	3.34	100.00	1.15
SND152, AL	100.00	0.58	100.00	0.82	100.00	0.31
SPD111, TN	98.90	1.35	98.90	1.00	98.90	0.34
STK138, IL	87.00	3.67	92.00	2.55	92.00	1.11
SUM156, FL	100.00	2.77	100.00	1.91	98.92	0.29
UVL124, MI	97.62	3.25	98.81	2.79	100.00	0.27
VIN140, IN	100.00	0.28	100.00	0.69	100.00	0.48
VPI120, VA	98.63	3.12	100.00	2.79	100.00	0.19
WSP144, NJ	96.74	2.42	98.88	1.12	100.00	0.18
WST109, NH	100.00	0.95	98.92	1.00	100.00	0.33

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 Third Quarter 2020

Site ID	QC Criterion	Comments
ARE128, PA	Span |%D| Single Point QC |%D|	The flow pump failed.
DCP114, OH	% Span Pass Span |%D| % Single Point QC Pass Single Point QC |%D|	The flow pump failed.
STK138, IL	% Span Pass	The failures were caused by a leak at the connecting tee for the calibration gas. The data are expected to be recovered.

Note: %D = percent difference

Table 10 Trace-level Gas QC Summary for Third 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	1.18	100.00	6.35	100.00	0.56
NO_y	91.11	10.00	91.11	10.94	100.00	0.52
CO	100.00	1.54	84.78	6.17	69.57	29.11
DUK008, NC						
NO_y	91.11	3.48	86.67	4.39	100.00	0.55
HWF187, NY						
NO_y	100.00	2.60	100.00	3.92	100.00	0.31
PND165, WY						
NO_y	100.00	3.21	100.00	1.56	95.00	0.41
PNF126, NC						
NO_y	93.02	6.21	90.70	7.16	97.67	0.36
ROM206, CO						
NO_y	100.00	0.83	100.00	1.16	97.87	0.69

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 Third Quarter 2020

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	NO_y	Single Point QC |%D|	The NO_y analyzer solenoid failed.
	CO	% Single Point QC Pass % Zero Pass	The CO analyzer required recalibration.
DUK008, NC	NO_y	% Single Point QC Pass	There was a leak at the converter box.

Notes: %D = percent difference

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

Site ID	Sample No.	Reason
ABT147, CT	2032001-01	The site experienced an extended power outage.
BWR139, MD	2030001-09	The Teflon filter was perforated.
CDR119, WV	2029001-12	The mass flow controller (MFC) malfunctioned and was replaced.
CHE185, OK	2034004-02	The MFC malfunctioned and was replaced.
CTH110, NY	2030001-18	The cause of the problem is under investigation.
FOR605, WY	2031005-03	Flow data are missing.
JOT403, CA	2031003-12	Flow data are missing.
PSU106, PA	2031001-43	The sample was invalidated for suspect data.
SHE604, WY	2035005-05	Flow data are missing.
SPD111, TN	2036001-48	The site experienced a power outage.
UND002, VT	2033001-51 2034001-51	The site experienced an extended power outage.

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	481
60	14
90	3
Unresolved by End of Quarter	2

