Summary of Quarterly Operations (October through December) with 2019 Annual Summary

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 fourth quarter 2019. It also provides an annual summary that includes data from the three previous quarters. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP; Wood, 2019). 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.

Significant Events for 2019

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 accreditation for Wood's laboratory and field operations was prepared and submitted to A2LA. Revisions to ISO/IEC 17025 were promulgated in 2017. A2LA requested additional documentation in support of the upcoming 2019 assessment for ISO/IEC 17025:2017 accreditation. Wood submitted the additional documentation as requested.

The QA Manager conducted the annual management review in accordance with Wood's analytical laboratory's ISO/IEC 17025:2005 accreditation between October 2, 2018 and February 12, 2019. The annual management review report in support of ISO/IEC 17025:2005 accreditation was completed and distributed to the Wood QA and management teams. The review included the elements required for ISO/IEC 17025:2017 accreditation to ensure the laboratory and field operations groups were prepared for the upcoming assessment by A2LA. The annual management meeting to discuss the review results was held April 11, 2019. The Wood management group remains supportive of ISO/IEC 17025 accreditation activities.

During second quarter, preparations for the ISO/IEC 17025:2017 accreditation assessment by the A2LA were completed. The assessment took place during the week of April 29, 2019. The assessment went well. There were two related findings requiring Wood to implement the reporting of field measurements independent proficiency testing to A2LA. Wood implemented the corrective action and submitted the required information to A2LA. The existing ISO/IEC 17025:2005 accreditation had been scheduled to expire at the end of May 2019. Wood submitted a request and received an extension in order to remain accredited until the paperwork related to the recent assessment was processed. Wood's 17025:2017 accreditation was reaffirmed through May 2021. A copy of the certificate was provided to EPA in early June 2019.

During first quarter 2019, the final version of the "40 Code of Federal Regulations (CFR) Part 58 Technical Systems Audit (TSA) of Clean Air Status and Trends Network (CASTNET) Program Ozone

Monitoring Process" that had been sent to Wood by RTI International, the TSA auditor, was sent to EPA. The CASTNET QA Manager worked with EPA and RTI on corrections and updates (e.g., EPA web addresses) to the final report.

Wood began implementing steps to ensure low-level ozone measurements are demonstrably accurate at CASTNET sites. During January 2019, the weekly multipoint challenge concentration of 40 parts per billion (ppb) was set to 30 ppb at five test sites. Data from the sites collected over a few weeks were reviewed to verify accuracy prior to lowering the multipoint challenge concentration at all EPA-sponsored ozone sites. Wood now reviews multipoint challenge data each month prior to calibrations of the sites to determine if adjustments are needed in order to ensure the accuracy of data between zero and 30 ppb. A calibration factor is determined after review of several weeks of data by Wood's field personnel. The data observed only during a calibration visit are insufficient to properly determine this factor. The calibration factor is then provided to the calibrator. Generally, this procedure is expected to be required only once per ozone instrument, not for each calibration visit. A similar procedure is followed for trace-level gas monitoring sites.

The internet protocol address for the KEF112, PA site was accidentally set to one being used by the MKG113, PA site in late November 2018 during its communications backplane replacement and upgrade. After polling, both sites showed MKG113 data. During February, the KEF112 data were recovered and correctly entered into the CASTNET database. To prevent this type of situation, Wood developed a screening tool that detects duplicate data insertions if they occur during polling.

During 2019, Wood continued to work with MTL Corp on a pre-washed nylon filter that meets CASTNET acceptance criteria. Wood and Environment and Climate Change Canada personnel reviewed the revised standard operating procedure (SOP) from MTL for nylon filter washing and drying procedures and monitoring of the deionized water system. Wood's laboratory confirmed that the water used by MTL meets CASTNET acceptance criteria and approved MTL's filter washing SOP, including monitoring and maintenance of the water system. Wood finalized plans to use MTL Corp pre-washed nylon filters for CASTNET sampling activities beginning with filter packs deployed on September 3, 2019. Wood updated the preventive action plan summary for transitioning to MTL pre-washed nylon filters and sent it to CASTNET stakeholders. Wood continues to work with MTL to maintain a year's supply of filters.

Wood was contacted by EPA Region 3 and requested to assist with additional work on the West Virginia Department of Environmental Protection (WVDEP) Quality Assurance Plan (QAP). Wood was provided with a model QAP for the District of Columbia's SLAMS/NCore ambient air monitoring program to use as a guide. Wood completed revisions and submitted the document to EPA Region 3 and WVDEP on March 15, 2019.

The CASTNET QAPP Revision 9.2 was approved and signed by CASTNET stakeholders during April 2019.

A corrective action was initiated during second quarter after it was discovered that there was an error in entering the intercept for a traveling ozone transfer. One of the six runs entered in the spreadsheet

had a typo. Data entered for site transfers are routinely double-checked, but data for traveling transfers had not been. A procedure to check entries for traveling ozone transfers has been developed and implemented.

The CASTNET Natural Disaster Preparedness and Response procedure was completed during August 2019. This document provides guidelines for preparing sites for impending severe storms and other natural disasters (e.g., hurricanes, wildfires) and for restoring sites after a natural disaster has occurred. This plan has been included in the revision of the CASTNET Health and Safety Plan, which is appendix 5 to the CASTNET QAPP Revision 9.3.

During August, the CASTNET QA Manager audited laboratory personnel on the laboratory method, GLM3180-001. The analyst demonstrated thorough knowledge of the method, instrument operation, and sample handling. A single finding was generated for the laboratory to reconcile a discrepancy between documented procedure and actual performance when volumes of impregnation fluid are added to blank spikes. The QA Manager routinely audits in support of the QA program.

Providing a safe working environment is one of Wood's goals. Sites are routinely checked for safe working conditions at each calibration (i.e., twice per year). During 2019, Wood performed an internal safety audit of the BVL130, IL site. A safety audit provides a more in-depth review of site safety and includes a safety-related evaluation of infrastructure condition and maintenance, use of equipment, site operator activities at the site, and verification that procedures are understood and followed by site personnel. There was one finding during the 2019 safety audit. To address the finding and satisfy the hazard communications rule promulgated by the Occupational Safety and Health Administration (OSHA, 2013), Wood is supplying safety data sheets for the gas cylinders used at the trace-level gas sites. This documentation is provided as hard copy in folders for the calibrators to leave at the sites that use gas cylinders.

Near the end of fourth quarter, the CASTNET management team submitted documentation to EPA for a change in Key Personnel for the CASTNET V contract. Ann Bernhardt, the current Quality Assurance (QA) Supervisor, has been promoted within Wood and will be assuming different duties within the Wood corporate structure. Wood recommended that Ms. Bernhardt be replaced by Anne Glubis.

Quarterly/Annual Summary
Table 1 lists the quarters of data that were validated to Level 3 during 2019 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 continuous field measurements. These criteria apply to the instrument challenges performed during site calibrations. Table 4 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 5 presents the critical criteria for ozone monitoring. Table 6 presents the critical criteria for trace-level gas monitoring.

Laboratory Intercomparison Results Summary
Wood's CASTNET laboratory regularly participates in the Environment and Climate Change Canada (ECCC) Proficiency Testing (PT) Program for Inorganic Environmental Substances. The results reported

by the participating laboratories are evaluated for systematic bias and precision. Systematic bias is assessed using the Youden (1969) non-parametric analysis, while precision is calculated using algorithm A from the ISO standard 13528 (ISO, 2005). Laboratory results are considered systematically biased when individual parameters are ranked by the Youden analysis to be consistently and significantly higher or lower than the assigned value without regard to flagged results. The CASTNET laboratory's proficiency testing plan requires action for individual test results that are greater than three standard deviations from the assigned value, bias 5 percent or higher for a single parameter, three or more biased results of any magnitude in a single study, or a consecutive study result indicating bias of any magnitude for a given parameter.

During April 2019, Wood received results for sample analyses submitted for PT study 0113 for Rain and Soft Waters to the National Laboratory of Environmental Testing (NLET), a branch of the National Water Research Institute with ECCC that provides QA services. All results passed. Analyses of eight of nine parameters were rated as "ideal" for PT study 0113 (ECCC, 2019a).

