



Clean Air Status and Trends Network Second Quarter 2017 Quality Assurance Report

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 2017. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Amec Foster Wheeler, 2016). 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

The assessment needed to maintain International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 17025:2005 accreditation by the American Association for Laboratory Accreditation (A2LA) was performed April 4–6, 2017. The assessment covered the analytical laboratory and field laboratory. The noted deficiencies were straightforward and involved mainly updates to documentation plus the addition of two new standard operating procedures. Amec Foster Wheeler prepared a plan to address the deficiencies noted in the A2LA assessment and submitted the plan to A2LA, as required, within the 30-day post-assessment period on May 5, 2017. Amec Foster Wheeler completed the steps required by the A2LA to maintain ISO/IEC 17025:2005 accreditation, and the accreditation will continue through May 2019.

The meeting to discuss the annual management review report in support of ISO/IEC 17025:2005 accreditation was held May 19, 2017.

Amec Foster Wheeler continued evaluating possible replacements for the Pall Nylasorb nylon filter. Field testing of the co-located MTL Corp and Nylasorb filter packs at the Gainesville test site and at the co-located field sites at MCK131/231, KY and ROM406/206, CO continued through second quarter 2017. Review and analysis of the data collected continued. The aggregated precision statistic for sulfate is 22 percent, which is just outside the established precision metric (20 percent) as of mid-July 2017.

A technical systems audit (TSA) of CASTNET facilities supporting ozone monitoring is required once every three years. The routine TSA for the Air Resource Specialists, Inc. (ARS) ozone facility in Colorado and one field site in Tennessee was performed by RTI International (RTI). ARS is the National Park Service and Bureau of Land Management contractor for CASTNET. The audit report, including the ARS audit response, is available on the EPA CASTNET website, <https://java.epa.gov/castnet/documents.do>.

Corrective action for site operator non-compliance with site procedures was required for the site operator at the HOW191, ME site. The site operator was retrained by Amec Foster Wheeler field staff.

Table 1 lists the quarters of data that were validated to Level 3 during second quarter 2017 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 2017.

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 2017.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for second quarter 2017. All results were within the criteria listed in Table 3. The shift in RF and CCV recoveries for cellulose filter samples near the end of the quarter occurred due to the replacement of instrument columns and sample injector.

Table 8 presents summary statistics of critical criteria measurements at ozone sites collected during second quarter 2017. 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 2017. 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 second quarter 2017. All recovery values were between 91 percent and 110 percent. The shift in LCS recoveries for cellulose filter samples near the end of the quarter occurred due to the replacement of instrument columns and sample injector.

Blank Results

Figures 5 through 7 present the results of MB, LB, and FB QC sample analyses for second quarter 2017. All second quarter results were within criteria (two times the reporting limit) listed in Table 3 with the exception of one Teflon FB potassium value. All analytical batch QC was within criteria and field samples from the site (RED004, MN) were reasonable compared with other sites and historical values.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during second quarter 2017 are listed in Table 12. This table also includes associated site identification and a brief description of the reason the sample was flagged. During second quarter, 20 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 second quarter 2017. 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). 2016. Clean Air Status and Trends Network (CASTNET) Quality Assurance Project Plan (QAPP) Revision 9.0. 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>.
- 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 Monitors used in Evaluations of National Ambient Air Quality Standards. 40 CFR Part 58.

Table 1 Data Validated to Level 3 during Second Quarter 2017

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-1/SE-5	August 2016 – January 2017	6	Quarter 4 2016	1
MW-7/W-9	September 2016 – February 2017	6	Quarter 4 2016	1
E-2/MW-8	October 2016 – March 2017	6	Quarter 4 2016 – Quarter 1 2017	2

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

Table 2 Field Calibration Schedule for 2017

Calibration Group	Months Calibrated	Sites Calibrated			
Eastern Sites (24 Total)					
E-1 (8 Sites)	February/August	BEL116, MD ¹ 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 ²	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	COW137, NC DUK008, NC ²	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 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 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, 2016).

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, 2015). The minimum frequency for these checks is once every two weeks.

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 ± 31 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.

