Summary of Quarterly Operations (April through June)

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 second quarter 2018. 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

Amec Foster Wheeler Environment & Infrastructure Inc.'s name change to Wood Environment & Infrastructure Solutions, Inc. became official with Contract Modification P00013, which was issued by EPA on May 24, 2018.

Filter pack receipt statistics continue to be routinely monitored. Corrective action has been initiated. If filter packs have not been received by Monday morning, members of the CASTNET management team are informed. At that time, the post office is contacted, and if delivery cannot be made within the required window, Wood personnel will pick up the filter packs. During second quarter 2018, filter pack return statistics improved by 3 percent as compared with first quarter results.

The final version of the CASTNET Quality Assurance Project Plan (QAPP) Revision 9.1 was submitted to EPA and uploaded to the EPA CASTNET web page. Beginning with Revision 9.1, the contact information for the site operators listed in Appendix 2 was not uploaded to the web page. Instead, a disclaimer was added to the cover page to indicate that the contents of the appendix are for authorized personnel only.

The GAS153, GA site failed an ozone performance evaluation audit by the State of Georgia due to a failing ozone sample pump. The failing pump would normally have been observed during routine review procedures. In this instance, the routine reviewer was on leave and covering assignments had been made for those review functions with this single exception. A corrective action was initiated to ensure backups are assigned for Wood reviewers and all of their designated review functions during personnel absences. The sample pump was replaced. The site was re-audited and passed the audit.

Review of filter pack analysis control charts during creation of the First Quarter 2017 QA Report indicated possible potassium and calcium contamination. A corrective action was initiated. During May 2018, the QA Manager and Laboratory Operations Manager began investigating possible sources of contamination. Opportunities for contamination can occur during the filter pack

loading/unloading and filter pack component cleaning processes. The QA Manager observed washing procedures and noted several steps were not being performed according to documented procedure. The technician handling the filter packs was re-trained, and his packing/unpacking and cleaning activities were observed to verify compliance. Additionally, a set of filter packs was prepared each week for testing as process blanks to verify the effectiveness of the actions taken. As of the end of June, the process blanks were not showing signs of contamination.

Wood's laboratory participated in the interlaboratory comparison program in support of the readiness verification plan to verify that the Wisconsin State Laboratory of Hygiene (WSLH) produces data of sufficient quality to detect and quantify trends in atmospheric chemistry. The WSLH will become the next National Atmospheric Deposition Program (NADP) Central Analytical Laboratory (WCAL). Thirty-two samples were analyzed by the Wood laboratory for the study.

Documentation needed for the annual review by the American Association for Laboratory Accreditation (A2LA) in order to maintain International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2005 accreditation for Wood's laboratory and field operations was prepared and submitted to A2LA. The documentation was subsequently accepted by A2LA, and Wood received notice that the 17025:2005 accreditation was reaffirmed until the routine A2LA assessment in spring 2019.

Preparation of the annual management review report in support of ISO/IEC 17025:2005 accreditation was completed, and the review report was provided to CASTNET management and QA personnel for review. The meeting to discuss the report will be held during third quarter.

MTL Corp continued to work with Wood to provide a pre-washed nylon filter that meets CASTNET acceptance criteria. After receiving recommendations from the CASTNET Laboratory Operations Manager, MTL agreed to make additional changes in its washing protocol. MTL fabricated a slotted tray for filter washing, but it did not function as expected, and the filters would not stay in the slots. The subsequent batch of filters that was washed by MTL without using a slotted tray or following all of the recommended steps did not pass CASTNET acceptance criteria. MTL ordered slotted trays similar to the trays used by Wood and modified its washing procedures. The filters washed using the slotted tray and modified washing procedures passed acceptance criteria. However, Wood will continue washing MTL nylon filters in-house until MTL demonstrates that it can reliably deliver an acceptable product in the quantities needed for the project.

Table 1 lists the quarters of data that were validated to Level 3 during second quarter 2018 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 second quarter 2018.

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 second quarter 2018.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for second quarter 2018. All results were within the criteria listed in Table 3.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during second quarter 2018. 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 second quarter 2018. 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. During second quarter, no values exceeded documented criteria or were otherwise notable.

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 second quarter 2018. All recovery values were between 93 percent and 110 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for second quarter 2018. All second quarter results were within criteria (two times the reporting limit) listed in Table 3 with the exception of several Teflon results[1]. Three Teflon LB results exceeded criteria. Two calcium values were between 2.0 and 4.0 times the reporting limit, and one potassium value was 2.5 times the reporting limit. Nineteen Teflon FB results exceeded criteria. Fifteen calcium values were between 2.0 and 4.0 times the reporting limit; two potassium values were 2.5 and 7.0 times the reporting limit, respectively; one sodium value was 2.5 times the reporting limit; and one magnesium value was 2.5 times the reporting limit.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during second quarter 2018 are listed in Table 11. This table also includes associated site identification and a brief description of the reason the sample was flagged. During second quarter, 10 filter pack samples were invalidated.

