Summary of Quarterly Operations

EPA Contract No. EP-W-15-003

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 2015. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Amec Foster Wheeler, 2014). 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

On July 30, 2015, AMEC Environment and Infrastructure, Inc. (AMEC) received Modification 0006 to Contract EP-W-15-003 in which EPA accepted AMEC's name change to Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler).

The CASTNET QA Manager worked with EPA during the quarter to revise the CASTNET QAPP siting criteria to include siting criteria from Section 40 Code of Federal Regulations (CFR), Part 58 that specifically addresses ozone monitoring for Air Quality System (AQS)-submitting sites. Modifications to the QAPP siting criteria will include specific sets of criteria for the different types of sites: small-footprint, filter pack-only sites; AQS-submitting (i.e., 40 CFR Part 58-compliant) ozone sites; and classic sites.

Amec Foster Wheeler received final results from sample analyses for proficiency test (PT) study 106 for Rain and Soft Waters from the National Laboratory of Environmental Testing (NLET), a branch of the National Water Research Institute (NWRI) with Environment Canada that provides QA services. Amec Foster Wheeler was rated "very good" for analyses for PT study 106. Amec Foster Wheeler's 5-year average remained "very good," the highest rating available.

During second quarter, Amec Foster Wheeler determined that ozone concentration data from the ROM206, CO site showed concentrations have been 2 to 3 parts per billion (ppb) higher than those measured by the collocated ROM406 site since installation of the reactive oxides of

nitrogen (NO_y) analyzer at ROM206. During third quarter, Amec Foster Wheeler took steps to eliminate possible bias by placing all of the ozone analyzers at the trace-level gas monitoring sites on the standard zero air generation system used at CASTNET sites that do not measure trace-level gases.

EPA's Office of Air Quality Planning and Standards (OAQPS) requested that only ozone 1-point QC checks that are associated with valid data be submitted to AQS. EPA's Clean Air Markets Division (CAMD) and Amec Foster Wheeler began working on a plan to systematically exclude those 1-point QC checks that are associated with data that have been invalidated. The change in protocol for submitting 1-point QC checks will begin with the January 2015 ozone data.

Road construction is planned during the warm season over the next two years near the PND165, WY site. Road construction activities began during third quarter and are anticipated to affect monitoring activities at the site. Amec Foster Wheeler is working with EPA, the National Park Service, and the Bureau of Land Management to develop a flagging protocol for data collected during active road construction periods.

The CASTNET QA Manager is working with RTI International, Inc. to coordinate the required 3-year technical systems audit (TSA) of the Amec Foster Wheeler ozone facility and one field site (PED108,VA). The TSA will take place during fourth quarter 2015.

Table 1 lists the quarters of data that were validated to Level 3 during third quarter 2015 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 2015.

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 2015.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for third quarter 2015. All results were within the criteria listed in Table 3.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during third quarter 2015. 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 affect 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 2015. 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 affect 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 2015. All recovery values were between 90 percent and 105 percent.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for third quarter 2015. All third quarter results were within criteria (two times the reporting limit) listed in Table 3 with the exception of a single potassium FB. All other QC data associated with this FB were within criteria including the laboratory MB samples. Investigation has not revealed the

cause for this result. Preventive action has been initiated to eliminate possible routes of contamination including purchase and installation of an enclosure for the inductively coupled plasma-optical emission spectrometer autosampler.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during third quarter 2015 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, nine filter pack samples were invalidated. Data for several of these samples are at Level 2 validation and may be recovered during Level 3 validation.

Field Problem Count

Table 13 presents counts of field problems affecting continuous data collection for more than one day for third quarter 2015. The problem counts are sorted by a 30-, 60-, or 90-day time period to resolution. A category for unresolved problems is also included. Time to resolution indicates the period taken to implement corrective action.

References

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler). 2014. *Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 8.2*. Prepared for U.S. Environmental Protection Agency (EPA), Office of Air and Radiation, Clean Air Markets Division, Washington, DC. Contract No. EP-W-15-003. Gainesville, FL. http://java.epa.gov/castnet/documents.do.

American Society for Testing and Materials (ASTM). 2008. *ASTM E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*. ASTM International, West Conshohocken, PA, DOI:10.1520/E0029-08. www.astm.org.

U.S. Environmental Protection Agency (EPA). 2015. Appendix A to Part 58 – Quality Assurance Requirements for State and Local Air Monitoring Stations (SLAMS), Special Purpose Monitors (SPMs), and Prevention of Significant Deterioration (PSD) Air Monitoring. 40 *CFR* Part 58.