In September 2019, Wood received results for sample analyses submitted to the NLET for PT study 0114 for Rain and Soft Waters. All CASTNET parameters were rated as "ideal" with the exception of sulfate (ECCC, 2019b). The results of the analyses showed a 1 percent high bias for sulfate. No corrective action was needed.

The CASTNET laboratory's results for ECCC PT study codes 0113 and 0114 for the eight CASTNET parameters are listed in Table 7. The overall laboratory rating by ECCC indicates a percent score. A "Very Good" rating, the highest rating, is 0–5 percent of the sum of parameters biased and results flagged. A "Good" rating, the second highest rating, is greater than 5–12.5 percent of the sum of the parameters biased and results flagged. For results received during 2019, the overall laboratory performance rating for Wood's analytical laboratory was "Good" for PT study 0113 and for PT study 0114 (ECCC, 2019a; 2019b).

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. Tables 8 through 11 present the number of analyses in each category that were performed during each quarter of 2019.

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 12 presents the relevant sample receipt statistics for each of the four quarters of 2019 together with an annual summary for each category.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for fourth quarter 2019. All results were within the criteria listed in Table 4. Table 13 presents the percent recoveries and standard deviations for RF, CCV, and RP QC sample analyses for 2019. Quarterly averages are all within criteria. Two individual magnesium RP results exceeded the 20 percent difference criterion at 21 and 32 percent respectively. These samples were both less than 5 times the reporting limit and the absolute difference for both met the alternative criterion of absolute value of the reporting limit.

Table 14 presents quarterly co-located filter pack precision results for data validated to Level 3 during the year. Results for MCK131/231, KY and ROM406/206, CO were within the criterion for all of the 11 parameters reported with the exception of fourth quarter 2018 results for ROM406/206. The mean absolute relative percent difference (MARPD) values exceeded the 20 percent criterion at ROM406/206 for calcium, magnesium, and sodium. Cation measurements taken during week 45 (11/6/18) at ROM406 were significantly higher than concentrations measured at ROM206. These resulted in an increased quarterly MARPD. Excluding week 45 from the data would have resulted in MARPD values less than 20 percent. The receiving technician for the analytical laboratory noted that the ROM406 filter was extremely dirty for that week. Additionally, filters were not collected during weeks 52 and 53 because of the government shutdown.

Figure 4 presents completeness statistics for continuous measurements validated to Level 3 during the year. All parameters met the 90 percent criterion.

Table 15 presents summary statistics of critical criteria measurements at ozone sites collected during fourth quarter 2019. 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 16 presents observations associated with the shaded cell results in Table 15.

Table 17 presents summary statistics of critical criteria measurements at trace-level gas monitoring sites collected during fourth quarter 2019. 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 6 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 18 presents observations associated with the shaded cell results in Table 17.

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 5 presents LCS analysis results for fourth quarter 2019. All recovery values were between 89.2 percent and 105.5 percent.

Blank Results
Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for fourth quarter 2019. All fourth quarter results were within criteria (two times the reporting limit) listed in Table 4 with the exception of a single nylon filter LB result for nitric acid at 4.4 times the reporting limit. The results for the other LB samples prepared at the same time were below the reporting limit, and all other batch QC passed. Table 19 summarizes the record of filter blanks for 2019. All 2019 results were within criteria listed in Table 4 with the exception of four Teflon calcium FB results that occurred during first and second quarters, and the fourth quarter LB result listed previously. All other blank QC checks in their respective batches were within criteria.

Suspect/Invalid Filter Pack Samples
Filter pack samples that were flagged as suspect or invalid during each of the four quarters of 2019 are listed in Table 20. This table also includes associated site identification and a brief description of the reason the sample was flagged. During fourth quarter, 10 filter pack samples were invalidated.

Field Problem Count
Table 21 presents counts of field problems affecting continuous data collection for more than one day for each quarter during 2019. 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.

Field Calibration Results
A summary of field calibration failures by parameter for each quarter of 2019 is listed in Table 22. Calibrations were performed at 24 sites during fourth quarter 2019. During 2019, all sites and parameters were within the criteria listed in Table 3 with the exception of the parameters at the nine sites that are listed in Table 22.

Table 23 presents field accuracy results for 2019 based on instrument challenges performed using independent reference standards during site calibration visits. Each parameter was within its criterion with at least 90 percent frequency except delta temperature (ambient) at 87.5 percent and solar radiation at 85.7 percent frequency. Per CASTNET project protocols, data are flagged but still considered valid if the calibration criterion is not exceeded by more than its magnitude (i.e., if within two times the criterion). All calibration failures reported in 2019 for the indicated parameters were within two times the criterion with the exception of the sites and parameters with colored shading listed in Table 22. Data associated with the failures at these sites were invalidated.

References
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International Organization for Standardization (ISO). 2017. *Statistical Methods for the Use in Proficiency Testing by Interlaboratory Comparisons, Annex C, Robust Analysis, Section C.1: Algorithm A*. Standard 13528. ISO 13528:2005(E).

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Table 1 Data Validated to Level 3 through Fourth Quarter 2019

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
SE-4/MW-6[†]	July 2018 – June 2019	12	Quarter 3 2018 – Quarter 2 2019	4
E-1/SE-5	August 2018 – July 2019	12	Quarter 4 2018 – Quarter 2 2019	3
MW-7/W-9	September 2018 – August 2019	12	Quarter 4 2018 – Quarter 2 2019	3
E-2/MW-8	October 2018 – September 2019	12	Quarter 4 2018 – Quarter 3 2019	4
E-3/W-10[‡]	May 2018 – April 2019	12	Quarter 3 2018 – Quarter 1 2019	3

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

Table 2 Field Calibration Schedule for 2019

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[4] 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.
　　　　[4] The site was decommissioned in March 2019.

Table 3 Data Quality Indicators for CASTNET Continuous Measurements

Measurement		Criteria[1]	
Parameter[2]	Method	Precision	Accuracy
Filter pack flow	Mass flow controller	± 10%	± 5%
Ozone[3]	UV absorbance	All points within ± 2% of full scale of best fit straight line Linearity error < 5%	
Wind speed	Anemometer	± 0.5 m/s	The greater of ± 0.5 m/s for winds < 5 m/s or ± 5% for winds ≥ 5 m/s
Wind direction	Wind vane	± 5°	± 5°
Sigma theta	Wind vane	Undefined	Undefined
Ambient temperature	Platinum RTD	± 1.0°C	± 0.5°C
Delta temperature	Platinum RTD	± 0.5°C	± 0.5°C
Relative humidity	Thin film capacitor	± 10% (of full scale)	± 10%
Precipitation	Tipping bucket rain gauge	± 10% (of reading)	± 0.05 inch[4]
Solar radiation	Pyranometer	± 10% (of reading taken at local noon)	± 10%
Surface wetness	Conductivity bridge	Undefined	Undefined

Notes: °C = degrees Celsius
m/s = meters per second
RTD = resistance-temperature device
UV = ultraviolet

[1]Precision criteria apply to co-located instruments, and accuracy criteria apply to calibration of instruments. Co-located precision criteria do not apply to CASTNET sites that are configured and operated in accordance with Part 58 of Title 40 of the *Code of Federal Regulations* (EPA, 2017)

[2]Meteorological parameters are only measured at five of the EPA-sponsored CASTNET sites: IRL141, FL; BVL130, IL; BEL116, MD; CHE185, OK; and PND165, WY.

[3]Ozone is not measured at eight EPA-sponsored CASTNET sites: KIC003, KS; KNZ184, KS; RED004, MN; EGB181, ON; CAT175, NY; NIC001, NY; WFM105, NY; and UND002, VT.

[4]For target value of 0.50 inch

Table 4 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. The acceptance criterion is ±20 percent for samples greater than or equal to five times the reporting limit and is plus or minus the reporting limit if the sample concentration is less than 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, 2019).