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

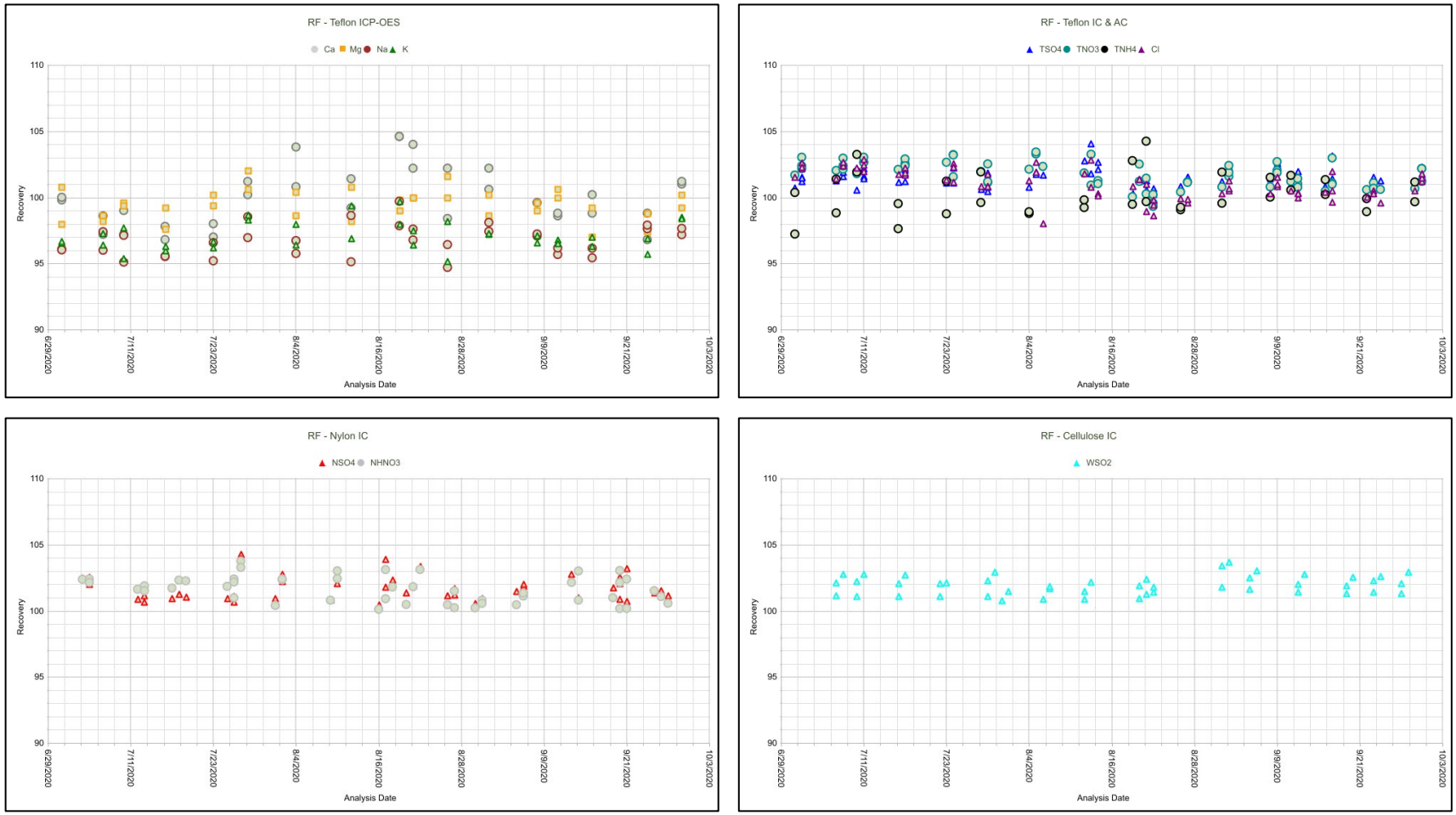

Figure 2 Continuing Calibration Spike Results for Third Quarter 2020 (percent recovery)

