Summary of Quarterly Operations (October – December) with 2010 Annual Summary

EPA Contract No. EP-W-09-028

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 2010. It also provides an annual summary that includes data from the three previous quarters. The results presented for filter pack data collection and field calibrations are generated from data extracted from the CASTNET Data Management Center database using the CASTNET Data Management System Application. The various QA/QC criteria and policies are documented in the CASTNET Quality Assurance Project Plan (QAPP). 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 2010

During first quarter 2010, MACTEC prepared and submitted samples of a new format for standard operating procedures (SOP) for the field, laboratory, and data SOPs. EPA approved the proposed changes, which include flow charts, photographs, and illustrations along with rewritten text to better explain the steps required. The new SOPs are included in the QAPP Revision 7.0 draft.

Restrictions on the availability of external field auditor findings and comments were lifted by EPA. During the CASTNET III contract, only audit findings of unsafe conditions were immediately released to the contractor operating the site (i.e., MACTEC or Air Resource Specialists, Inc.). Review of audit report findings was restricted to the QA Manager until after the site's subsequent calibration. As of March 2010, spot reports and audit findings for EPA-sponsored sites began being disseminated to MACTEC as soon as the reports are available.

The CASTNET QAPP Revision 6.0 was approved by EPA during May 2010.

During second quarter, MACTEC upgraded the laboratory instruments used for CASTNET. MACTEC obtained four new autosamplers, two new ion chromatographs, and a new inductively coupled argon plasma atomic emission spectrometer. Data comparisons were run to ensure proper operation and compatibility with CASTNET analyses. The SOPs for the new instruments were modified as needed and submitted with the CASTNET QAPP Revision 7.0 draft.

During March 2010, final results were received by MACTEC for analyses completed for proficiency test (PT) study (0095) 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. MACTEC performed well on the analyses for all parameters except conductivity. Conductivity is not required for CASTNET analyses; however, it is required for the cloud water samples obtained through the Mountain Acid Deposition Program (MADPro). MACTEC tested the conductivity meter and discovered that it was no longer functioning reliably. The meter and probe were replaced prior to the start of the 2010 cloud water sampling season for MADPro.

Battelle Memorial Institute (Battelle) conducted an audit of the MACTEC laboratory on August 16, 2010. The audit evaluated sample media handling procedures for Task Order 0011, Analytical Support for Environmental Testing and Verification (ETV) Program, as well as laboratory analyses. The audit report indicated that MACTEC's laboratory and handling procedures met audit criteria with the exception of two minor findings. The Battelle auditor noted: 1) documentation of personnel training in the methods performed was insufficient, and 2) thermometers used in laboratory refrigerators had not been recertified. Overall, the audit indicated that MACTEC laboratory personnel had detailed knowledge of the procedures that they perform and were thoroughly cross-trained. MACTEC addressed both findings to the satisfaction of Battelle prior to the completion of Task Order 0011.

During third quarter 2010, EPA's external auditor (ee&ms) performed an unofficial performance evaluation audit on the Air Quality System (AQS)-protocol ozone system at the PED108, VA CASTNET site. Representatives from EPA and MACTEC attended the audit to provide ee&ms with information on the new AQS-protocol ozone setup approved for use at CASTNET sites. The unofficial audit also provided an opportunity for discussion and feedback regarding audit methods versus calibration methods for other instruments, as well as the AQS-protocol ozone setup. Data collected after September 30, 2010, from the 19 AQS-protocol CASTNET sites will be validated and submitted to AQS in March 2011. Each AQS-protocol site will be audited annually by ee&ms.

During third quarter 2010, EPA, MACTEC, the National Park Service (NPS), and Air Resource Specialists (ARS) developed an ozone data screening protocol for application to ozone data collected from all sites. The screening protocol includes rules for annual review screening and

validation. Some of the rules include identifying percentiles out of bounds, discontinuities in concentration data, correlation with site visits, and correlation with synoptic weather patterns. Ozone data identified by the screening will require additional review. Data may also be compared to data from nearby sites.

Possible sources for the suspected intermittent potassium contamination of filters used for filter packs and filter blanks continued to be investigated during third and fourth quarter 2010. Audits of all stages of handling procedures (e.g., filter pack packing and unpacking, extraction and analysis, and impregnation of the potassium carbonate filters) indicated that SOPs are followed, and contamination is not likely to be introduced by current handling methods. Additionally, the reagents used were checked and verified to be stored properly. Recent investigations have included verifying that adequate time is allowed for drying freshly impregnated cellulose filters and reviewing sample intake coding. Review of the intake coding procedures resulted in clarification of the defining rule for coding filters as being excessively wet. A filter with visible wetness is to be coded as "excessive wetness." It is generally believed that the upgrade of the heating, ventilation, and air conditioning (HVAC) system and resultant construction for installation of new ducts, vents, and thermostats at MACTEC's laboratory contributed to the contamination. Currently, the room where filters are handled is being isolated during handling procedures. Only filter packs and filter blanks have showed evidence of contamination. Method blanks, filter acceptance test results, and all other QC samples remained within established limits. Investigation of potential sources for the suspected contamination is ongoing.