Table 5 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 6 Trace-level Gas Monitoring Critical Criteria[*]

Parameter	Analyzer Response	
	Zero Check	Span Check / Single Point QC Check
SO_2	Less than $\pm$ 1.51 ppb	Less than $\pm$ 10.1 percent between supplied and observed concentrations
NO_y	Less than $\pm$ 1.51 ppb	
CO	Less than $\pm$ 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 7 CASTNET Laboratory Results for ECCC PT Studies

Test Parameter	Analytical Method	Reference Method	Laboratory Performance Rating[*]	
			Good: Study 0113 Winter 2019	Good: Study 0114 Summer 2019
Ammonia	AC	EPA Method 350.1	Ideal	Ideal
Chloride	IC	EPA Method 300.0	High bias: -0.1% | 0.0322	Ideal
Nitrate + Nitrite	IC	EPA Method 300.0	Ideal	Ideal
Sulfate	IC	EPA Method 300.0	Ideal	High bias: – 1.1% | 0.0209
Calcium	ICP-OES	EPA Method 6010	Ideal	Ideal
Magnesium	ICP-OES	EPA Method 6010	Ideal	Ideal
Potassium	ICP-OES	EPA Method 6010	Ideal	Ideal
Sodium	ICP-OES	EPA Method 6010	Ideal	Ideal

Notes: *Expressed as bias percent slope (percent deviation of test results from assigned values) | y-intercept.
Ideal slope = 1 | y-intercept = 0. Any result not 1 | 0 is reported as biased by ECCC.
AC   = automated colorimetry
ICP-OES = inductively coupled plasma-optical emission spectrometry
IC   = ion chromatography

Source: ECCC (2019a; 2019b)

Table 8 QC Analysis Count for First Quarter 2019

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-}	59	175	73	15	24	90
	NO_3^-	59	175	73	15	24	90
	NH_4^+	30	158	73	15	24	90
	Cl^-	59	175	73	15	24	90
	Ca^{2+}	30	159	73	15	24	90
	Mg^{2+}	30	159	73	15	24	90
	Na^+	30	159	73	15	24	90
	K^+	30	159	73	15	24	90
Nylon	SO_4^{2-}	42	172	69	14	24	90
	NO_3^-	42	172	69	14	24	90
Cellulose	SO_4^{2-}	43	163	72	16	24	90

Table 9 QC Analysis Count for Second Quarter 2019

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	202	85	18	26	93
	NO_3^-	68	202	85	18	26	93
	NH_4^+	36	183	85	18	26	93
	Cl^-	68	202	85	18	26	93
	Ca^{2+}	36	183	85	18	26	93
	Mg^{2+}	36	183	85	18	26	93
	Na^+	36	183	85	18	26	93
	K^+	36	183	85	18	26	93
Nylon	SO_4^{2-}	57	223	88	19	26	93
	NO_3^-	57	223	88	19	26	93
Cellulose	SO_4^{2-}	50	188	84	19	26	93

Table 10 QC Analysis Count for Third Quarter 2019

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-}	64	188	80	16	26	93
	NO_3^-	64	188	80	16	26	93
	NH_4^+	32	172	79	16	26	93
	Cl^-	64	188	80	16	26	93
	Ca^{2+}	32	172	79	16	26	93
	Mg^{2+}	32	172	79	16	26	93
	Na^+	32	172	79	16	26	93
	K^+	32	172	79	16	26	93
Nylon	SO_4^{2-}	48	192	78	16	26	93
	NO_3^-	48	192	78	16	26	93
Cellulose	SO_4^{2-}	46	171	78	16	26	93

Table 11 QC Analysis Count for Fourth Quarter 2019

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-}	64	181	77	16	17	92
	NO_3^-	64	181	77	16	17	92
	NH_4^+	32	166	77	16	17	92
	Cl^-	64	181	77	16	17	92
	Ca^{2+}	32	165	80	17	17	92
	Mg^{2+}	32	165	80	17	17	92
	Na^+	32	165	80	17	17	92
	K^+	32	165	80	17	17	92
Nylon	SO_4^{2-}	45	182	71	15	17	92
	NO_3^-	45	182	71	15	17	92
Cellulose	SO_4^{2-}	47	171	78	16	17	92

Table 12 Filter Pack Receipt Summary for 2019

Description	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Summary
Count of samples received more than 14 days after removal from tower:	41	14	14	20	89
Count of all samples received:	804	783	777	703	3067
Fraction of samples received within 14 days:	0.949	0.982	0.982	0.972	0.971
Average interval in days:	6.514	5.487	6.060	5.940	6.000[*]
First receipt date:	01/02/2019	04/01/2019	07/01/2019	10/2/2019	01/02/2019
Last receipt date:	03/29/2019	06/28/2019	09/27/2019	12/26/2019	12/26/2019

Note: Sample shipments for the Egbert, Ontario site (EGB181) are in groups of four. Samples associated with EGB181 are excluded from this statistic.
[*]annual average

Table 13 Filter Pack QC Summary for 2019

Filter Type	Parameter	Reference Sample[1] Recovery (%R)			Continuing Calibration Verification Samples (%R)			In-Run Replicate[2] (RPD)		
		Mean	Std. Dev.	Count[3]	Mean	Std. Dev.	Count[3]	Mean	Std. Dev.	Count[3]
Teflon	SO_4^{2-}	99.44	1.44	255	100.63	0.90	746	0.86	0.77	315
	NO_3^-	99.58	0.94	255	99.06	0.99	746	1.33	1.24	315
	NH_4^+	101.24	1.49	130	100.31	1.35	679	0.58	0.79	314
	Ca^{2+}	103.08	2.65	130	100.41	1.20	679	1.35	1.54	317
	Mg^{2+}	99.91	1.52	130	99.81	0.86	679	1.72	2.73	317
	Na^+	96.90	1.66	130	99.84	0.99	679	1.19	1.47	317
	K^+	99.51	1.90	130	99.80	0.90	679	1.93	2.06	317
	Cl^-	98.70	1.44	255	102.64	0.87	746	1.70	2.09	315
Nylon	SO_4^{2-}	104.45	0.80	192	101.73	1.58	769	3.60	2.78	306
	NO_3^-	99.81	1.39	192	98.22	2.22	769	2.27	2.24	306
Cellulose	SO_4^{2-}	102.09	1.83	186	101.09	0.98	693	1.43	1.33	312

Notes: % R = percent recovery
RPD = relative percent difference

[1]Results of reference sample analyses provide accuracy estimates
[2]Results of replicate analyses provide precision estimates
[3]Number of QC Samples

Table 14 Precision Results for Third Quarter 2018 through Second Quarter 2019

Quarter	SO_4^{2-}	NO_3^-	NH_4^+	Ca^{2+}	Mg^{2+}	Na^+	K^+	Cl^-	HNO_3	SO_2	Total NO_3^-
MCK131/231, KY											
2018 Q3	3.12	7.90	3.14	5.10	5.51	4.90	4.33	0.37	5.46	6.92	5.65
2018 Q4	4.02	5.02	6.20	12.52	9.74	6.91	6.95	18.48	5.00	3.88	4.22
2019 Q1	3.97	5.58	3.57	10.15	6.29	4.48	2.88	4.47	6.69	4.84	4.31
2019 Q2	3.50	7.06	2.41	7.79	7.77	3.85	5.56	0.43	4.65	5.24	4.54
Average	3.65	6.39	3.83	8.89	7.33	5.04	4.93	5.94	5.45	5.22	4.68
ROM406/206, CO											
2018 Q3	3.77	10.18	5.24	3.72	5.79	7.76	5.51	4.11	10.42	14.96	6.89
2018 Q4	13.83	18.67	14.13	24.16	21.04	20.85	16.05	3.36	17.46	14.72	15.25
2019 Q1	7.61	20.14	12.55	9.78	11.05	9.78	16.35	13.69	14.64	11.25	12.85
2019 Q2	5.90	13.72	8.65	6.63	10.90	11.74	10.98	10.82	10.76	12.11	6.65
Average	7.78	15.68	10.14	11.07	12.20	12.53	12.22	8.00	13.32	13.26	10.41

Notes: Three of 88 site-quarter-parameters were outside criterion.
Shaded cells exceeded the MARPD criterion of 20 percent.