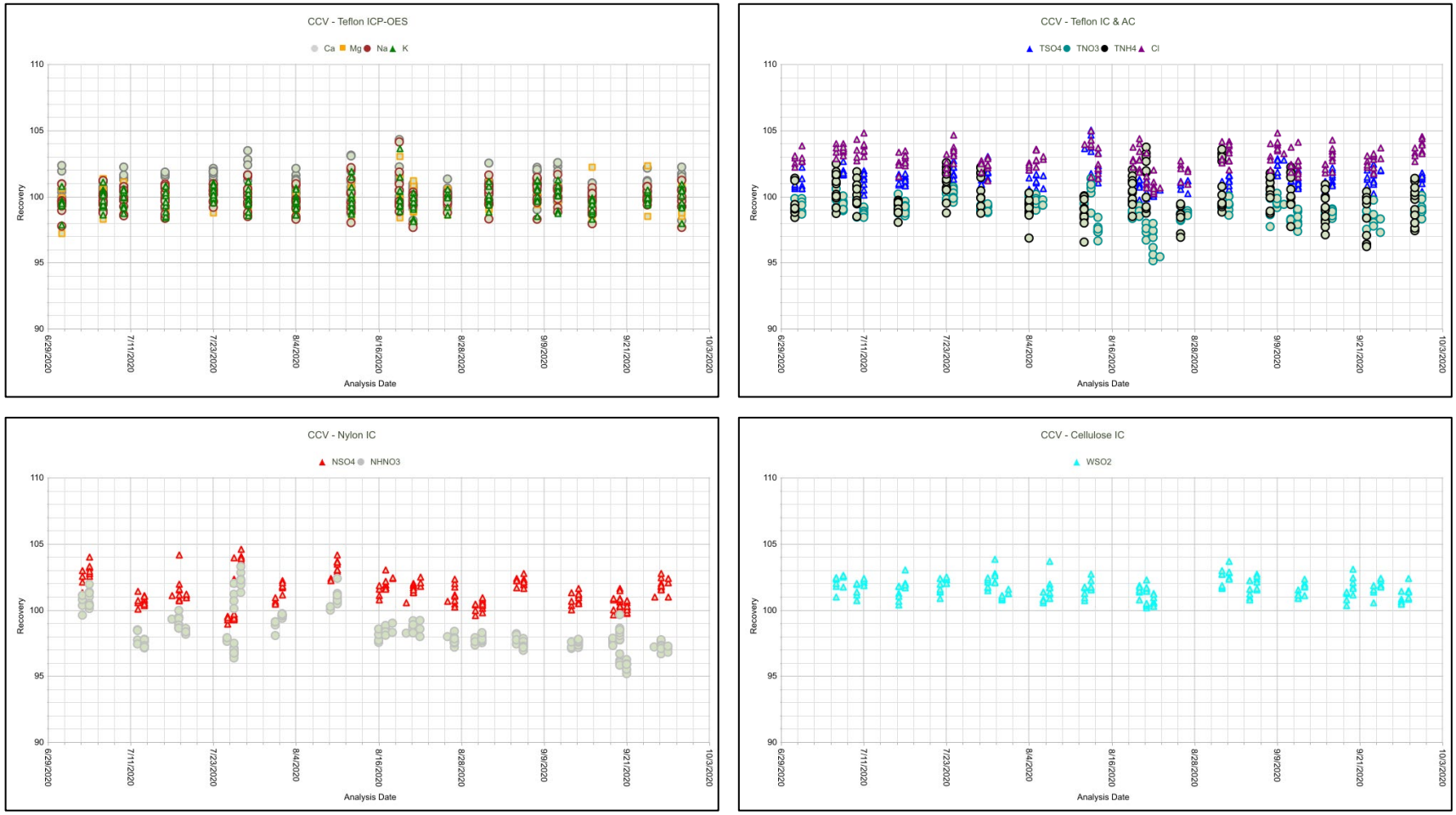

Figure 3 Replicate Sample Analysis Results for Third Quarter 2020 (percent difference)