During fourth quarter 2010, the annual internal technical systems audits of the CASTNET analytical laboratory and the CASTNET field instrumentation laboratory were performed by the CASTNET Quality Assurance Manager, Laboratory Operations Manager, and select field operations personnel. These audits are designed to verify conformance of laboratory activities with those established by the QAPP and associated SOPs. In general, the activities and facilities audited were in compliance with project requirements. The project team overall adheres to established procedures and documents activities as required.

Quarterly/Annual Summary

Collocated filter pack precision data and completeness data for meteorological measurements are presented for data validated to Level 3 during the quarter/year. Table 1 lists the quarters of data that were validated to Level 3 during 2010 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.

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 5 through 8 present the number of analyses in each category that were performed during each quarter of 2010.

Sample Receipt Statistics

EPA requires that 95 percent of field samples from EPA-sponsored sites be received by the CASTNET laboratory in Gainesville, FL no later than 14 days after removal from the sampling tower. Table 9 presents the relevant sample receipt statistics for each of the four quarters of 2010 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 2010. All results were within the criteria listed in Table 4 with the exception of two individual RP results. However, these are considered reasonable since higher relative percent differences generally correlate with lower sample concentrations. These samples were both less than twice the reporting limit. Table 10 presents the percent recoveries and standard deviations for RF, CCV, and RP QC sample analyses for 2010. Quarterly averages are all within criteria.

Table 11 presents quarterly collocated filter pack precision results for data validated to Level 3 during the year. Results for MCK131/231, KY were within criteria for 10 of the 11 parameters reported. Results for ROM406/206, CO were within criteria for 9 of the 11 parameters. The majority of site-parameters were within the current 20 percent criterion.

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

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. The current action limits for LCS recovery are 80 percent and 120 percent. Figure 5 presents LCS analysis results for fourth quarter 2010.

Blank Results

Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for fourth quarter 2010. All results were within criteria (two times the reporting limit) listed in Table 4. Table 12 summarizes the record of filter blanks for 2010. In addition to the potassium issue previously noted, the FB data also show a transient problem with nylon filter sulfate results. During the first quarter of 2010, there were 12 FB results between 2 and 7.5 times the reporting limit. While no systemic problems were indicated upon review, these results were unusual. FB samples were re-analyzed and reported results confirmed. Other QC blanks in the data batches associated with these samples were within their established criteria, as were the RF, RP, and CCV samples. Filter media acceptance tests were also within criteria. Additionally, the laboratory routinely analyses the solutions used to extract filter media. No responses were detected during these tests.

Suspect/Invalid Filter Pack Samples

Filter pack samples that were flagged as suspect or invalid during each of the four quarters of 2010 are listed in Table 13. This table also includes associated site identification and a brief description of the reason the sample was flagged. During fourth quarter, 12 filter pack samples were invalidated due to insufficient flow volume.

Field Problem Count

Table 14 presents counts of field problems affecting continuous data collection for more than one day for each quarter during quarter 2010. 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. The time period does not correlate with the quantity of data affected. For example, if a 5-hour block of missing data takes 60 days to replace, it will show up in the 60-day category. By the same token, a site missing 200 hours of data due to the damage caused by a lightning strike will show up in the 30-day category if the site is repaired within 30 days, even though the data cannot be replaced.

Field Calibration Results

A summary of field calibration failures by parameter for each quarter of 2010 is listed in Table 15. Calibrations were performed at 20 sites during fourth quarter 2010. For fourth quarter, all sites and parameters were within the criteria listed in Table 3 with the exception of the parameters at the six sites that are listed in Table 15.

Table 16 presents field accuracy results for 2010 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.

Tables and Figures

Table 1. Data Validated to Level 3 during Fourth Quarter 2010

Calibration Group*	Months Available	Number of Months	Complete Quarters**	Number of Quarters
SE-4 MW-6†	July 2009 – June 2010	12	Quarter 3 2009 – Quarter 2 2010	4
E-1 SE-5	August 2009 – July 2010	12	Quarter 4 2009 – Quarter 2 2010	3
MW-7 W-9	September 2009 – August 2010	12	Quarter 4 2009 – Quarter 2 2010	3
E-2 MW-8	October 2009 – September 2010	12	Quarter 4 2009 – Quarter 3 2010	4
E-3 W-10‡	May 2009 – April 2010	12	Quarter 3 2009 – Quarter 1 2010	3