Table 1 Data Validated to Level 3 during Third Quarter 2015

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-3/W-10†	November 2014 – April 2015	6	Quarter 1 2015	1
SE-4/MW-6‡	January 2015 – June 2015	6	Quarter 1 2015 – Quarter 2 2015	2

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

Table 2 Field Calibration Schedule for 2015

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (24 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 (11 Sites)	April/October	ABT147, CT ASH135, ME HOW191, ME	WST109, NH CAT175, NY HWF187, NY	NIC001, NY WFM007, NY WFM105, NY	EGB181, ON UND002, VT
E-3 (5 Sites)	May/November	KEF112, PA MKG113, PA	LRL117, PA PAR107, WV	CDR119, WV	
Southeastern Sites (11 Total)					
SE-4 (7 Sites)	January/July	SND152, AL GAS153, GA	BFT142, NC CND125, NC	COW005, NC COW137, NC	SPD111, TN
SE-5 (4 Sites)	February/August	CAD150, AR CVL151, MS	IRL141, FL SUM156, FL		
Midwestern Sites (19 Total)					
MW-6 (6 Sites)	January/July	CDZ171, KY CKT136, KY	MCK131, KY MCK231, KY	PNF126, NC ESP127, TN	
MW-7 (9 Sites)	March/September	ALH157, IL BVL130, IL 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 (10 Total)					
W-9 (5 Sites)	March/September	KNZ184, KS KIC003, KS	CHE185, OK SAN189, NE	ALC188, TX	
W-10 (5 Sites)	May/November	GTH161, CO ROM206, CO	CNT169, WY PND165, WY	PAL190, TX	

Table 3 Data Quality Indicators for CASTNET Laboratory Measurements

Analyte	Method	Precision[1] (MARPD)	Accuracy[2] (%)	Nominal Reporting Limits	
				mg/L	µg/Filter
Ammonium (NH_4^+)	AC	20	90 - 110	0.020*	0.5
Sodium (Na^+)	ICP-OES	20	95 - 105	0.005	0.125
Potassium (K^+)	ICP-OES	20	95 - 105	0.006	0.15
Magnesium (Mg^{2+})	ICP-OES	20	95 - 105	0.003	0.075
Calcium (Ca^{2+})	ICP-OES	20	95 - 105	0.006	0.15
Chloride (Cl^-)	IC	20	95 - 105	0.020	0.5
Nitrate (NO_3^-)	IC	20	95 - 105	0.008*	0.2
Sulfate (SO_4^{2-})	IC	20	95 - 105	0.040	1.0

Notes: [1] This column lists precision goals for both network precision calculated from collocated filter samples and laboratory precision based on replicate samples.

[2] This column lists laboratory accuracy goals based on reference standards and continuing calibration verification spikes. The criterion is 90–110 percent for ICP-OES reference standards.

AC = automated colorimetry
IC = ion chromatography
ICP-OES = inductively coupled plasma-optical emission spectrometry
MARPD = mean absolute relative percent difference
mg/L = milligrams per liter
µg/Filter = micrograms per filter
* = as nitrogen

Values are rounded according to American Society for Testing and Materials (ASTM) E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (ASTM, 2008).

For more information on analytical methods and associated precision and accuracy criteria, see the CASTNET QAPP, (Amec Foster Wheeler, 2014).

Table 4 Ozone Critical Criteria*

Type of Check	Analyzer Response
Zero	Less than ± 3 parts per billion (ppb)
Span	Less than or equal to ± 7 percent between supplied and observed concentrations
Single Point QC	Less than or equal to ± 7 percent between supplied and observed concentrations

Notes: * Applies to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the Code of Federal Regulations (EPA, 2015). The minimum frequency for these checks is once every two weeks.

Values are rounded according to ASTM E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications (ASTM, 2008).

Table 5 Trace-level Gas Monitoring Critical Criteria*

Parameter	Analyzer Response	
	Zero Check	Span Check / Single Point QC Check
SO_2	Less than ± 3 ppb	Less than or equal to ± 10 percent between supplied and observed concentrations
NO_y	Less than ± 3 ppb	
CO	Less than ± 40 ppb	

Notes: *Applies to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the Code of Federal Regulations (EPA, 2015). The minimum frequency for these checks is once every two weeks.

Values are rounded according to ASTM E29-08, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications E29 (ASTM, 2008).

SO_2 = sulfur dioxide
NO_y = total reactive oxides of nitrogen
CO = carbon monoxide
ppb = parts per billion

Table 6 QC Analysis Count for Third Quarter 2015

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-}	51	196	82	18	26	94
	NO_3^-	51	196	82	18	26	94
	NH_4^+	36	179	81	18	26	94
	Cl^-	51	196	82	18	26	94
	Ca^{2+}	36	181	82	18	26	94
	Mg^{2+}	36	181	82	18	26	94
	Na^+	36	181	82	18	26	94
	K^+	36	181	82	18	26	94
Nylon	SO_4^{2-}	41	182	80	20	26	94
	NO_3^-	53	194	86	26	26	100
Cellulose	SO_4^{2-}	37	182	82	18	26	94

Table 7 Filter Pack Receipt Summary for Third Quarter 2015

Count of samples received more than 14 days after removal from tower:	11
Count of all samples received:	832
Fraction of samples received within 14 days:	0.987
Average interval in days:	4.993
First receipt date:	07/01/2015
Last receipt date:	09/30/2015

Table 8 Ozone QC Summary for Third Quarter 2015 (1 of 2)