Field Problem Count

Table 12 presents counts of field problems affecting continuous data collection for more than one day for second quarter 2018. 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) formerly known as Amec Foster Wheeler Environment & Infrastructure, Inc. 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.

[1] All exceptions occurred prior to actions taken mid-May to address contamination issues.

Table 1 Data Validated to Level 3 during Second Quarter 2018

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-1/SE-5	August 2017 – January 2018	6	Quarter 4 2017	1
MW-7/W-9	September 2017 – February 2018	6	Quarter 4 2017	1
E-2/MW-8	October 2017 – March 2018	6	Quarter 4 2017 – Quarter 1 2018	2

Note: * The sites contained in each calibration group are listed in Table 2.

Table 2 Field Calibration Schedule for 2018

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 HOW191, ME	WST109, NH CAT175, NY HWF187, NY[2]	NIC001, 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 (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.
[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
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 Second Quarter 2018

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-}	55	206	84	18	26	96
	NO_3^-	55	206	84	18	26	96
	NH_4^+	34	180	84	17	26	96
	Cl^-	55	206	84	18	26	96
	Ca^{2+}	34	184	84	17	26	96
	Mg^{2+}	34	184	84	17	26	96
	Na^+	34	184	84	17	26	96
	K^+	34	184	84	17	26	96
Nylon	SO_4^{2-}	54	210	82	18	26	95
	NO_3^-	54	210	82	18	26	95
Cellulose	SO_4^{2-}	50	178	81	17	26	95

Table 7 Filter Pack Receipt Summary for Second Quarter 2018

Count of samples received more than 14 days after removal from tower:	15
Count of all samples received:	854
Fraction of samples received within 14 days:	0.982
Average interval in days:	4.933
First receipt date:	4/2/2018
Last receipt date:	6/29/2018

Table 8 Ozone QC Summary for Second Quarter 2018 (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	1.01	100.00	1.02	100.00	0.22
ALC188, TX	100.00	0.76	100.00	1.47	100.00	0.61
ALH157, IL	100.00	0.97	100.00	1.17	100.00	0.23
ANA115, MI	100.00	2.63	100.00	2.73	100.00	0.12
ARE128, PA	100.00	0.94	100.00	0.76	100.00	0.31
ASH135, ME	100.00	1.74	100.00	1.74	100.00	0.20
BEL116, MD	100.00	1.03	100.00	0.87	100.00	0.36
BFT142, NC	100.00	0.46	100.00	0.92	98.91	0.52
BVL130, IL	98.86	1.88	98.85	1.52	100.00	0.21
BWR139, MD	100.00	2.67	100.00	2.01	100.00	0.44
CAD150, AR	100.00	0.99	100.00	1.54	100.00	0.59
CDR119, WV	100.00	1.07	100.00	1.35	100.00	0.23
CDZ171, KY	100.00	1.33	100.00	1.70	100.00	0.14
CKT136, KY	100.00	0.62	100.00	0.57	100.00	0.15
CND125, NC	98.99	2.51	92.93	3.74	97.98	0.86
CNT169, WY	100.00	0.60	100.00	0.79	100.00	0.24
COW137, NC	100.00	0.74	100.00	1.01	100.00	0.24
CTH110, NY	100.00	1.78	100.00	1.21	100.00	0.45
CVL151, MS	98.91	3.01	100.00	1.37	100.00	0.19
DCP114, OH	100.00	1.23	100.00	1.77	100.00	0.24
ESP127, TN	100.00	1.05	100.00	1.56	100.00	0.57
GAS153, GA	100.00	1.89	96.88	3.70	96.88	1.76
GTH161, CO	100.00	1.86	100.00	1.97	100.00	0.14
HOX148, MI	100.00	2.26	100.00	1.27	100.00	0.53
HWF187, NY	100.00	1.52	98.91	1.67	100.00	0.16