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

Table 2. Field Calibration Schedule

Calibration Groups	Months Calibrated	Sites Calibrated			
Eastern Sites (20 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 (7 Sites)	April/October	ABT147, CT WST109, NH	HOW132, ME ASH135, ME	CAT175, NY HWF187, NY	EGB181 ON
E-3 (5 Sites)	May/November	KEF112, PA MKG113, PA	LRL117, PA PAR107, WV	CDR119, WV	
Southeastern Sites (10 Total)					
SE-4 (6 Sites)	January/July	SND152, AL GAS153, GA	BFT142, NC CND125, NC	COW137, NC PNF126, NC	
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	ESP127, TN SPD111, TN	
MW-7 (8 Sites)	March/September	ALH157, IL BVL130, IL	STK138, IL VIN140, IN	DCP114, OH OXF122, OH	QAK172, OH PRK134, WI
MW-8 (5 Sites)	April/October	SAL133, IN HOX148, MI	ANA115, MI UVL124, MI	LYK123, OH	
Western Sites (10 Total)					
W-9 (4 Sites)	March/September	KNZ184, KS CHE185, OK	SAN189, NE ALC188, TX		
W-10 (6 Sites)	May/November	CON186, CA PAL190, TX	GTH161, CO ROM206, CO	CNT169, WY PND165, WY	

Table 3. Data Quality Indicators for CASTNET Continuous Measurements

Measurement		Criteria*	
Parameter	**Method**	**Precision**	**Accuracy**
Filter pack flow	Mass flow controller	± 10%	± 5%
Ozone	UV absorbance	± 10% (of reading)	± 10%
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†
Solar radiation	Pyranometer	± 10% (of reading taken at local noon)	± 10%
Surface wetness	Conductivity bridge	Undefined	Undefined

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

* Precision criteria apply to collocated instruments, and accuracy criteria apply to calibration of instruments
† For target value of 0.50 inch

Table 4. Data Quality Indicators for CASTNET Laboratory Measurements

Analyte	Medium	Method	Precision[1] (MARPD)	Accuracy[2] (%)	Nominal Reporting Limits	
					mg/L	µg/Filter
Ammonium (NH_4^+)	F	AC	20	90 - 110	0.020 *	0.5
Sodium (Na^+)	F	ICP-AES	20	95 - 105	0.005	0.125
Potassium (K^+)	F	ICP-AES	20	95 - 105	0.006	0.15
Magnesium (Mg^{2+})	F	ICP-AES	20	95 - 105	0.003	0.075
Calcium (Ca^{2+})	F	ICP-AES	20	95 - 105	0.006	0.15
Chloride (Cl^-)	F	IC	20	95 - 105	0.020	0.5
Nitrate (NO_3^-)	F	IC	20	95 - 105	0.008 *	0.2
Sulfate (SO_4^{2-})	F	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. The goal for the RPD criterion changed to 20 percent at the onset of the CASTNET IV contract beginning on August 11, 2009.
[2] This column lists laboratory accuracy goals based on reference standards and continuing calibration verification spikes. The criterion is 90-110 percent for ICP-AES reference standards.

F = filter pack samples
AC = automated colorimetry
ICP-AES = inductively coupled plasma-atomic emission spectrometry
IC = ion chromatography
MARPD = mean absolute relative percent difference
* = as nitrogen

For more information on analytical methods and associated precision and accuracy criteria, see the CASTNET QAPP, Revision 6.0. (MACTEC, 2010).

Table 5. QC Analysis Count for First Quarter 2010

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-}	34	172	78	17	26	115
	NO_3^-	34	172	78	17	26	115
	NH_4^+	32	167	80	17	26	114
	Cl^-	34	172	78	17	26	115
	Ca^{2+}	32	168	78	16	26	114
	Mg^{2+}	32	168	78	16	26	114
	Na^+	32	168	78	16	26	114
	K^+	32	168	78	16	26	114
Nylon	SO_4^{2-}	35	167	78	18	28	91
	NO_3^-	35	167	78	18	28	91
Cellulose	SO_4^{2-}	44	170	85	22	28	89

Table 6. QC Analysis Count for Second Quarter 2010

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-}	37	186	89	18	28	86
	NO_3^-	37	186	89	18	28	86
	NH_4^+	34	182	94	17	28	86
	Cl^-	37	186	89	18	28	86
	Ca^{2+}	34	189	92	17	28	86
	Mg^{2+}	34	189	92	17	28	86
	Na^+	34	189	92	17	28	86
	K^+	34	189	92	17	28	86
Nylon	SO_4^{2-}	45	180	88	20	24	101
	NO_3^-	45	180	88	20	24	101
Cellulose	SO_4^{2-}	50	184	90	23	26	84