Site ID	% Span Pass[1]	Span |%D |[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	Single Point QC CL[3]	% Zero Pass[1]	Zero Average (ppb)[2]
ABT147, CT	100.00	1.85	98.95	1.81	0.22	100.00	0.24
ALC188, TX	96.59	3.08	93.18	2.46	0.74	97.73	1.47
ALH157, IL	96.84	3.66	97.89	2.70	1.14	98.91	0.49
ANA115, MI	100.00	1.22	98.95	0.92	0.19	100.00	0.16
ARE128, PA	100.00	1.33	100.00	1.22	0.20	100.00	0.28
ASH135, ME	100.00	1.86	100.00	1.66	0.10	100.00	0.21
BEL116, MD	96.63	2.83	92.13	4.17	0.50	100.00	1.27
BFT142, NC	97.96	1.59	95.92	1.62	0.42	100.00	0.42
BVL130, IL	97.80	3.85	97.73	5.16	2.05	97.75	1.91
BWR139, MD	100.00	2.18	100.00	2.83	0.20	100.00	0.22
CAD150, AR	100.00	1.50	100.00	1.08	0.25	100.00	0.43
CDR119, WV	94.19	3.93	90.59	3.91	0.32	100.00	0.49
CDZ171, KY	100.00	0.78	100.00	0.68	0.07	100.00	0.14
CKT136, KY	100.00	0.69	100.00	1.05	0.10	100.00	0.12
CND125, NC	98.94	1.82	100.00	1.13	0.15	100.00	0.15
CNT169, WY	100.00	1.92	100.00	2.10	0.23	100.00	0.56
COW137, NC	84.47	13.85	84.47	14.76	5.40	100.00	0.52
CTH110, NY	100.00	2.23	100.00	2.67	0.34	100.00	0.41
CVL151, MS	100.00	1.03	100.00	0.87	0.25	100.00	0.27
DCP114, OH	100.00	1.99	98.84	1.99	0.28	100.00	0.41
ESP127, TN	100.00	1.40	100.00	1.33	0.13	100.00	0.12
GAS153, GA	100.00	0.47	100.00	0.51	0.09	100.00	0.43
GTH161, CO	100.00	1.28	100.00	1.08	0.16	100.00	0.26

Table 8 Ozone QC Summary for Third Quarter 2015 (2 of 2)

Site ID	% Span Pass[1]	Span |%D |[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	Single Point QC CL[3]	% Zero Pass[1]	Zero Average (ppb)[2]
HOX148, MI	100.00	1.20	100.00	0.70	0.13	100.00	0.63
HWF187, NY	100.00	0.43	100.00	0.61	0.12	100.00	0.32
IRL141, FL	100.00	2.19	98.95	1.82	0.29	100.00	1.02
KEF112, PA	100.00	0.71	100.00	0.93	0.18	100.00	0.44
LRL117, PA	100.00	1.21	100.00	0.73	0.17	100.00	0.28
MCK131, KY	98.91	2.85	98.91	2.99	0.26	100.00	0.66
MCK231, KY	97.98	2.20	95.96	3.03	0.28	100.00	0.76
MKG113, PA	100.00	0.95	97.92	1.21	0.28	100.00	0.44
OXF122, OH	100.00	3.25	95.65	4.21	0.55	100.00	0.80
PAL190, TX	100.00	2.73	100.00	3.44	0.14	100.00	0.49
PAR107, WV	98.00	2.38	99.00	2.15	0.22	98.00	1.15
PED108, VA	100.00	2.49	98.96	2.76	0.21	100.00	0.42
PND165, WY	100.00	0.76	100.00	2.57	0.18	100.00	1.48
PNF126, NC	100.00	1.17	100.00	1.56	0.24	100.00	0.56
PRK134, WI	100.00	2.51	98.96	2.05	0.28	100.00	0.33
PSU106, PA	100.00	1.26	100.00	1.49	0.21	100.00	0.15
QAK172, OH	98.98	2.40	98.97	1.58	0.35	100.00	0.40
ROM206, CO	100.00	1.26	100.00	1.69	0.14	100.00	0.19
SAL133, IN	100.00	1.38	97.89	1.45	0.29	100.00	0.28
SAN189, NE	100.00	1.31	100.00	1.04	0.07	100.00	0.11
SND152, AL	100.00	1.81	98.92	2.22	0.22	100.00	0.31
SPD111, TN	100.00	1.79	98.96	2.01	0.22	100.00	0.51
STK138, IL	100.00	1.37	100.00	1.07	0.23	100.00	0.47
SUM156, FL	98.92	1.80	100.00	1.43	0.12	100.00	0.39
UVL124, MI	100.00	0.59	100.00	0.76	0.13	100.00	0.15
VIN140, IN	100.00	1.58	100.00	1.45	0.21	100.00	0.35
VPI120, VA	100.00	0.85	100.00	0.93	0.10	100.00	0.35
WSP144, NJ	98.95	1.76	100.00	1.76	0.21	100.00	0.69
WST109, NH	100.00	1.57	98.91	1.72	0.29	100.00	0.43

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.

[3] 90 percent confidence limit of the coefficient of variation. This should be less than or equal to the 7 percent single point QC check critical criterion. Values exceeding this criterion are addressed in Table 9.

%D = percent difference
CL = confidence limit
ppb = parts per billion

Table 9 Ozone QC Observations for Third Quarter 2015

Site ID	QC Criterion	Comments
COW137, KY	% Span Pass Span |%D | % Single Point QC Pass Single Point QC |%D|	The analyzer sample pump failed and was subsequently replaced in early September. Associated data were invalidated.