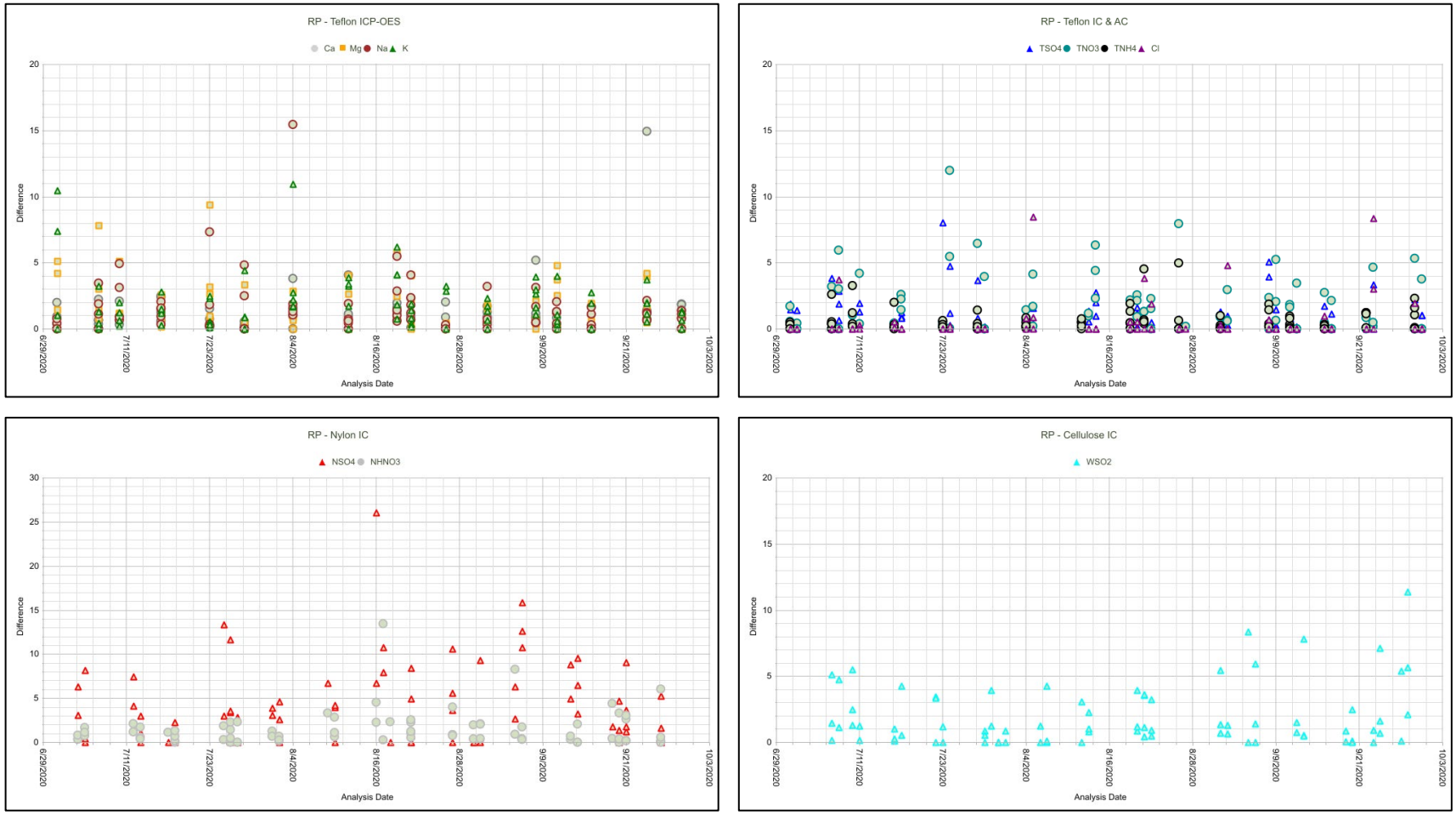

Figure 4 Laboratory Control Sample Results for Third Quarter 2020 (percent recovery)