Table 8 Ozone QC Summary for Second Quarter 2018 (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]
IRL141, FL	100.00	0.45	99.00	1.35	100.00	0.99
KEF112, PA	100.00	1.04	100.00	1.54	100.00	0.39
LRL117, PA	100.00	0.56	98.94	2.10	98.94	0.33
MCK131, KY	95.00	2.09	97.00	2.06	94.00	1.21
MCK231, KY	98.78	0.99	98.78	1.15	98.78	0.49
MKG113, PA	100.00	1.55	98.99	1.96	97.98	0.39
NPT006, ID	100.00	1.10	100.00	1.06	100.00	0.17
OXF122, OH	100.00	1.23	100.00	1.19	100.00	0.43
PAL190, TX	100.00	1.63	100.00	1.93	100.00	0.76
PAR107, WV	100.00	0.57	100.00	0.82	100.00	0.21
PED108, VA	100.00	0.87	100.00	0.85	100.00	0.27
PND165, WY	100.00	0.68	100.00	1.27	100.00	0.58
PNF126, NC	100.00	0.46	100.00	0.81	100.00	0.42
PRK134, WI	100.00	1.40	100.00	1.21	100.00	0.43
PSU106, PA	100.00	1.50	98.92	2.02	100.00	0.44
QAK172, OH	95.60	2.51	91.21	5.23	90.11	2.90
ROM206, CO	100.00	2.19	100.00	2.08	100.00	0.15
SAL133, IN	100.00	4.36	98.94	4.54	100.00	0.20
SAN189, NE	100.00	1.37	100.00	1.35	100.00	0.44
SND152, AL	98.17	2.56	90.83	4.53	88.89	2.08
SPD111, TN	100.00	0.74	100.00	0.78	96.74	0.63
STK138, IL	100.00	1.81	100.00	1.66	100.00	0.24
SUM156, FL	100.00	0.90	100.00	0.48	100.00	0.97
UVL124, MI	100.00	0.86	100.00	0.67	100.00	0.20
VIN140, IN	100.00	0.99	100.00	1.28	100.00	0.59
VPI120, VA	98.81	2.06	98.81	1.85	100.00	0.67
WSP144, NJ	100.00	1.60	95.70	2.26	95.70	1.33
WST109, NH	100.00	0.71	98.77	0.82	100.00	0.11

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 Second Quarter 2018

Site ID	QC Criterion	Comments
SND152, AL	% Zero Pass	The analyzer malfunctioned and was replaced 6/13/2018.

Note: %D = percent difference

Table 10 Trace-level Gas QC Summary for Second Quarter 2018

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	1.32	100.00	1.67	100.00	0.52
NO_y	100.00	2.64	100.00	2.09	100.00	1.00
CO	100.00	1.60	92.68	4.82	95.12	12.45
DUK008, NC[3]						
NO_y	100.00	2.53	100.00	3.66	100.00	0.93
HWF187, NY						
NO_y	100.00	1.12	100.00	1.56	100.00	0.31
PND165, WY						
NO_y	100.00	1.43	100.00	3.40	100.00	0.28
PNF126, NC						
NO_y	100.00	1.36	100.00	3.73	100.00	0.48
ROM206, CO						
NO_y	100.00	1.64	100.00	2.54	100.00	0.55

Notes: [1] Percentage of comparisons that pass the criteria listed in Table 5.

[2] Absolute value of the average percent differences between the supplied and observed concentrations.

[3] QC data were only available through June 1, 2018 because the data logger channels were left down. The subsequent QC check on July 11, 2018 was within criteria. June ambient data were collected and are available.

%D = percent difference
ppb = parts per billion

Table 11 Filter Packs Flagged as Suspect or Invalid during Second Quarter 2018

Site ID	Sample No.	Reason
BAS601, WY	1817005-01	Suspect values
BUF603, WY	1815005-02	Power outage
CKT136, KY	1817001-13 1818001-13	Suspect values
CTH110, NY	1815001-17	Suspect potassium value
EGB181, ON	1814001-21	Filter pack was not secure
GRS420, TN	1817003-11	Failed leak check
NIC001, NY	1814001-35	Power outage
UND002, VT	1818001-51	Power outage
WFM105, NY	1818001-55	Power outage

Table 12 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	515
60	34
90	3
Unresolved by End of Quarter	11

Figure 1 Reference Standard Results for Second Quarter 2018 (percent recovery)