Table 15 Ozone QC Summary for Fourth Quarter 2019 (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	1.02	100.00	1.10	100.00	0.12
ALC188, TX	100.00	0.78	100.00	0.64	100.00	0.36
ALH157, IL	100.00	0.46	100.00	0.67	100.00	0.18
ANA115, MI	100.00	1.40	100.00	1.02	100.00	0.29
ARE128, PA	100.00	4.00	100.00	3.96	100.00	0.12
ASH135, ME	100.00	0.77	100.00	0.75	100.00	0.19
BEL116, MD	100.00	0.81	100.00	1.33	100.00	0.34
BFT142, NC	100.00	2.06	100.00	2.20	100.00	0.20
BVL130, IL	100.00	1.63	100.00	1.72	100.00	0.14
BWR139, MD	100.00	0.49	100.00	1.27	100.00	0.48
CAD150, AR	100.00	1.22	100.00	1.64	100.00	0.37
CDR119, WV	100.00	1.20	100.00	1.40	100.00	0.23
CDZ171, KY	100.00	1.81	100.00	1.44	100.00	0.53
CKT136, KY	100.00	0.82	100.00	0.71	100.00	0.13
CND125, NC	100.00	0.59	100.00	0.80	100.00	0.27
CNT169, WY	100.00	0.62	100.00	1.02	100.00	0.27
COW137, NC	100.00	1.86	100.00	1.38	98.06	1.02
CTH110, NY	100.00	0.64	100.00	1.06	100.00	0.26
CVL151, MS	100.00	0.95	100.00	1.23	100.00	0.39
DCP114, OH	100.00	1.67	100.00	1.33	100.00	0.34

Table 15 Ozone QC Summary for Fourth Quarter 2019 (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]
ESP127, TN	100.00	1.57	100.00	2.24	100.00	0.22
GAS153, GA	100.00	0.82	100.00	1.08	100.00	0.66
GTH161, CO	100.00	0.47	100.00	0.64	100.00	0.14
HOX148, MI	94.19	5.50	94.19	4.08	95.29	1.50
HWF187, NY	100.00	0.56	100.00	0.81	98.91	0.32
IRL141, FL	90.29	5.52	90.20	5.75	96.08	0.65
KEF112, PA	100.00	1.24	100.00	1.66	100.00	0.36
LRL117, PA	100.00	0.66	100.00	0.86	100.00	0.23
MCK131, KY	100.00	1.05	98.92	0.93	100.00	0.21
MCK231, KY	100.00	1.30	100.00	1.78	100.00	0.18
MKG113, PA	100.00	0.77	100.00	0.96	100.00	0.26
NPT006, ID	90.82	7.36	90.82	5.79	100.00	0.25
OXF122, OH	100.00	0.26	100.00	0.39	100.00	0.27
PAL190, TX	100.00	0.37	98.92	2.73	98.92	2.65
PAR107, WV	100.00	0.99	100.00	0.96	100.00	0.25
PED108, VA	100.00	0.68	100.00	0.61	100.00	0.25
PND165, WU	100.00	0.67	100.00	1.08	100.00	0.37
PNF126, NC	100.00	0.63	100.00	0.80	100.00	0.29
PRK134, WI	100.00	1.19	100.00	0.83	100.00	0.14
PSU106, PA	100.00	0.34	100.00	0.62	100.00	0.16
QAK172, OH	95.74	4.51	95.74	3.51	95.74	1.55
ROM206, CO	98.92	4.78	97.83	5.04	100.00	0.18
SAL133, IN	100.00	0.36	100.00	0.44	100.00	0.15
SAN189, NE	100.00	1.49	100.00	1.23	100.00	0.51
SND152, AL	100.00	2.78	100.00	3.43	100.00	0.37
SPD111, TN	100.00	0.64	100.00	0.77	100.00	0.21
STK138, IL	100.00	1.09	100.00	0.82	100.00	0.24
SUM156, FL	100.00	0.93	100.00	1.05	100.00	0.24
UVL124, MI	98.89	2.29	98.89	1.95	100.00	0.15
VIN140, IN	100.00	0.72	100.00	0.78	100.00	0.19
VPI120, VA	100.00	1.67	98.85	1.35	100.00	0.16
WSP144, NJ	100.00	2.20	100.00	2.84	100.00	0.25
WST109, NH	100.00	0.80	100.00	1.00	100.00	0.17

Notes: [1]Percentage of comparisons that pass the criteria listed in Table 5 Values falling below 90 percent are addressed in Table 16.
[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 5 are addressed in Table 16.
%D = percent difference
ppb = parts per billion

Table 16 Ozone QC Observations for Fourth Quarter 2019

Site ID	QC Criterion	Comments
NPT006, ID	Span |%D|	The ozone sample pump malfunctioned in late December 2019. The pump was replaced 1/02/2020. Associated data will be invalidated.

Note: %D = percent difference

Table 17 Trace-level Gas QC Summary for Fourth Quarter 2019

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	0.71	100.00	1.48	100.00	0.14
NO_y	100.00	1.01	100.00	1.55	100.00	0.61
CO	100.00	1.67	47.06	11.95	66.67	24.79
DUK008, NC						
NO_y	81.63	10.21	81.63	10.56	95.92	0.69
HWF187, NY						
NO_y	91.80	9.91	80.33	12.71	93.33	0.43
PND165, WY						
NO_y	100.00	3.98	97.78	4.10	100.00	0.12
PNF126, NC						
NO_y	100.00	2.27	100.00	2.59	100.00	0.16
ROM206, CO						
NO_y	100.00	0.39	100.00	1.44	100.00	0.09

Notes: [1]Percentage of comparisons that pass the criteria listed in Table 6. Values falling below 90 percent are addressed in Table 18.

[2]Absolute value of the average percent differences between the supplied and observed concentrations. Values exceeding the criteria listed in Table 6 are addressed in Table 18.

%D = percent difference
ppb = parts per billion

Table 18 Trace-level Gas QC Observations for Fourth Quarter 2019

Site ID	Parameter	QC Criterion	Comments
BVL130, IL	CO	% Single Point QC Pass Single Point QC |%D| % Zero Pass	The analyzer has continued to malfunction since its reinstallation in late July. Readings will not stabilize. Wood is working with the manufacturer to resolve this issue.
DUK008, NC	NO_y	% Span Pass Span |%D| % Single Point QC Pass Single Point QC |%D|	The analyzer had problems with recurring analyzer drift. The instrument was recalibrated twice during October.
HWF187, NY	NO_y	% Single Point QC Pass Single Point QC |%D|	Failures were caused by a malfunctioning solenoid. It was replaced 12/11/2019.

Notes: %D = percent difference

Table 19 Summary of Filter Blanks for 2019 (1 of 2)

Parameter Name	Detection Limit Total µg	Total Number	Number > Detection Limit	Average Total µg	Average Absolute Deviation	Maximum Total µg
Field Blanks						
Teflon-NH_4^+-N	0.500	319	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.200	319	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.000	319	0	1.000	0.000	1.000
Cl^-	0.500	319	1	0.500	0.000	0.558
Ca^{2+}	0.150	319	13	0.156	0.012	0.818
Mg^{2+}	0.075	319	0	0.075	0.000	0.075
Na^+	0.125	319	3	0.125	0.001	0.173
K^+	0.150	319	2	0.150	0.000	0.173
Nylon- NO_3^--N	0.200	319	0	0.200	0.000	0.200
Nylon - SO_4^{2-}	1.000	319	1	1.001	0.002	1.322
Cellulose - SO_4^{2-}	2.000	319	10	2.008	0.015	2.855
Laboratory Blanks						
Teflon-NH_4^+-N	0.500	96	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.200	96	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.000	96	0	1.000	0.000	1.000
Cl^-	0.500	96	0	0.500	0.000	0.500
Ca^{2+}	0.150	96	3	0.151	0.003	0.205
Mg^{2+}	0.075	96	0	0.075	0.000	0.075
Na^+	0.125	96	0	0.125	0.000	0.125
K^+	0.150	96	1	0.150	0.000	0.168
Nylon- NO_3^--N	0.200	96	1	0.207	0.014	0.888
Nylon -SO_4^{2-}	1.000	96	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.000	96	0	2.000	0.000	2.000

Table 19 Summary of Filter Blanks for 2019 (2 of 2)

Parameter Name	Detection Limit Total µg	Total Number	Number > Detection Limit	Average Total µg	Average Absolute Deviation	Maximum Total µg
Method Blanks						
Teflon-NH_4^+-N	0.500	61	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.200	61	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.000	61	0	1.000	0.000	1.000
Cl^-	0.500	61	0	0.500	0.000	0.500
Ca^{2+}	0.150	62	0	0.150	0.000	0.150
Mg^{2+}	0.075	62	0	0.075	0.000	0.075
Na^+	0.125	62	0	0.125	0.000	0.125
K^+	0.150	62	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.200	60	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.000	60	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.000	62	0	2.000	0.000	2.000
Acceptance Test Values[1]						
Teflon-NH_4^+-N	0.500	216	0	0.500	0.000	0.500
Teflon- NO_3^--N	0.200	216	0	0.200	0.000	0.200
Teflon- SO_4^{2-}	1.000	216	0	1.000	0.000	1.000
Cl^-	0.500	216	1	0.506	0.012	1.830
Ca^{2+}	0.150	216	2	0.150	0.001	0.228
Mg^{2+}	0.075	216	0	0.075	0.000	0.075
Na^+	0.125	216	0	0.125	0.000	0.125
K^+	0.150	216	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.200	340	8	0.203	0.006	0.378
Nylon -SO_4^{2-}	1.000	340	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.000	252	0	2.000	0.000	2.000

Note: [1]Only filter batches passing QC requirements are used for sampling and analysis.