Note: %D = percent difference

Table 10 Trace-level Gas QC Summary for Third Quarter 2015

Parameter	% Span Pass[1]	Span |%D |[2]	% Single Point QC Pass[1]	Single Point QC |%D|[2]	Single Point QC CL[3]	% Zero Pass[1]	Zero Average (ppb)[2]
BEL116, MD							
SO_2	92.31	9.87	94.87	7.82	5.89	100.00	0.74
NO_y	80.43	14.33	84.21	8.96	5.85	97.50	1.30
BVL130, IL							
SO_2	93.33	7.48	93.33	9.53	6.35	100.00	0.97
NO_y	100.00	2.65	100.00	4.98	0.53	100.00	0.96
CO	100.00	0.84	78.26	6.65	1.89	91.67	18.64
HWF187, NY							
NO_y	100.00	1.75	100.00	1.69	0.38	97.78	1.30
PND165, WY							
NO_y	100.00	3.64	100.00	2.76	0.42	100.00	0.74
PNF126, NC							
NO_y	84.78	4.43	89.13	4.26	1.17	100.00	0.65
ROM206, CO							
NO_y	100.00	0.30	100.00	0.97	0.19	100.00	1.72

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.

[3] 90 percent confidence limit of the coefficient of variation. This should be less than or equal to the 10 percent single point QC check critical criterion. Values exceeding this criterion are addressed in Table 11.

%D = percent difference
CL = confidence limit
ppb = parts per billion

Table 11 Trace-level Gas QC Observations for Third Quarter 2015

Site ID	Parameter	QC Criterion	Comments
BEL116, MD	NO_y	% Span Pass Span |%D | % Single Point QC Pass	A solenoid switch failed during September. Associated data were invalidated.
BVL130, IL	CO	% Single Point QC Pass	Instrument calibration settings drifted. The analyzer was remotely calibrated. Associated data were invalidated.
PNF126, NC	NO_y	% Span Pass % Single Point QC Pass	Instrument calibration settings drifted. The analyzer was remotely calibrated. Associated data were invalidated.

Notes: %D = percent difference

Table 12 Filter Packs Flagged as Suspect or Invalid during Third Quarter 2015

Site ID	Sample No.	Reason
BEL116, MD	1533001-09	Insufficient flow volume
CAD150, AR	1530001-13	Insufficient flow volume
DCP114, OH	1537001-26	Power failure resulted in insufficient flow volume
FOR605, WY	1531003-03	Insufficient flow volume
JOT403, CA	1531001-42	Insufficient flow volume
PNF126, NC	1531001-61	Power failure resulted in insufficient flow volume
PSU106, PA	1536001-63	Insufficient flow volume
SHN418, VA	1536001-71	Insufficient flow volume
VIN140, IN	1536001-80	Insufficient flow volume

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	337
60	15
90	3
Unresolved by End of Quarter	24

Figure 1 Reference Standard Results for Third Quarter 2015 (percent recovery)