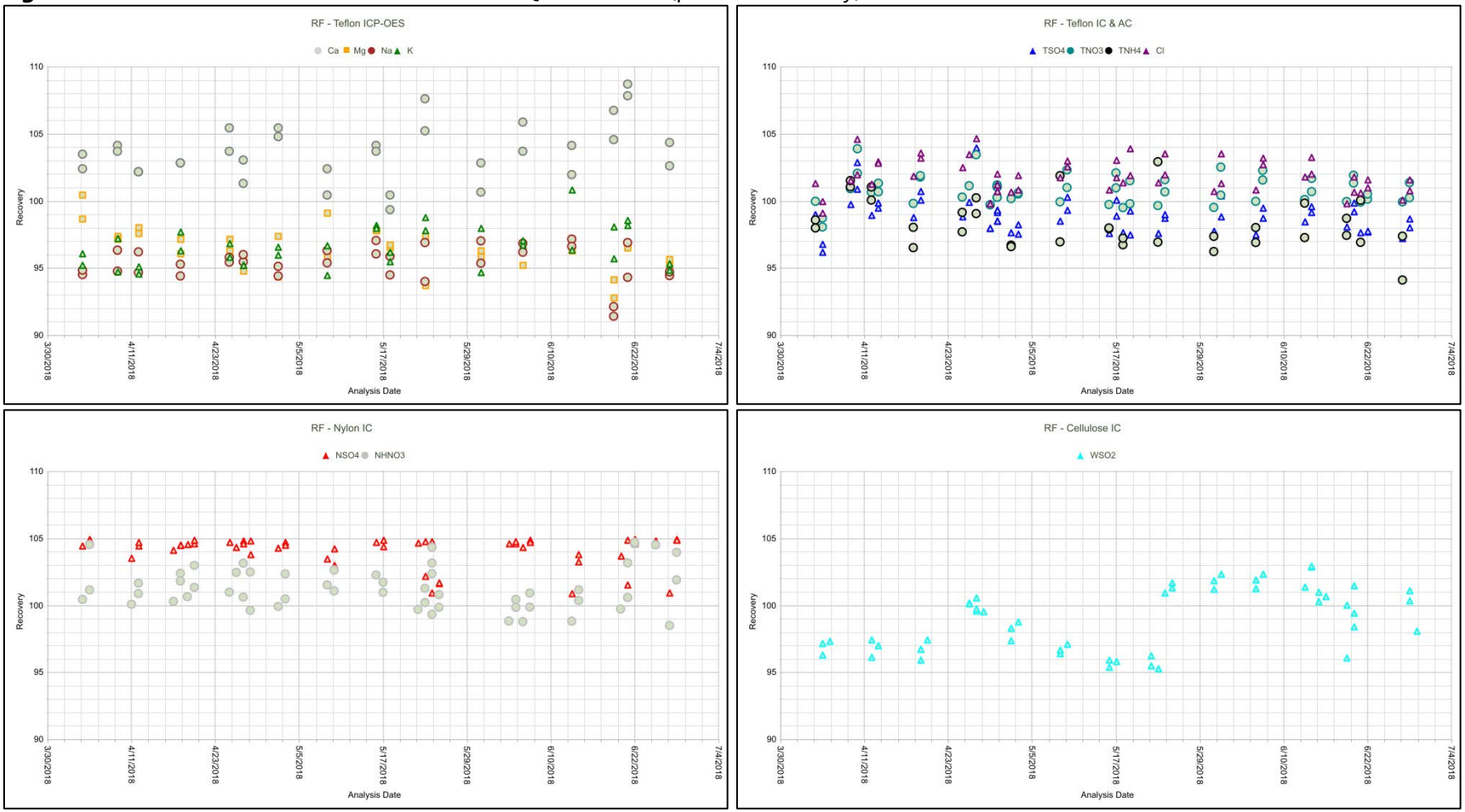

Figure 2 Continuing Calibration Spike Results for Second Quarter 2018 (percent recovery)