Table 20 Filter Packs Flagged as Suspect or Invalid (1 of 2)

Site ID	Sample	Reason
First Quarter 2019		
ANA115, MI	1902001-03	Calcium and magnesium values were invalidated as suspect.
JOT403, CA	1905003-12	Possible polling issue: flow data were null.
LAV410, CA	1907003-13	Insufficient flow volume due to intermittent power failures
UND002, VT	1910001-52	Insufficient flow volume due to a power failure
YEL408, WY	1901003-24	Data were invalidated as suspect. The sample was installed and left on the tower for four weeks due to the government shutdown.

Table 20 Filter Packs Flagged as Suspect or Invalid (2 of 2)

Second Quarter 2019		
BFT142, NC	1916001-07	The data logger malfunctioned.
FOR605, WY	1918005-03	The mass flow controller malfunctioned.
JOT403, CA	1918003-12	There was a problem with polling. Data may be recovered.
MEV405, CO	1914003-15	The flow pump failed.
NPT006, ID	1918004-04 1922004-04	The data logger malfunctioned.
PET427, AZ	1914003-16	Sampling tower was left down.
SND152, AL	1914001-48	The flow system leaked.
UND002, VT	1917001-52 1922001-52	Power failures interfered with data collection.
Third Quarter 2019		
BBE401, TX	1927003-02 1928003-02 1930003-02	The Teflon filters were perforated. The cause of the filter damage was not determined.
BFT142, NC	1929001-07 1930001-07 1931001-07	The mass flow controller malfunctioned as a result of storm damage.
CAN407, UT	1928003-03	The pump was accidentally turned off.
CHA467, AZ	1928003-04	Insufficient flow volume resulted in data missing for two days out of six.
CHE185, OK	1927004-02	A communications issue resulted in missing flow data.
CVL151, MS	1932001-19	The site was down for infrastructure repairs.
FOR605, WY	1928005-03	The mass flow controller malfunctioned as a result of storm damage.
GRB411, NV	1927003-09	A loose ground wire caused invalid flow values.
JOT403, CA	1931003-12	A leak in the flow system resulted in invalid flow values.
SEK430, CA	1929003-19	The Teflon filter was perforated. The cause of filter damage was not determined but was possibly due to acorn woodpecker activity.
UND002, VT	1927001-52 1928001-52	The flow pump malfunctioned.
Fourth Quarter 2019		
ACA416, ME	1944003-01	Power failure
FOR605, WY	1944005-03	A polling issue resulted in missing data. Data may be recovered.
HOX148, MI	1941001-27	The flow pump failed during week 40. It was replaced 10/12/19.
JOT403, CA	1944003-12	A leak in the flow system resulted in invalid flow values.
LAV410, CA	1941003-13 1943003-13	Power failures
MCK231, KY	1942001-34 1943001-34	The mass flow controller malfunctioned. It was replaced 10/24/19.
PIN414, CA	1943003-17	Power failure
WST109, NH	1941001-58	The mass flow controller malfunctioned. It was replaced 10/10/19.

Table 21 Field Problems Affecting Data Collection

Days to Resolution	Problem Count
First Quarter 2019	
30	365
60	13
90	2
Unresolved by End of Quarter	14
Second Quarter 2019	
30	307
60	5
90	0
Unresolved by End of Quarter	35
Third Quarter 2019	
30	428
60	13
90	1
Unresolved by End of Quarter	31
Fourth Quarter 2019	
30	324
60	5
90	1
Unresolved by Date of Publication	53

Table 22 Field Calibration Failures* by Parameter for 2019

Site ID	Parameter(s)
First Quarter 2019	
ARE128, PA	Temperature (ambient)
DCP114, OH	Temperature (0°C and ambient)
Second Quarter 2019	
EGB181, ON	Temperature (ambient)
Third Quarter 2019	
IRL141, FL	Solar radiation, delta temperature (ambient)
BEL116, MD	Flow
PED108, VA	Flow
WSP144, NJ	Flow
Fourth Quarter 2019	
WST109, NH	Temperature (0°C and ambient)
ABT147, CT	Flow

Note: °C = degrees Celsius

*Shaded parameters failed by more than two times the criterion at the designated sites. Per CASTNET project protocols, data for all parameters except flow are flagged as "suspect" (S) but still considered valid if the calibration criterion is not exceeded by more than its magnitude (i.e., if within two times the criterion). If flow calibrations fall within two times the criterion, these data are adjusted per approved protocol described in the CASTNET QAPP, (Wood, 2019). Please refer to Table 15 for documentation of the QC failures affecting the validity of ozone data.

Table 23 Accuracy Results for 2019 Field Measurements

Parameter	Percent Within Criterion
Flow Rate	96.8
Wind Speed < 5 m/s	100.0
Wind Speed ≥ 5 m/s	100.0
Wind Direction North	100.0
Wind Direction South	100.0
Temperature (0°C)	98.4
Temperature (ambient)	96.8
Delta Temperature (0°C)	100.0
Delta Temperature (ambient)	87.5*
Relative Humidity	100.0
Precipitation	100.0
Solar Radiation	85.7*
Wetness (w/in 0.5 volts)	100.0

Notes: °C = degrees Celsius

m/s = meters per second

* = Per CASTNET project protocols, data are flagged as "suspect" (S) but still considered valid if the calibration criterion is not exceeded by more than its magnitude (i.e., if within two times the criterion). All calibration failures reported in 2019 for the indicated parameters were within two times the criterion with the exception of the parameters with colored shading at the sites listed in Table 22. Associated data were invalidated for failures exceeding two times the criterion.

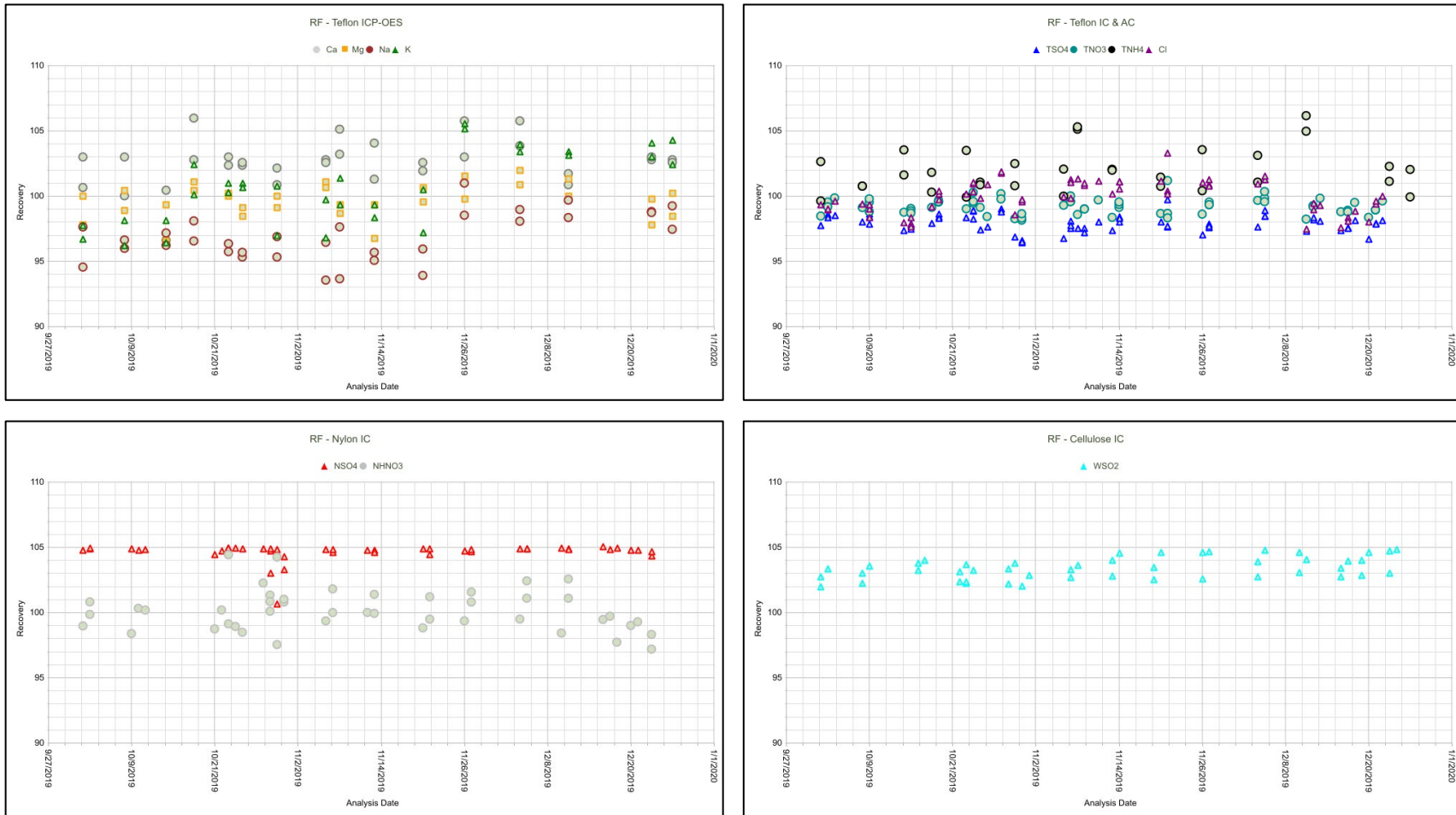**Figure 1** Reference Standard Results for Fourth Quarter 2019 (percent recovery)