SO₂ = sulfur dioxide

NO_y = total reactive oxides of nitrogen

CO = carbon monoxide

ppb = parts per billion

Table 6 QC Analysis Count for Second Quarter 2017

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⁻	62	192	83	16	24	87
	NO ₃ ⁻	62	192	83	16	24	87
	NH ₄ ⁺	32	176	81	16	24	87
	Cl ⁻	62	192	83	16	24	87
	Ca ²⁺	32	176	81	16	24	87
	Mg ²⁺	32	176	81	16	24	87
	Na ⁺	32	176	81	16	24	87
	K ⁺	32	176	81	16	24	87
Nylon	SO ₄ ²⁻	48	195	80	16	24	87
	NO ₃ ⁻	48	195	80	16	24	87
Cellulose	SO ₄ ²⁻	47	176	74	15	24	86

Table 7 Filter Pack Receipt Summary for Second Quarter 2017

Count of samples received more than 14 days after removal from tower:	14
Count of all samples received:	751
Fraction of samples received within 14 days:	0.981
Average interval in days:	4.61
First receipt date:	04/04/2017
Last receipt date:	06/29/2017

Table 8 Ozone QC Summary for Second Quarter 2017 (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	0.43	100.00	0.51	98.91	0.27
ALC188, TX	95.88	2.51	93.81	2.21	100.00	0.27
ALH157, IL	100.00	0.37	100.00	0.46	100.00	0.15
ANA115, MI	100.00	1.83	100.00	1.71	96.74	0.41
ARE128, PA	100.00	1.07	100.00	1.31	100.00	0.30
ASH135, ME	100.00	1.68	100.00	1.82	100.00	0.19
BEL116, MD	98.85	1.14	97.70	1.00	98.85	0.26
BFT142,NC	99.02	1.70	92.16	2.69	96.08	0.83
BVL130, IL	100.00	1.40	100.00	1.10	100.00	0.20
BWR139, MD	100.00	3.03	96.84	3.59	98.95	0.63
CAD150, AR	97.80	1.34	98.92	1.64	100.00	0.40
CDR119, WV	100.00	1.08	100.00	0.96	100.00	0.28
CDZ171, KY	98.92	0.73	100.00	0.62	100.00	0.22
CKT136, KY	100.00	0.59	100.00	0.71	100.00	0.17
CND125, NC	97.89	2.03	97.87	1.87	100.00	0.26
CNT169, WY	95.60	3.24	96.70	3.01	100.00	0.18
COW137, NC	100.00	1.73	100.00	2.00	98.91	0.38
CTH110, NY	100.00	0.53	100.00	1.23	100.00	0.59
CVL151, MS	98.94	1.36	98.94	1.18	100.00	0.29
DCP114, OH	100.00	0.83	98.78	1.32	100.00	0.18
ESP127, TN	100.00	0.91	100.00	0.75	100.00	0.15
GAS153, GA	97.78	1.24	100.00	1.11	100.00	0.26
GTH161, CO	94.12	2.39	91.76	2.73	100.00	0.13

Table 8 Ozone QC Summary for Second Quarter 2017 (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	0.90	94.85	1.85	96.91	0.60
HWF187, NY	100.00	0.83	100.00	0.76	98.91	0.17
IRL141, FL	95.79	2.74	83.16	3.62	95.79	1.08
KEF112, PA	98.89	1.11	96.70	1.78	100.00	0.32
LRL117, PA	100.00	0.54	100.00	0.86	100.00	0.17
MCK131, KY	100.00	0.58	98.91	0.68	100.00	0.39
MCK231, KY	100.00	0.59	100.00	0.57	100.00	0.28
MKG113, PA	100.00	0.62	100.00	0.72	97.83	0.40
NPT006, ID	100.00	0.50	100.00	0.39	100.00	0.12
OXF122, OH	100.00	1.06	97.80	2.20	98.90	0.94
PAL190, TX	100.00	0.70	100.00	0.89	100.00	0.45
PAR107, WV	100.00	1.22	97.85	1.07	98.92	0.28
PED108, VA	100.00	1.79	96.70	2.05	100.00	0.50
PND165, WY	100.00	1.33	100.00	2.31	100.00	0.57
PNF126, NC	94.62	1.44	98.92	2.12	98.92	0.59
PRK134, WI	100.00	1.37	100.00	1.07	100.00	0.43
PSU106, PA	100.00	0.59	100.00	0.58	100.00	0.82
QAK172, OH	100.00	0.96	100.00	1.09	100.00	0.25
ROM206, CO	100.00	0.63	100.00	0.84	100.00	0.19
SAL133, IN	96.84	1.89	95.74	2.53	96.81	0.97
SAN189, NE	100.00	0.94	100.00	1.08	100.00	0.48
SND152, AL	100.00	4.67	100.00	4.86	100.00	0.31
SPD111, TN	100.00	0.77	100.00	0.59	100.00	0.30
STK138, IL	100.00	1.43	98.94	0.98	95.74	1.35
SUM156, FL	95.74	4.59	95.74	4.71	95.74	1.29
UVL124, MI	100.00	1.79	98.89	2.12	98.89	0.65
VIN140, IN	97.87	1.41	100.00	1.31	100.00	0.35
VPI120, VA	100.00	0.81	100.00	0.81	100.00	0.34
WSP144, NJ	100.00	1.29	100.00	1.50	100.00	0.58
WST109, NH	100.00	0.38	100.00	0.45	100.00	0.14

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 2017

Site ID	QC Criterion	Comments
IRL141, FL	% Single Point QC Pass	There were system moisture issues in late June. Associated data will be invalidated.