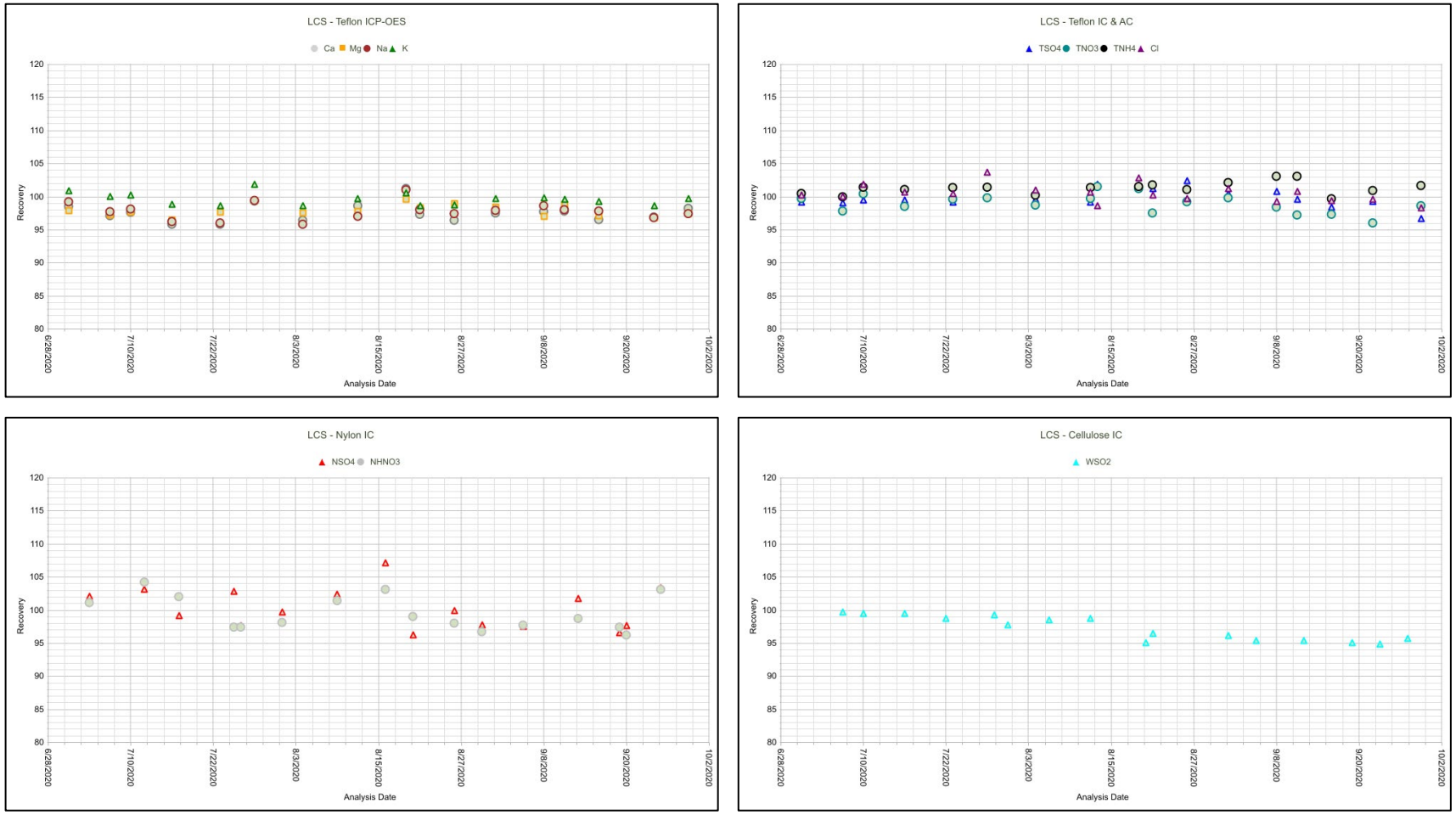

Figure 5 Method Blank Analysis Results for Third Quarter 2020 (total micrograms)