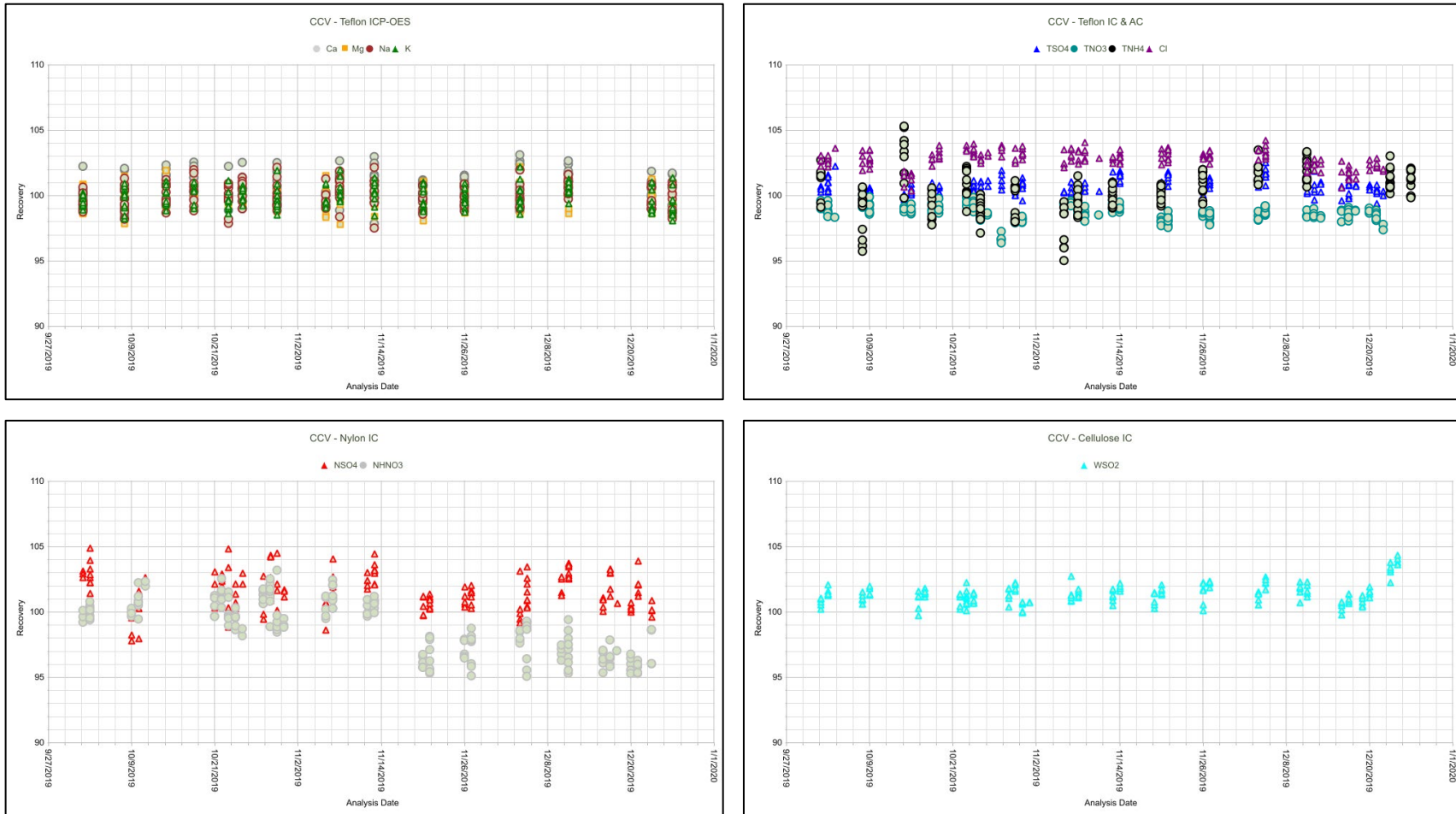**Figure 2** Continuing Calibration Spike Results for Fourth Quarter 2019 (percent recovery)