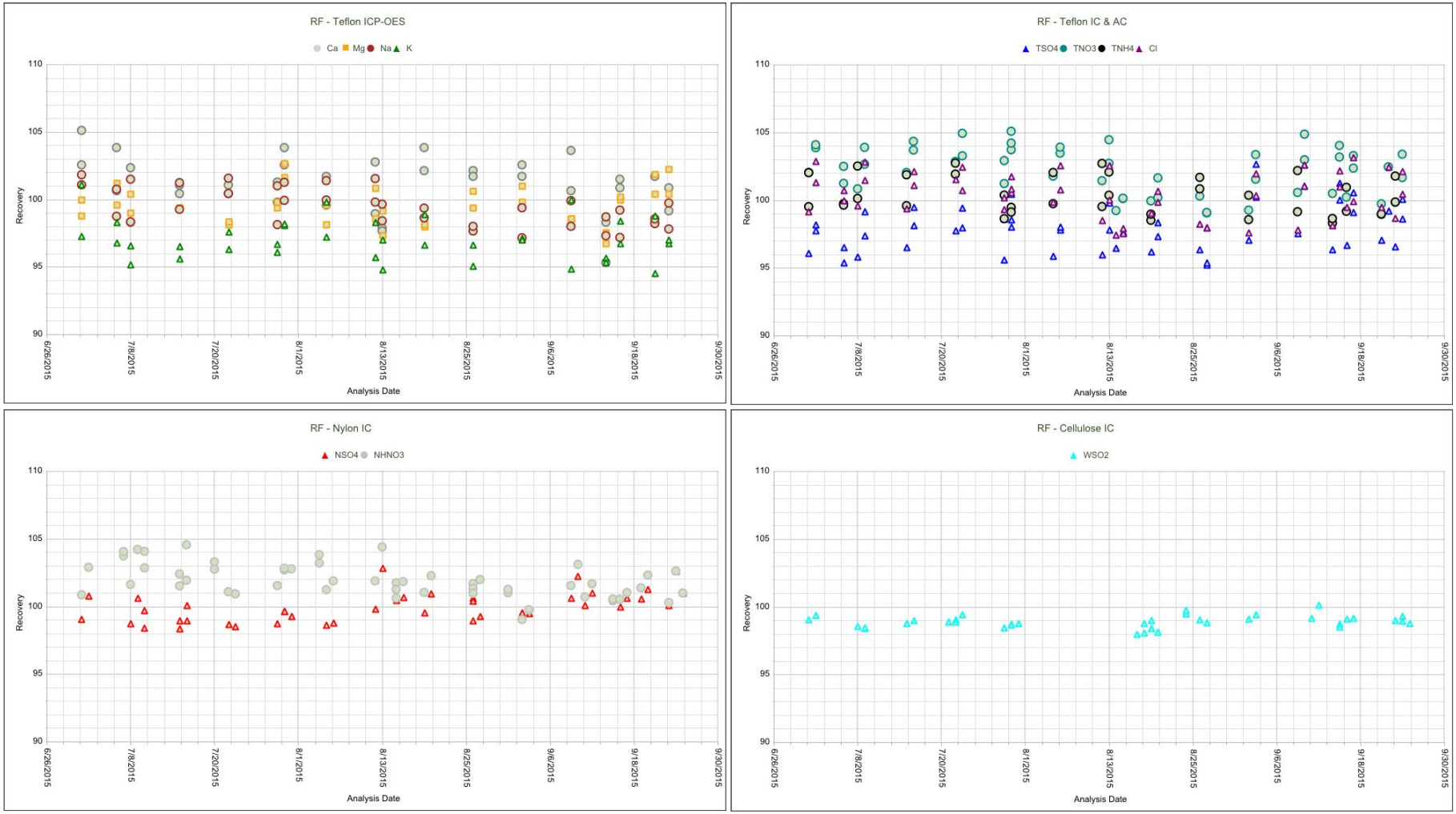

Figure 2 Continuing Calibration Spike Results for Third Quarter 2015 (percent recovery)

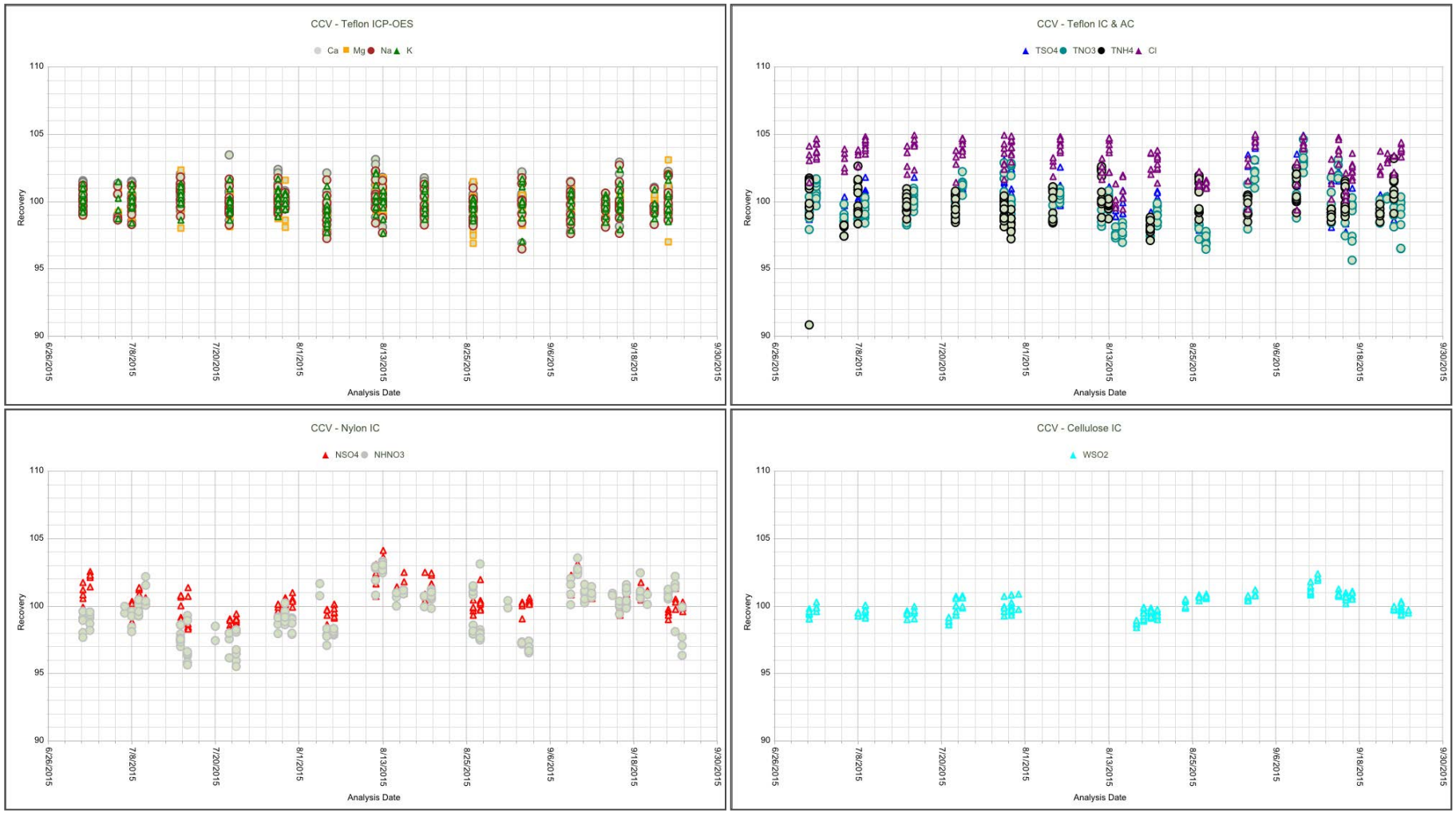

Figure 3 Replicate Sample Analysis Results for Third Quarter 2015 (percent difference)