Table 10 Trace-level Gas QC Summary for Second Quarter 2017

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	0.64	100.00	2.26	100.00	0.32
NO _y	100.00	3.25	97.44	7.19	94.87	1.02
CO	100.00	0.93	85.00	5.76	89.74	18.74
DUK008, NC						
NO _y	100.00	1.38	100.00	1.37	97.37	0.46
HWF187, NY						
NO _y	100.00	0.87	100.00	0.89	92.50	0.75
PND165, WY						
NO _y	93.62	4.48	93.62	6.08	100.00	0.10
PNF126, NC						
NO _y	100.00	2.88	100.00	2.12	100.00	0.64
ROM206, CO						
NO _y	100.00	2.40	100.00	4.01	100.00	0.79

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 Second Quarter 2017

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	CO	% Single Point QC Pass	Calibration drift. The analyzer was recalibrated in early April and mid-April.

Table 12 Filter Packs Flagged as Suspect or Invalid during Second Quarter 2017

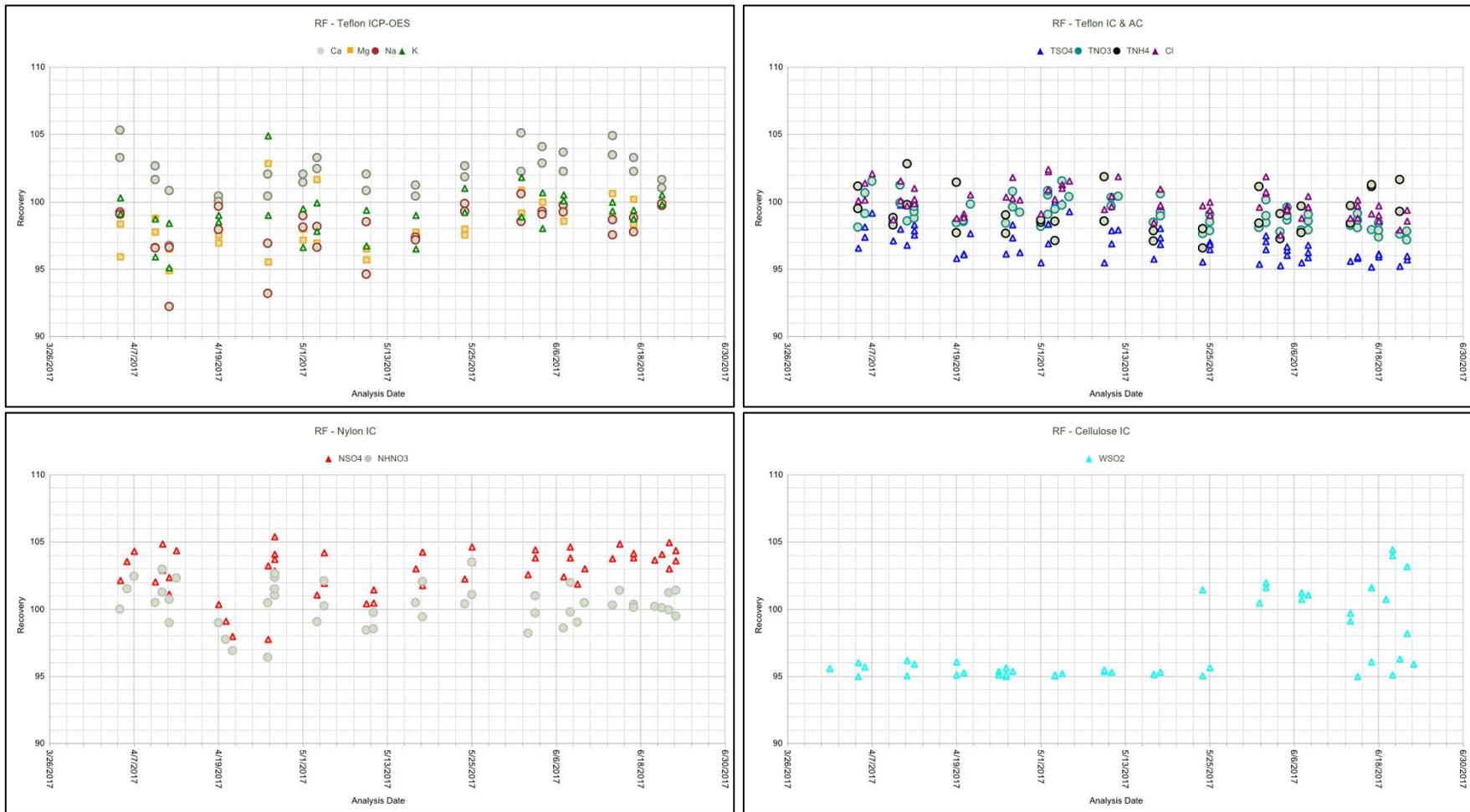
Site ID	Sample No.	Reason
ALH157, IL	1716001-02	Data logger malfunction
BEL116, MD	1720001-06	Power failure
BVL130, IL	1714001-08	Suspect potassium value invalidated
CAT175, NY	1721001-11	Data logger malfunction
CHE185, OK	1717004-02	Data collection problem – data should be recoverable.
GLR468, MT	1722003-08	Data logger malfunction
HOW191, ME	1716001-25 1717001-25	Flow system leak
KEF112, PA	1714001-29	Suspect potassium value invalidated
NEC602, WY	1717005-04	Polling error resulted in negative flow volume. Data should be recoverable.
NIC001, NY	1719001-35	Power failure
NPT006, ID	1720004-04	Channels left down after an audit. Data may be recoverable.
OXF122, OH	1721001-36	Data were flagged as “calibrator onsite” and may be recoverable.
QAK172, OH	1721001-44	Data were flagged as “calibrator onsite” and may be recoverable.
SAN189, NE	1716004-06	Filter pack data invalidated as suspect
STK138, IL	1717001-49	Filter pack not properly installed
UND002, VT	1718001-51	Power failure
UVL124, MI	1714001-52	Data logger malfunction
VIN140, IN	1719001-53	Data were flagged as “calibrator onsite” and may be recoverable