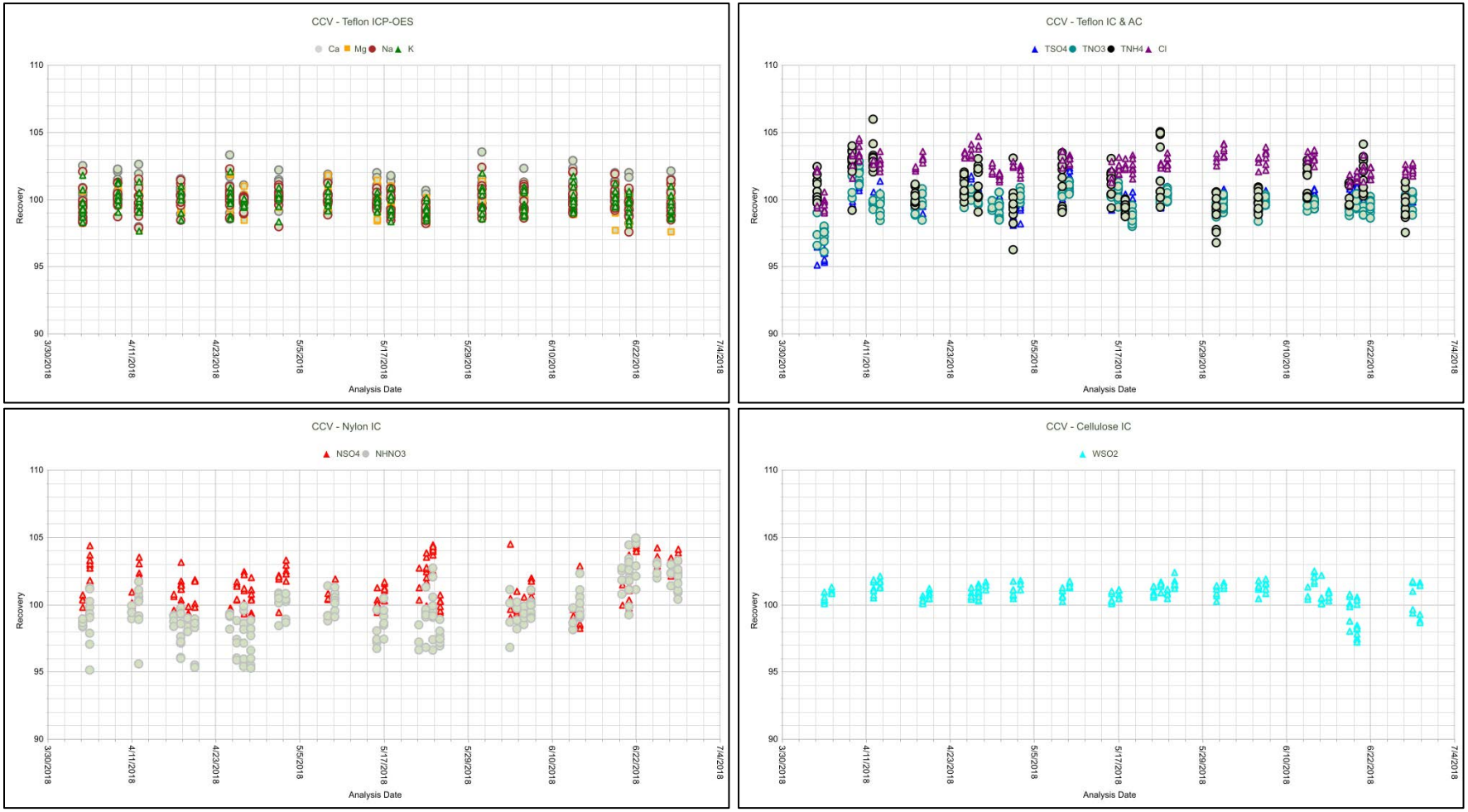

Figure 3 Replicate Sample Analysis Results for Second Quarter 2018 (percent difference)