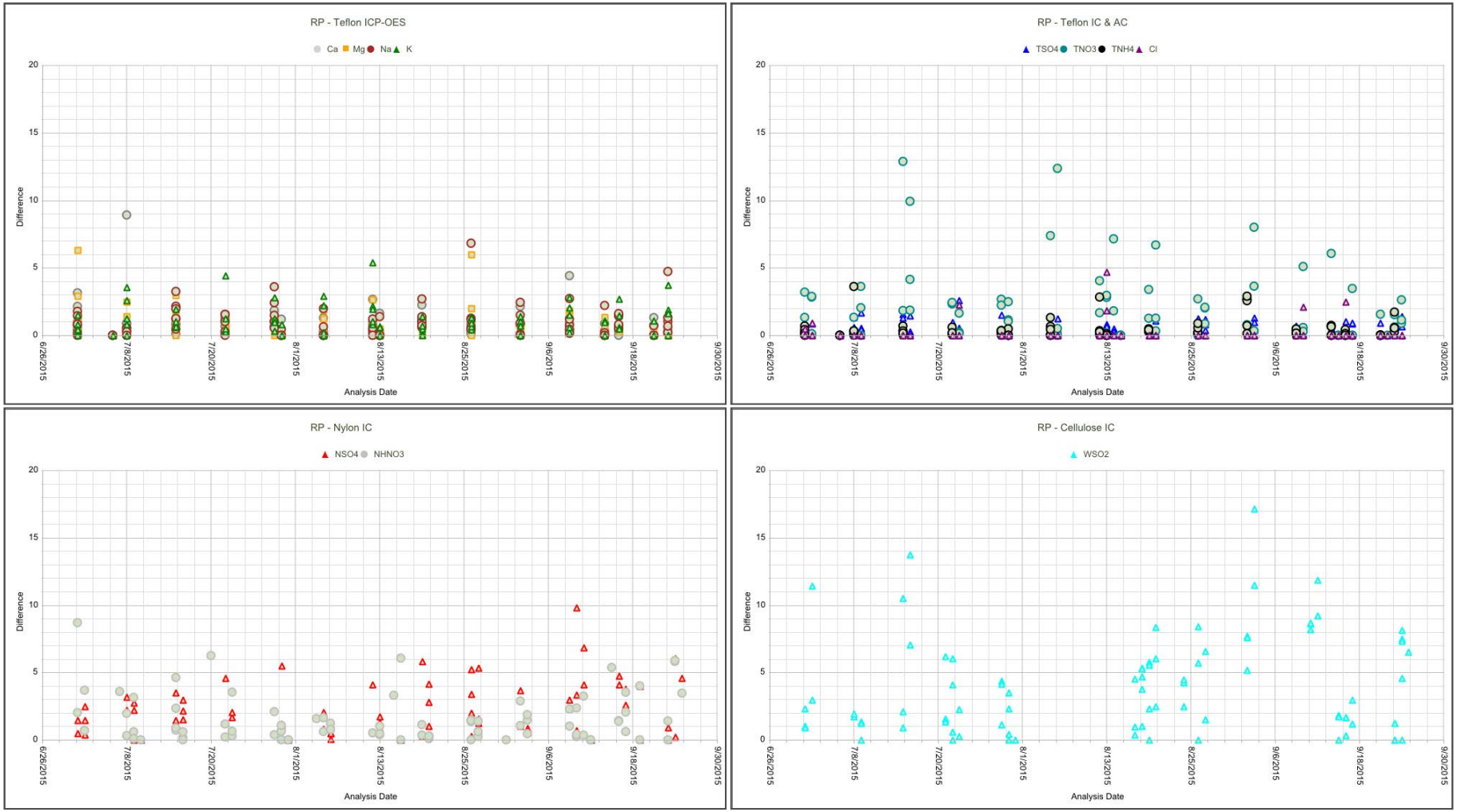

Figure 4 Laboratory Control Sample Results for Third Quarter 2015 (percent recovery)