Table 13 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	603*
60	6
90	0
Unresolved by End of Quarter	19

Note: *Count mostly due to high humidity in ozone monitoring sample streams identified via review of 1-minute data.

Figure 1 Reference Standard Results for Second Quarter 2017 (percent recovery)



Notes: The nylon SO_4^{2-} (NSO4) result is within the criterion listed in Table 3 when the established rounding rule is applied.

Figure 2 Continuing Calibration Spike Results for Second Quarter 2017 (percent recovery)

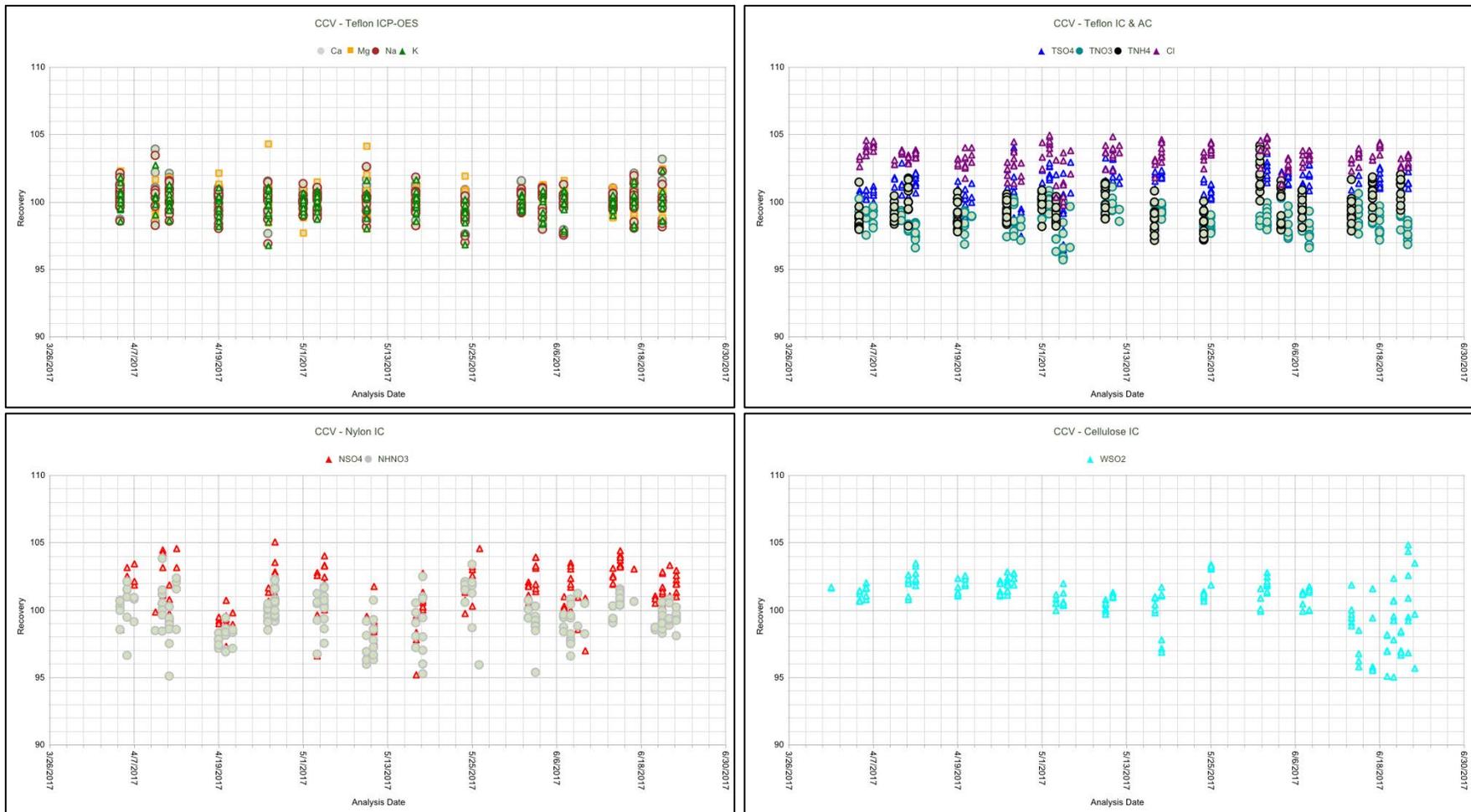


Figure 3 Replicate Sample Analysis Results for Second Quarter 2017 (percent difference)