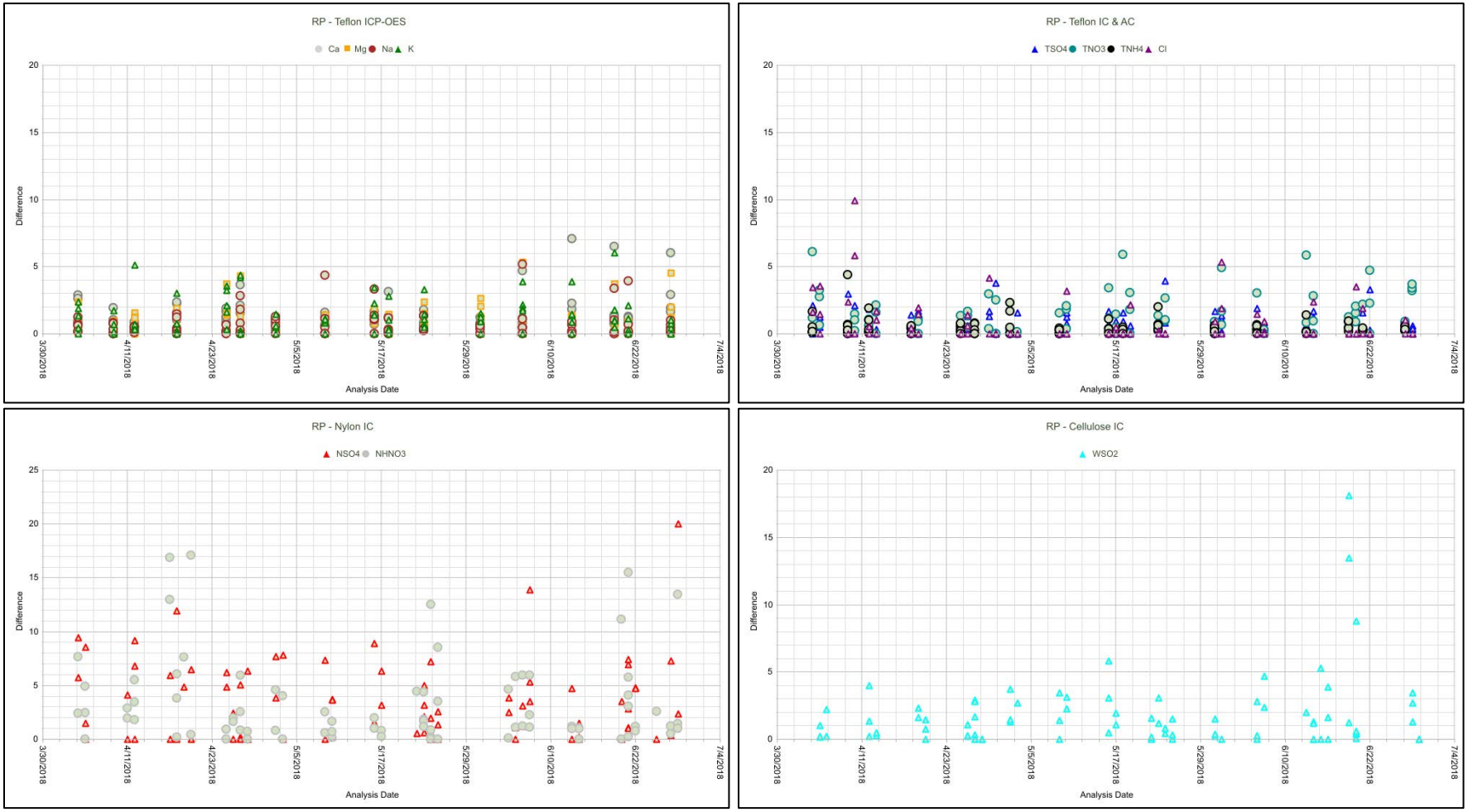

Figure 4 Laboratory Control Sample Results for Second Quarter 2018 (percent recovery)