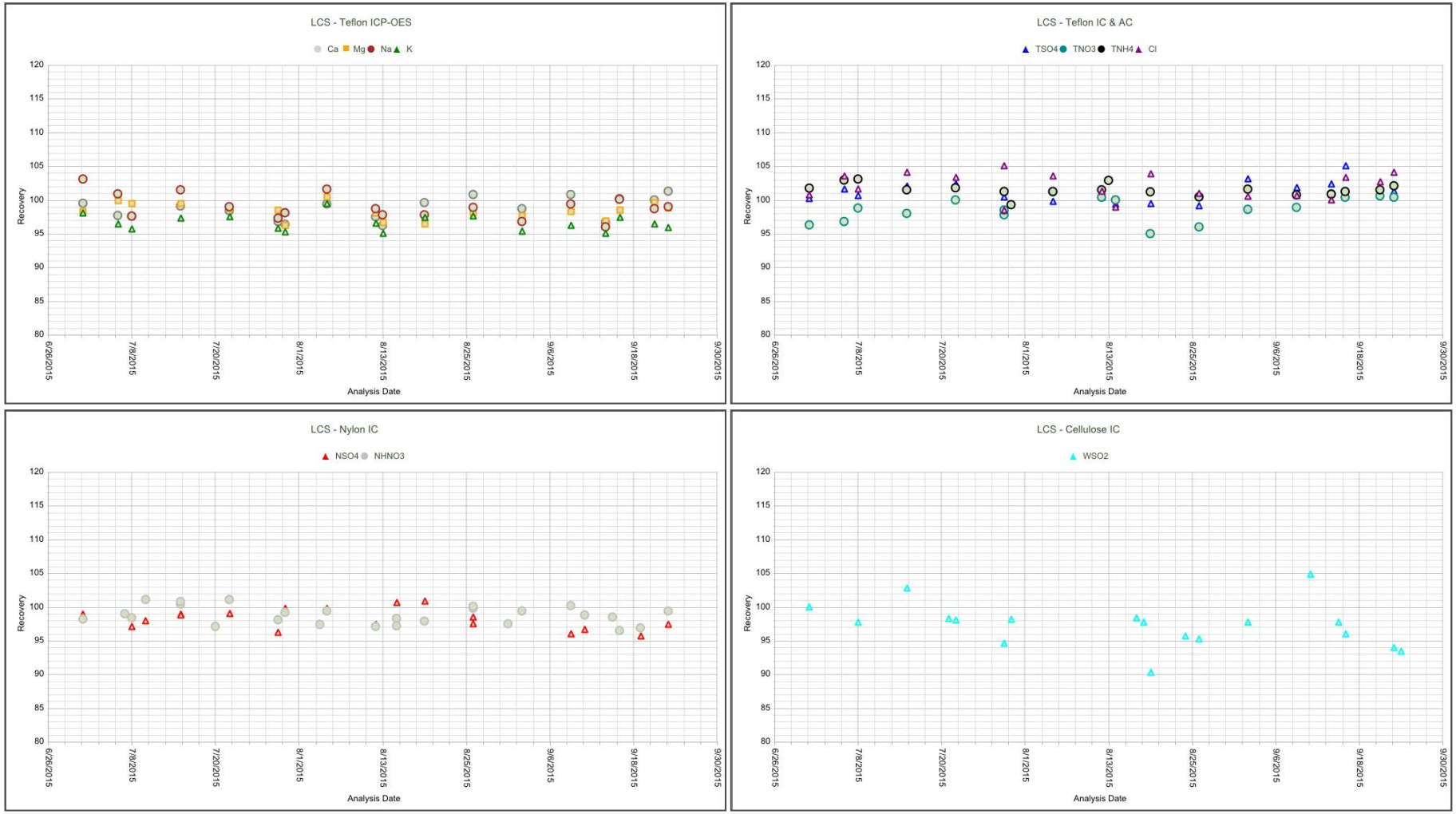

Figure 5 Method Blank Analysis Results for Third Quarter 2015 (total micrograms)