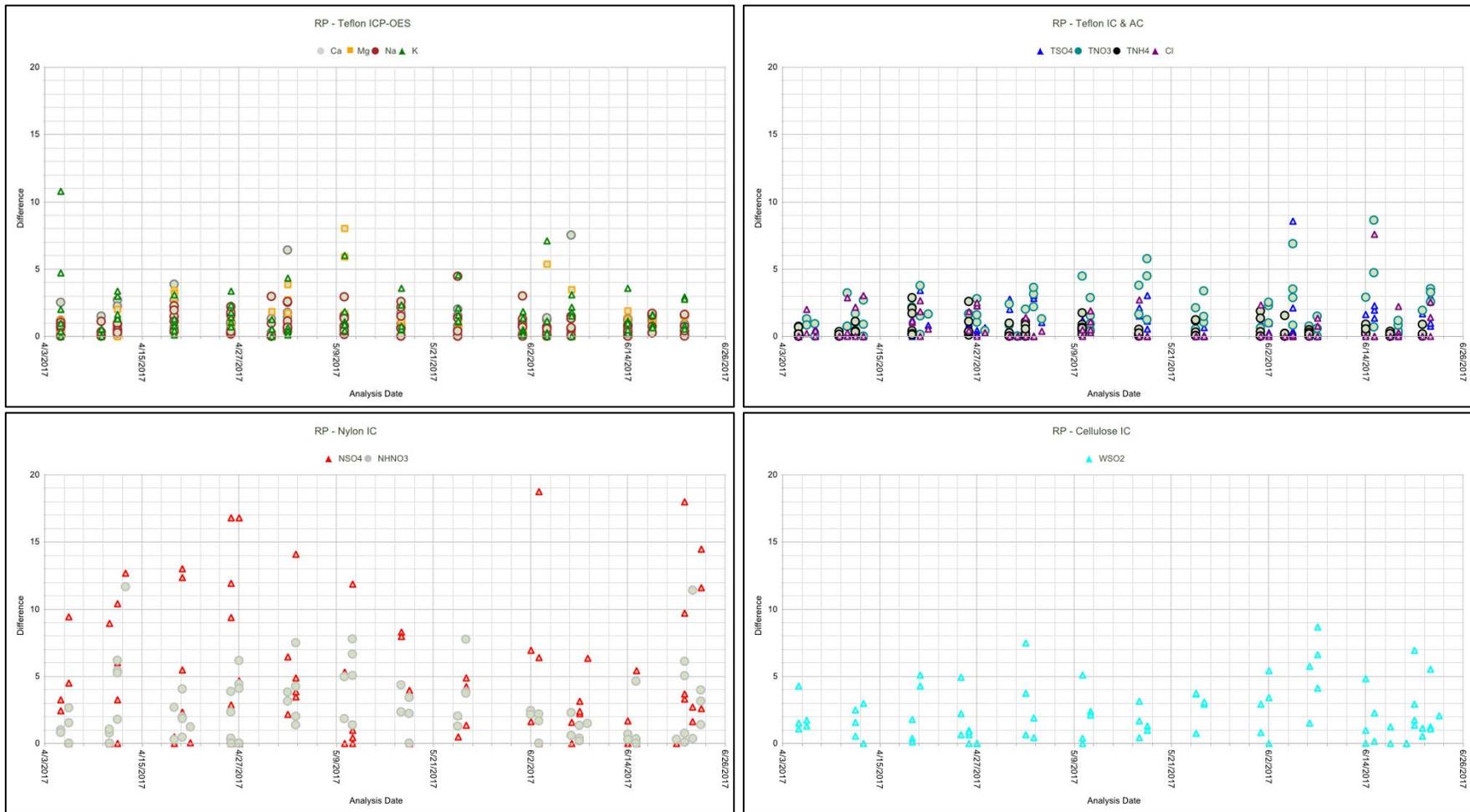


Figure 4 Laboratory Control Sample Results for Second Quarter 2017 (percent recovery)