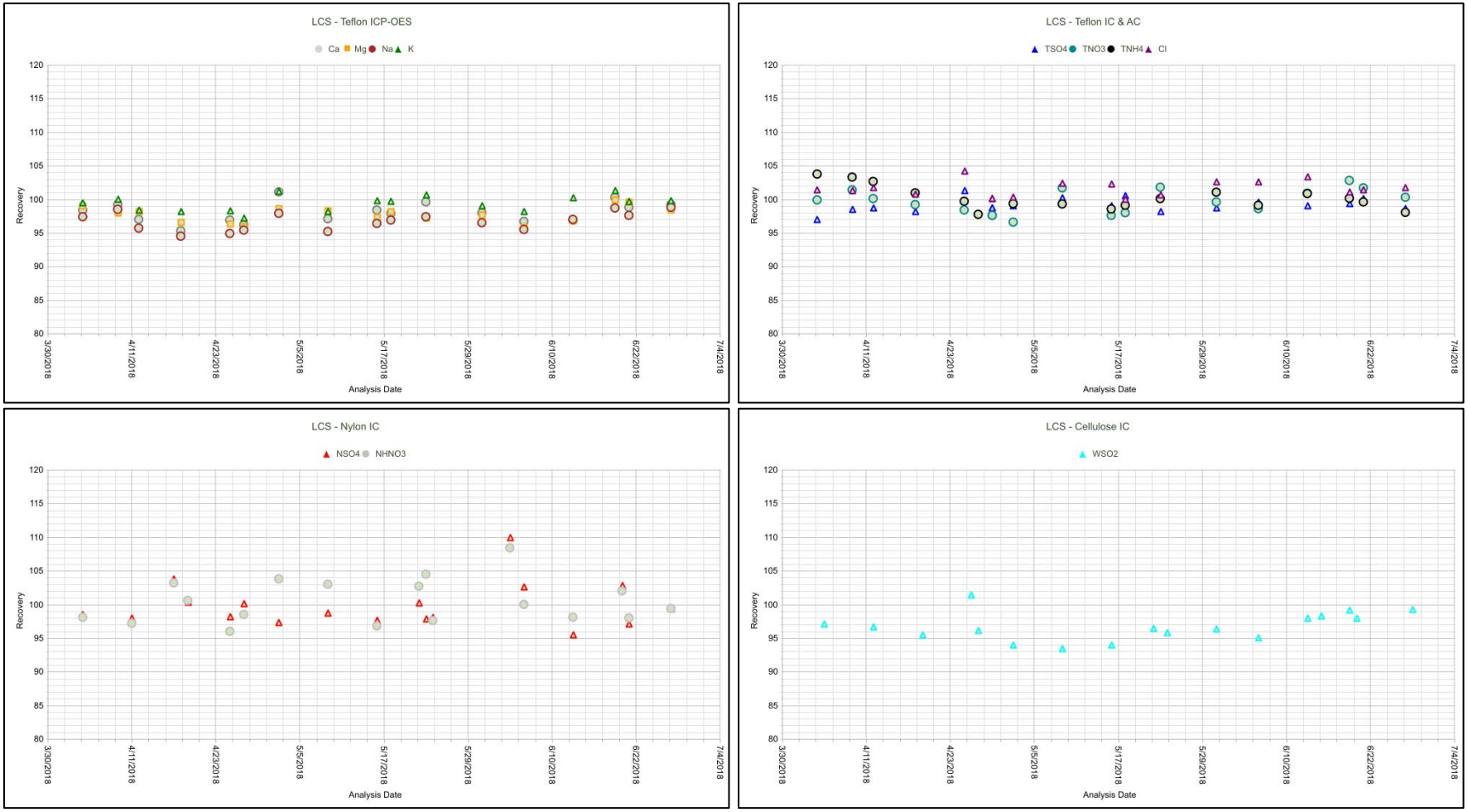

Figure 5 Method Blank Analysis Results for Second Quarter 2018 (total micrograms)

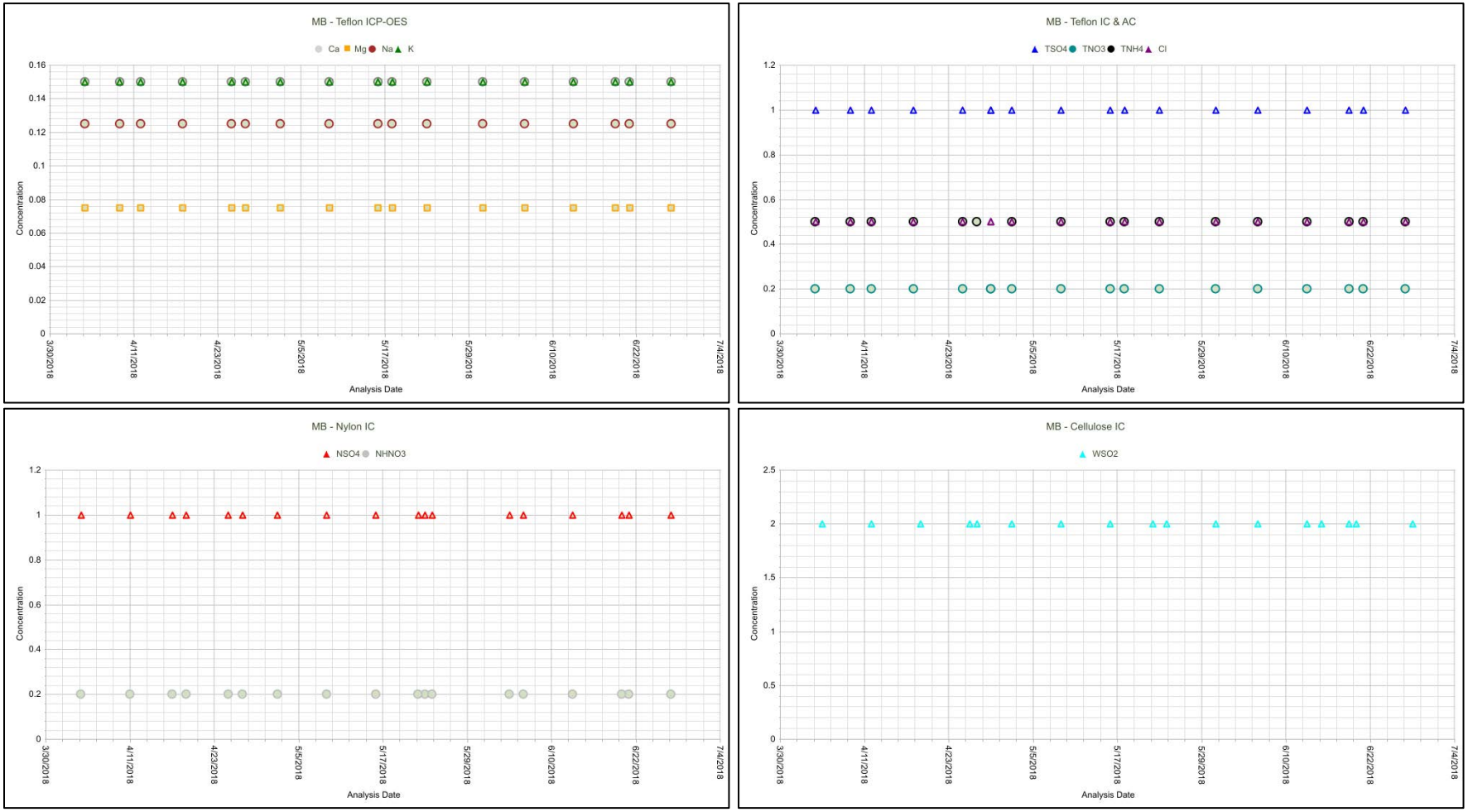

Figure 6 Laboratory Blank Analysis Results for Second Quarter 2018 (total micrograms)