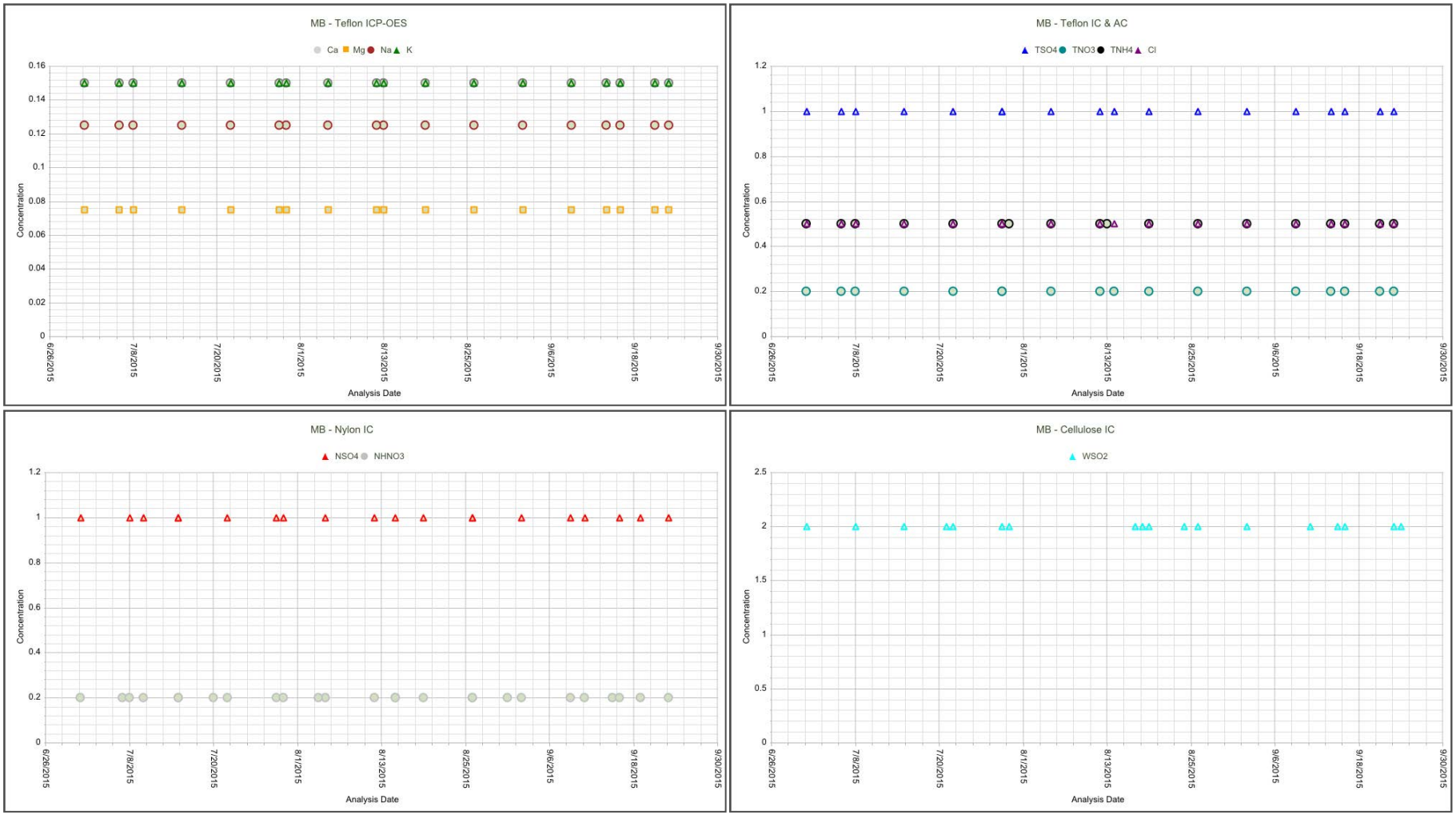

Figure 6 Laboratory Blank Analysis Results for Third Quarter 2015 (total micrograms)

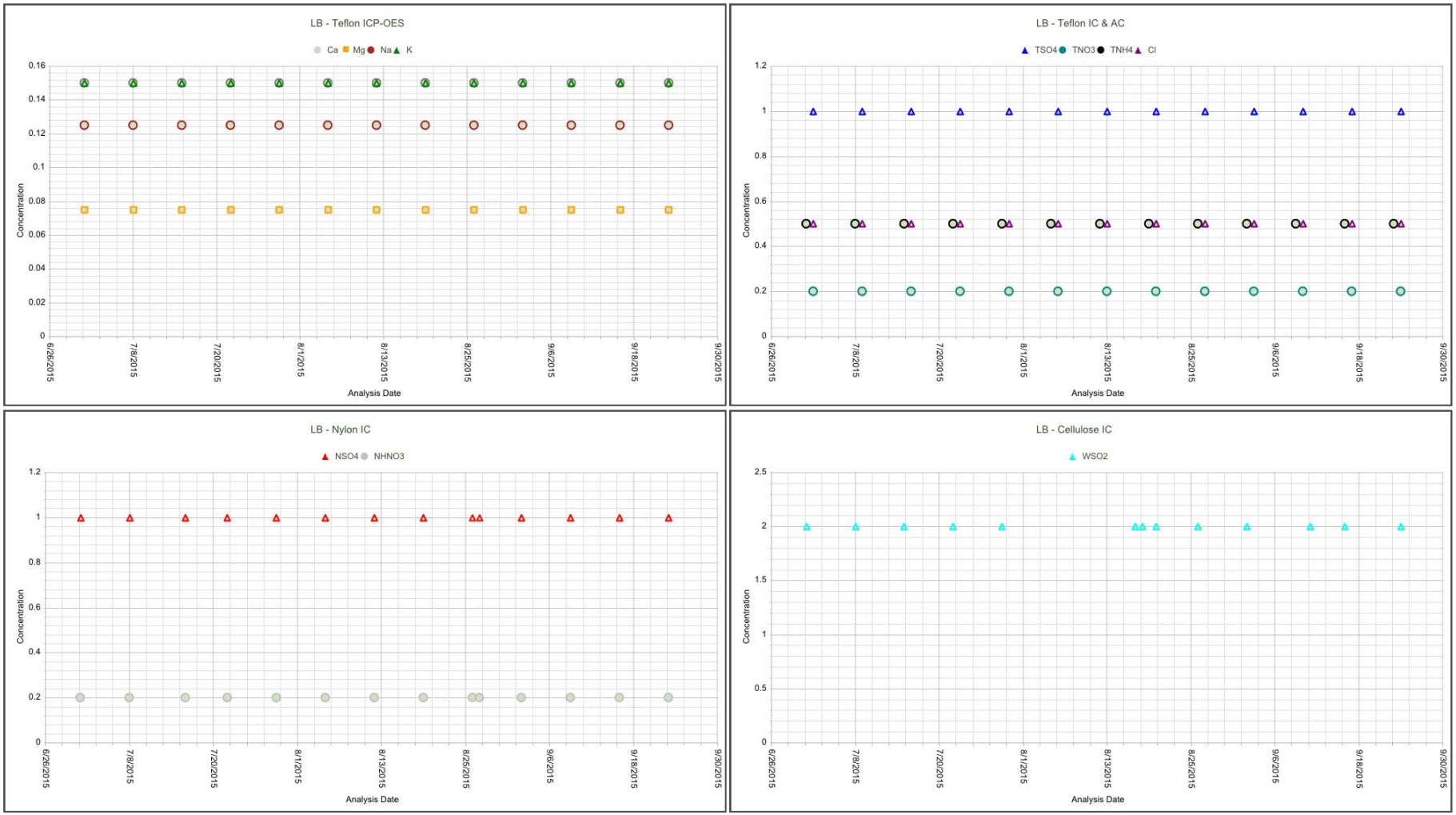

Figure 7 Field Blank Analysis Results for Third Quarter 2015 (total micrograms)