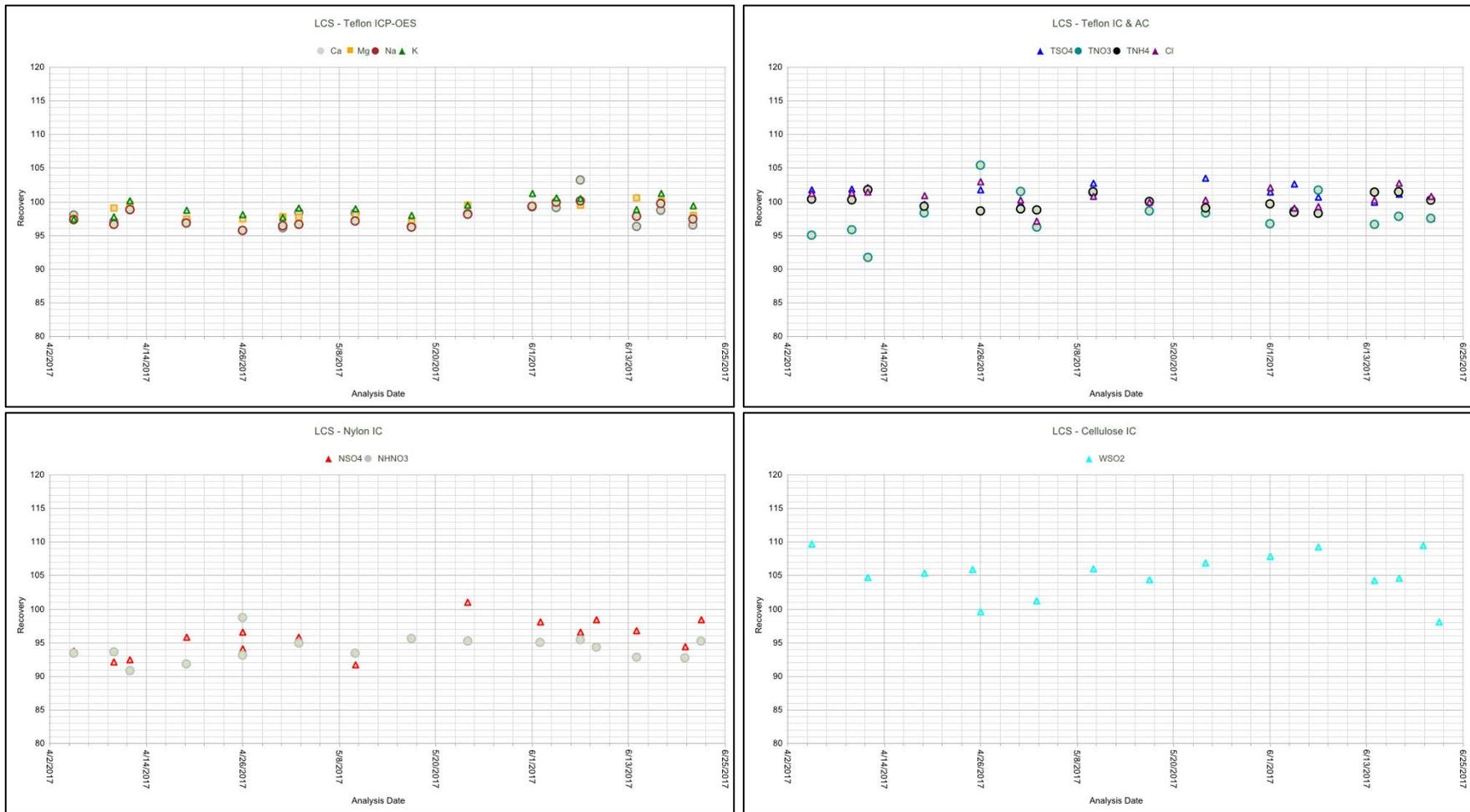


Figure 5 Method Blank Analysis Results for Second Quarter 2017 (total micrograms)