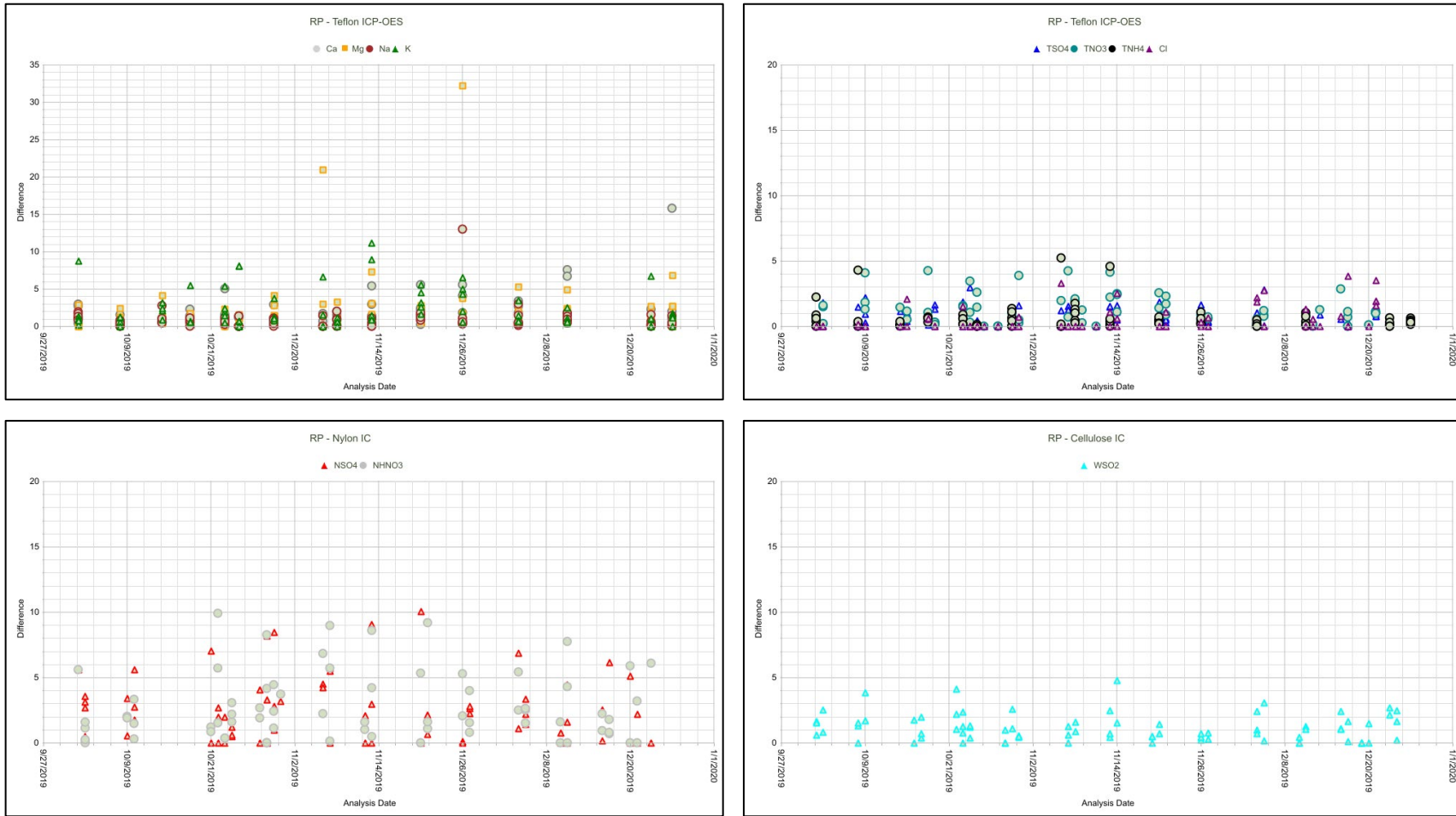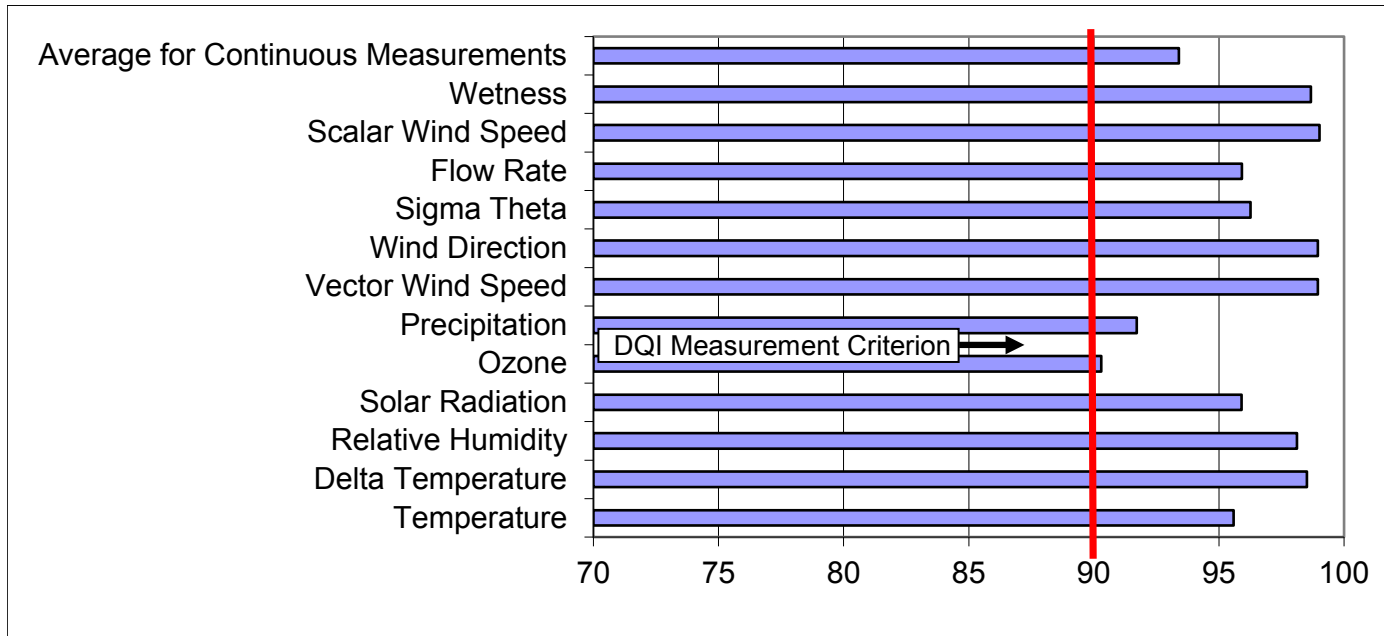**Figure 3** Replicate Sample Analysis Results for Fourth Quarter 2019 (percent difference)

Figure 4 Percent Completeness of Measurements for Second Quarter 2018 through Third Quarter 2019[*]