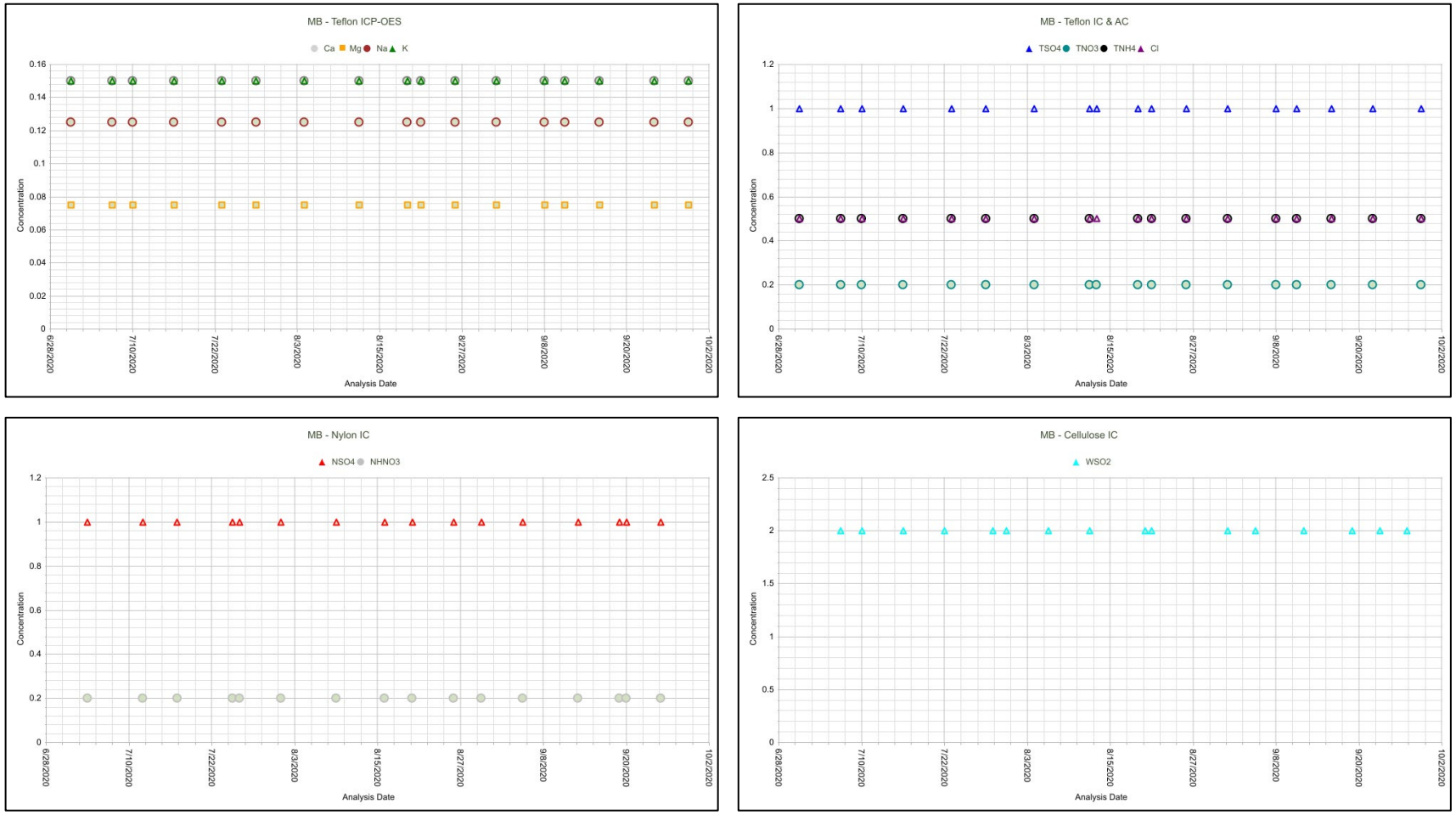

Figure 6 Laboratory Blank Analysis Results for Third Quarter 2020 (total micrograms)