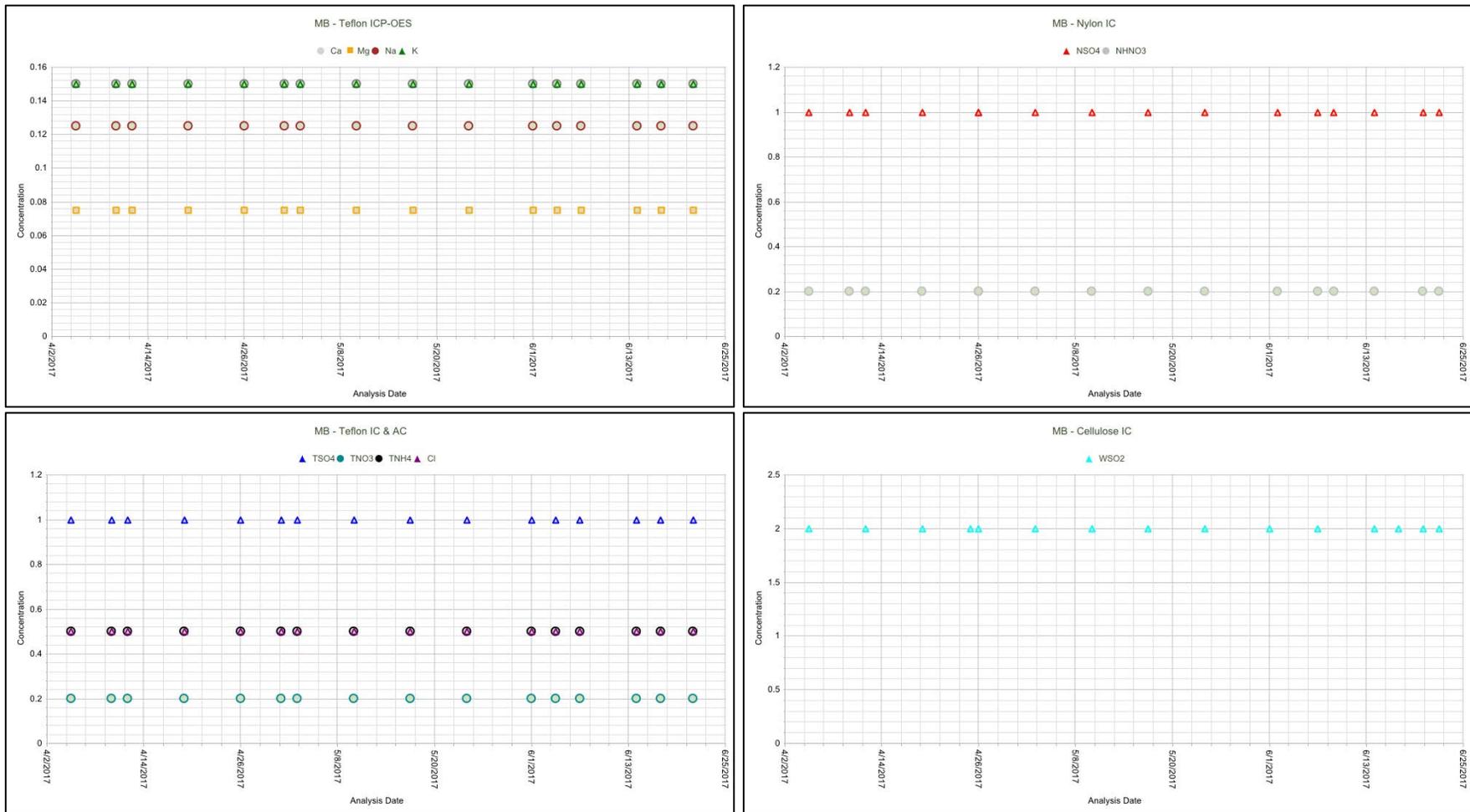


Figure 6 Laboratory Blank Analysis Results for Second Quarter 2017 (total micrograms)