Note: *Presents Level 3 data available during the fourth quarter of 2019

Figure 5 Laboratory Control Sample Results for Fourth Quarter 2019 (percent recovery)
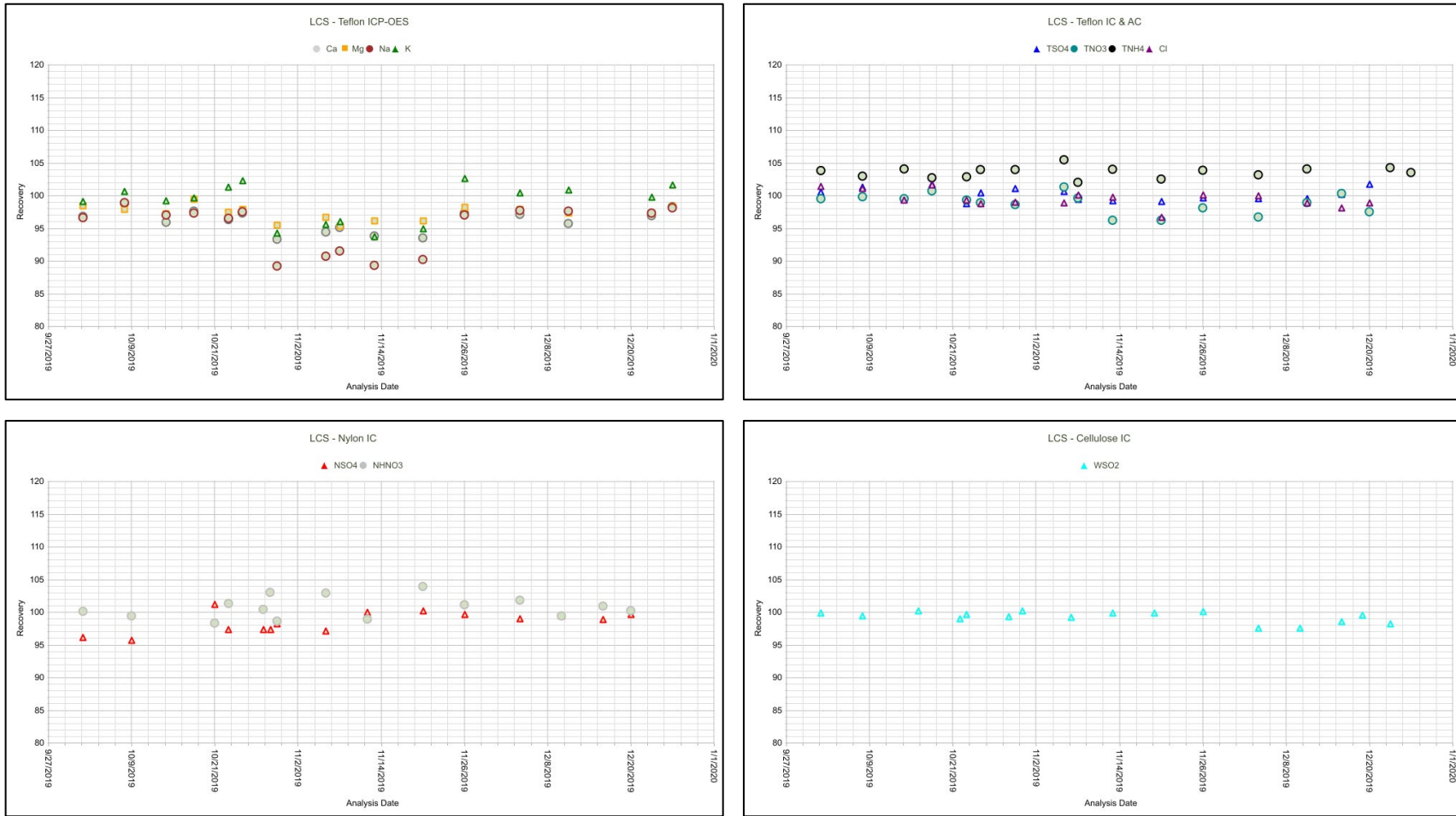
Figure 6 Method Blank Analysis Results for Fourth Quarter 2019 (total micrograms)
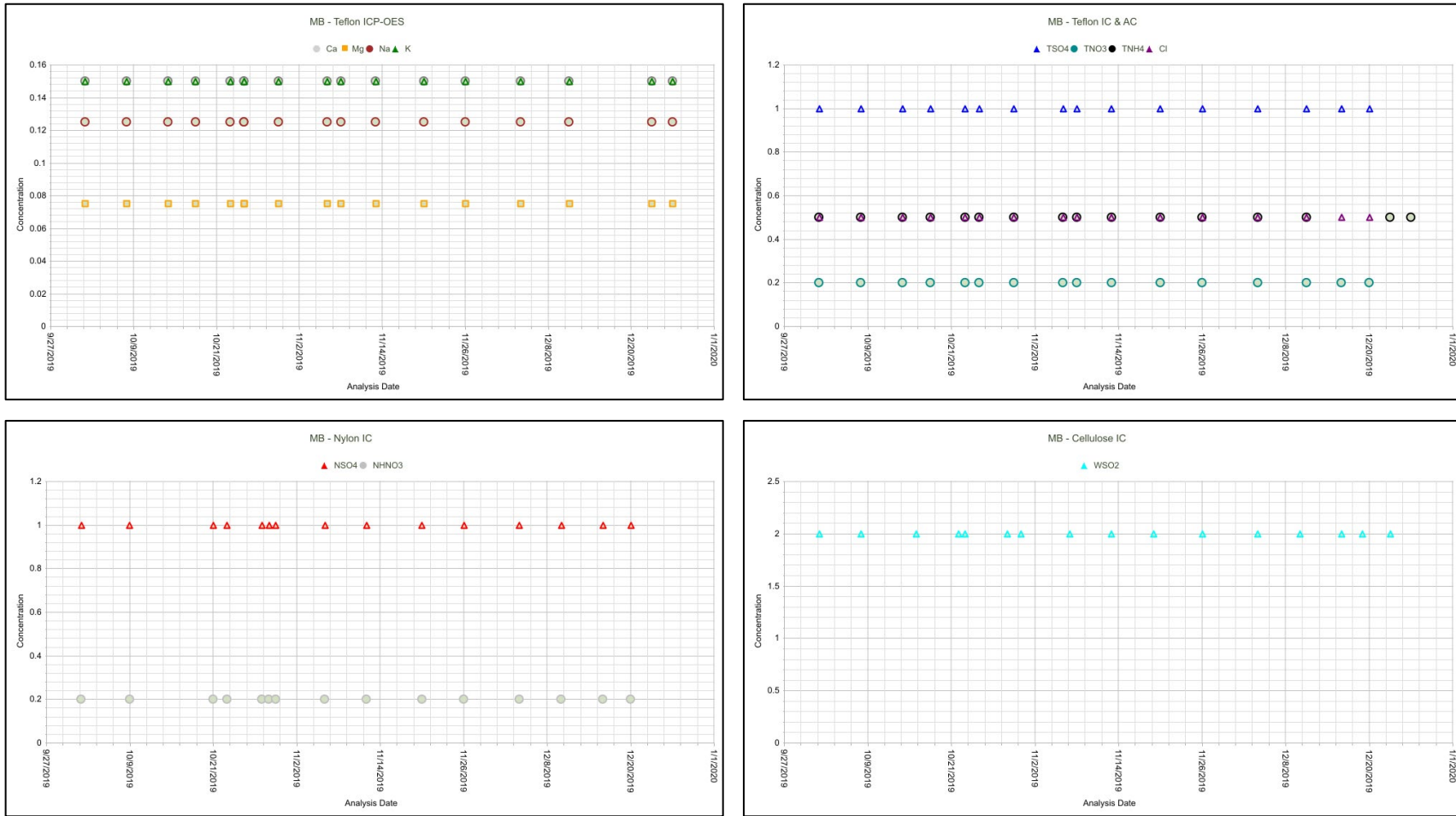
Figure 7 Laboratory Blank Analysis Results for Fourth Quarter 2019 (total micrograms)
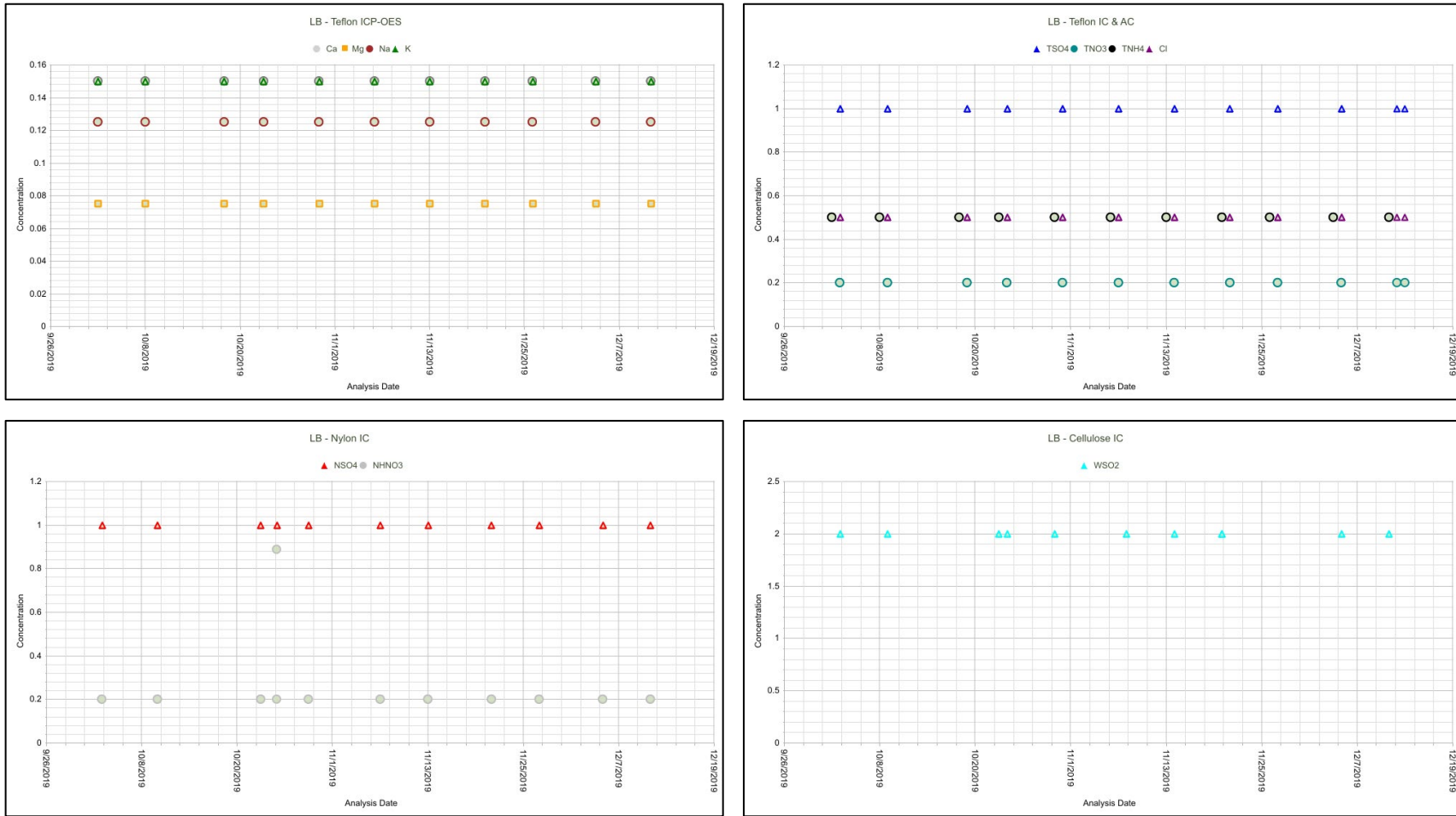
Figure 8 Field Blank Analysis Results for Fourth Quarter 2019 (total micrograms)