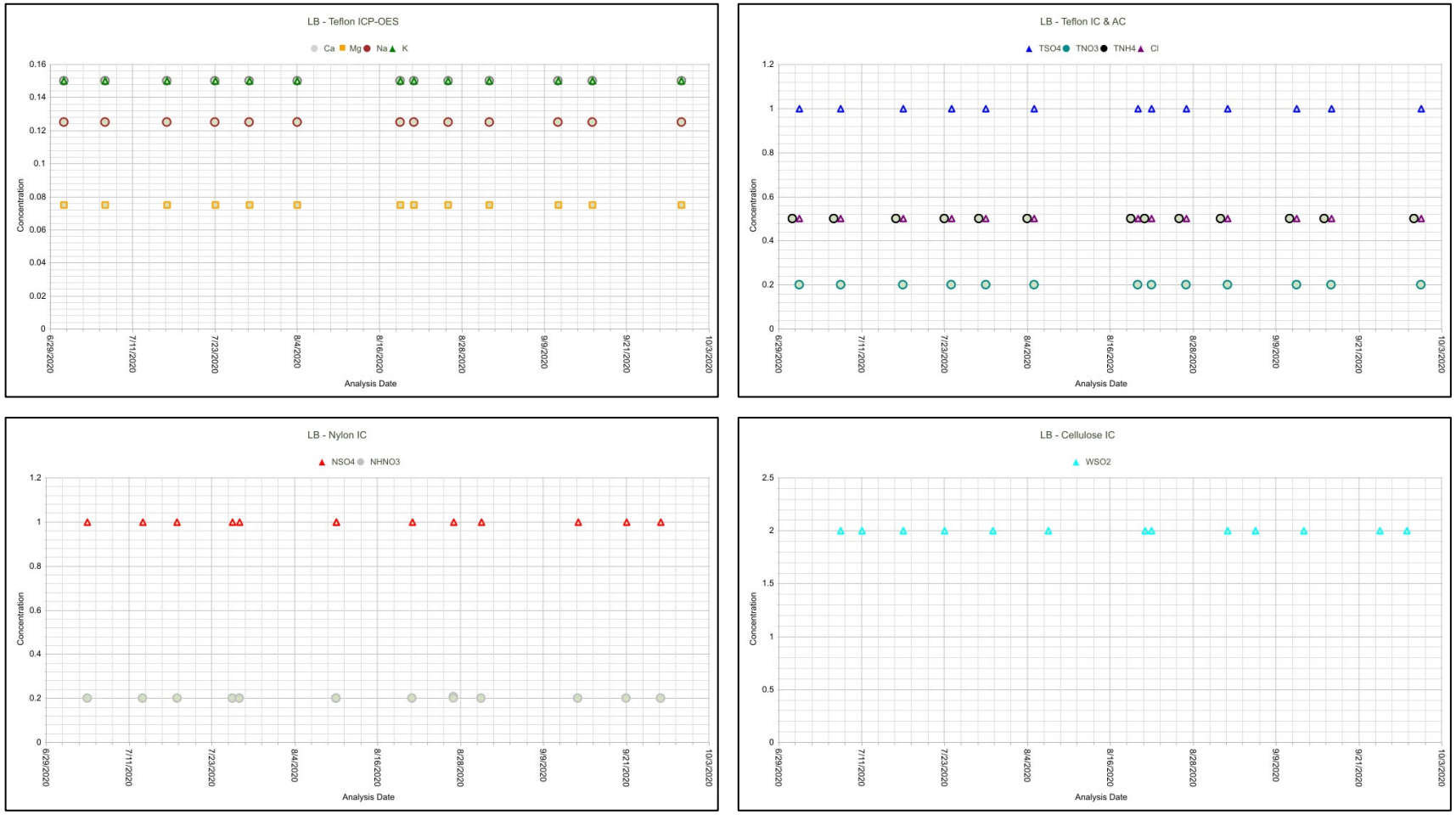

Figure 7 Field Blank Analysis Results for Third Quarter 2020 (total micrograms)