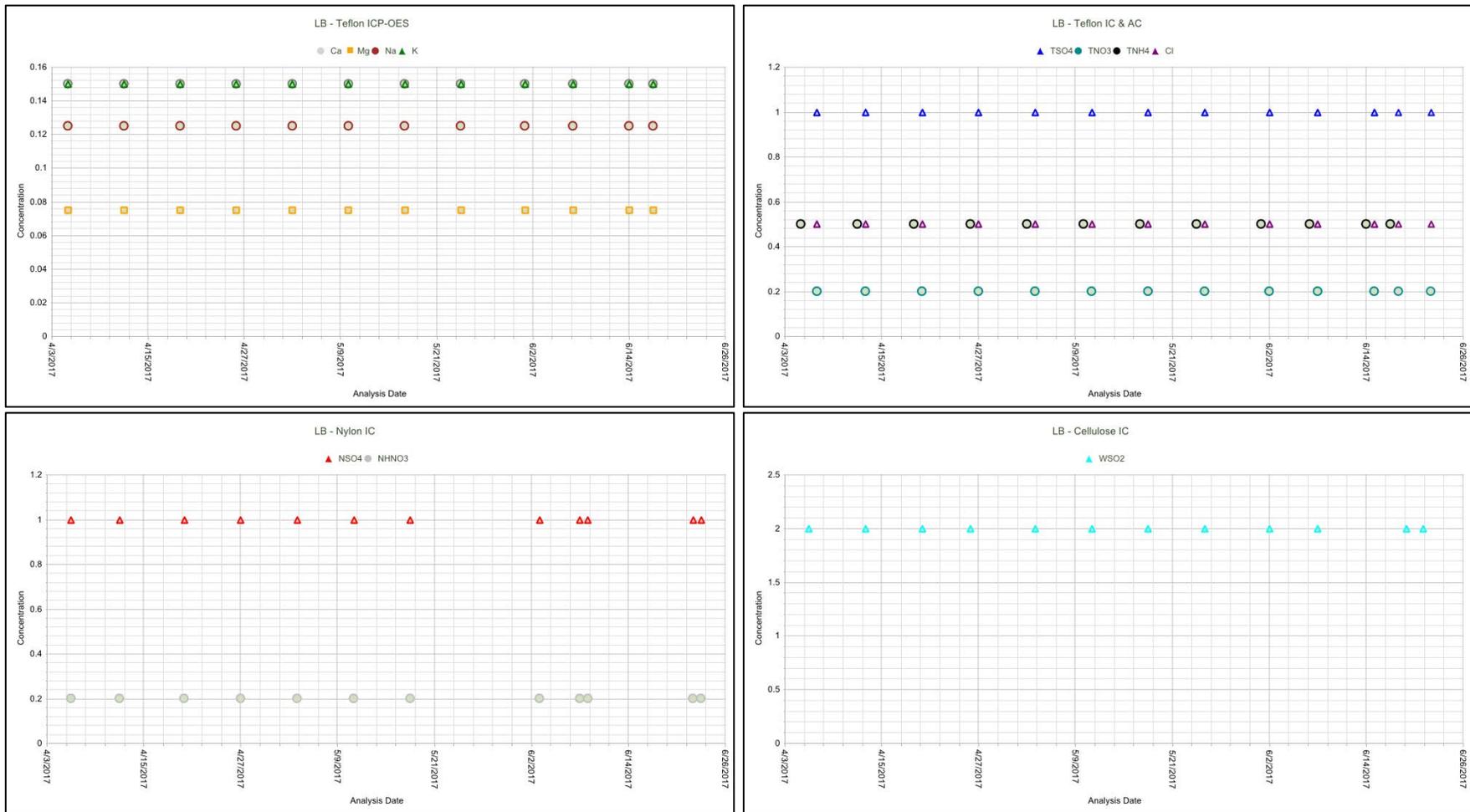


Figure 7 Field Blank Analysis Results for Second Quarter 2017 (total micrograms)