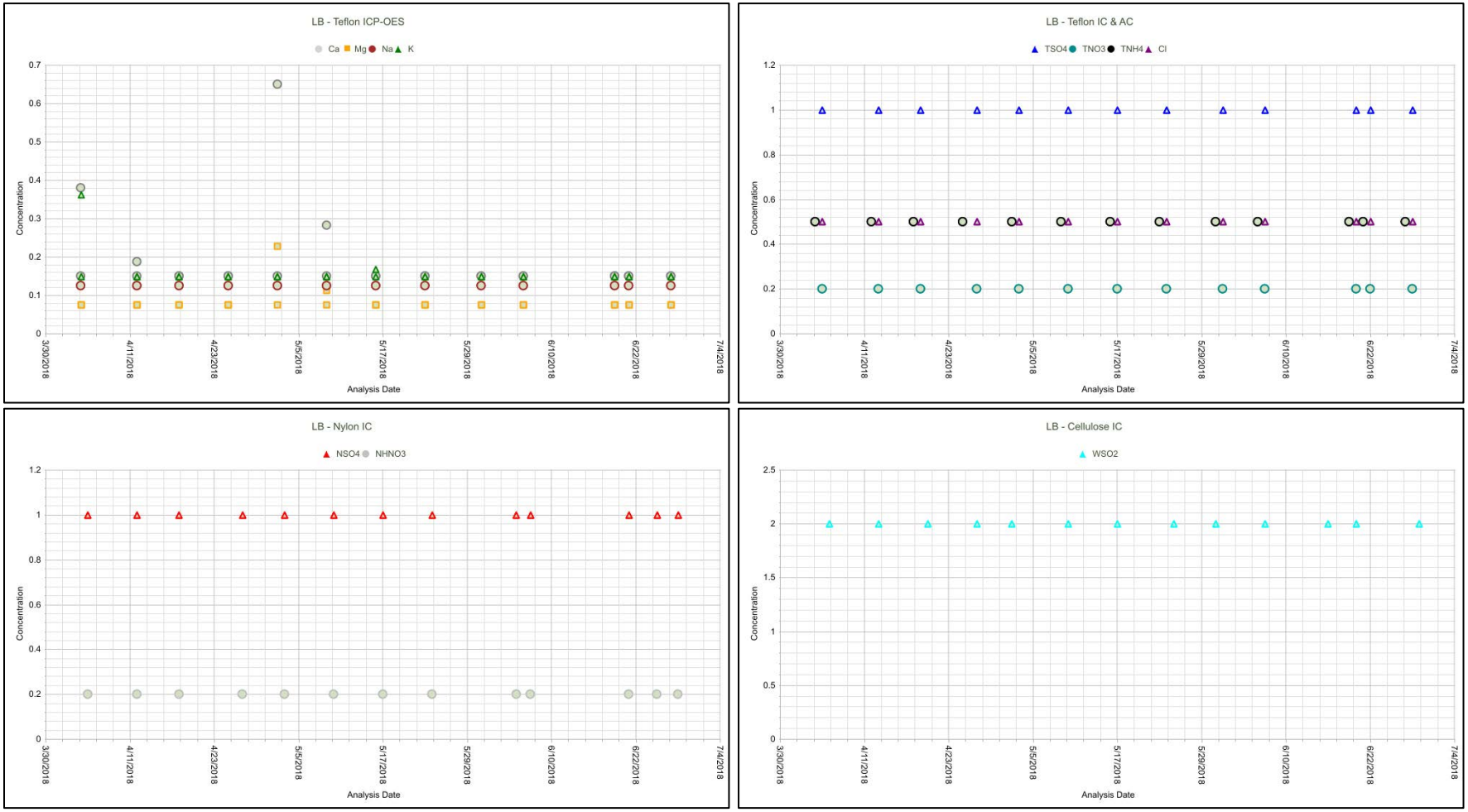

Figure 7 Field Blank Analysis Results for Second Quarter 2018 (total micrograms)