Table 7. QC Analysis Count for Third Quarter 2010

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-}	41	196	91	20	26	83
	NO_3^-	41	196	91	20	26	83
	NH_4^+	40	206	103	19	26	83
	Cl^-	41	196	90	20	26	83
	Ca^{2+}	39	203	99	19	26	83
	Mg^{2+}	39	203	99	19	26	83
	Na^+	39	203	99	19	26	83
	K^+	39	203	99	19	26	83
Nylon	SO_4^{2-}	41	200	95	19	28	81
	NO_3^-	41	200	95	19	28	81
Cellulose	SO_4^{2-}	41	178	90	22	26	83

Table 8. QC Analysis Count for Fourth Quarter 2010

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-}	37	166	80	16	22	42
	NO_3^-	37	166	80	16	22	42
	NH_4^+	30	159	81	15	22	42
	Cl^-	37	166	78	16	22	42
	Ca^{2+}	34	165	74	16	22	42
	Mg^{2+}	34	165	74	16	22	42
	Na^+	34	165	74	16	22	42
	K^+	34	165	74	16	22	42
Nylon	SO_4^{2-}	35	178	84	17	22	58
	NO_3^-	35	178	84	17	22	58
Cellulose	SO_4^{2-}	38	148	72	18	22	42

Table 9. Filter Pack Receipt Summary (2010)

Description	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual Summary
Count of samples received more than 14 days after removal from tower:	5	1	10	9	25
Count of all samples received:	696	761	758	758	2,973
Fraction of samples received within 14 days:	0.993	0.999	0.987	0.988	0.992*
Average interval in days:	5.092	4.947	5.431	5.227	5.174*
First receipt date:	01/04/2010	04/01/2010	07/01/2010	10/01/2010	01/04/2010
Last receipt date:	03/26/2010	06/30/2010	09/30/2010	12/30/2010	12/30/2010

Note: *annual average

Table 10. Filter Pack QC Summary for 2010

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-}	97.54	1.19	149	99.86	1.17	720	0.49	0.71	338
	NO_3^-	99.77	1.19	149	100.44	1.21	720	0.99	1.91	338
	NH_4^+	99.76	1.66	136	98.69	1.39	714	0.68	0.89	357
	Ca^{2+}	99.83	2.80	139	100.20	1.09	725	1.04	1.15	343
	Mg^{2+}	102.53	2.18	139	99.95	0.94	725	1.40	1.64	343
	Na^+	100.97	2.17	139	100.07	1.12	725	1.13	1.50	343
	K^+	97.83	2.87	139	100.04	0.93	725	1.75	1.93	343
	Cl^-	103.09	1.10	149	100.27	1.34	720	2.33	4.44	335
Nylon	SO_4^{2-}	98.01	1.15	156	99.74	1.10	725	2.50	2.55	345
	NO_3^-	100.37	1.13	156	100.52	1.09	725	1.07	1.47	345
Cellulose	SO_4^{2-}	99.04	1.58	176	100.32	1.49	680	1.13	1.58	337

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 11. Precision Results for Third Quarter 2009 through Second Quarter 2010

Site Pairs	SO_4^{2-}	NO_3^-	NH_4^+	Ca^{2+}	Mg^{2+}	Na^+	K^+	Cl^-	HNO_3	SO_2	Total NO_3^-
MCK131/231, KY											
2009 Q3	1.44	10.47	1.75	5.81	6.54	3.35	22.95	0.25	6.41	6.99	5.52
2009 Q4	2.69	6.61	11.94	8.07	6.96	5.89	24.59	2.72	12.30	5.68	6.89
2010 Q1	3.58	7.17	4.57	10.37	10.58	5.71	16.99	8.67	5.84	3.92	5.86
2010 Q2	2.52	13.57	2.54	6.38	4.91	4.82	15.96	0.90	4.15	4.42	4.78
Average	2.56	9.50	5.20	7.66	7.25	4.94	20.12	3.14	7.18	5.25	5.76
ROM406/206, CO											
2009 Q3	1.92	11.89	3.90	8.21	8.07	5.09	21.47	5.85	4.95	3.54	3.34
2009 Q4	6.01	21.83	6.80	12.03	9.86	8.26	46.70	4.20	9.62	8.31	10.61
2010 Q1	13.39	11.96	15.94	15.12	15.48	14.11	26.44	2.94	11.90	9.57	12.53
2010 Q2	7.51	3.08	6.92	16.14	14.73	11.46	23.62	6.35	11.37	7.55	7.15
Average	7.21	12.19	8.39	12.88	12.04	9.73	29.56	4.84	9.46	7.24	8.41

Note: 7 of 88 site-quarter-parameters were outside criterion

Table 12. Summary of Filter Blanks for 2010 (page 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	325	0	0.500	0.000	0.500
Teflon®- NO_3^--N	0.200	326	4	0.201	0.001	0.263
Teflon®- SO_4^{2-}	1.000	326	0	1.000	0.000	1.000
Cl^-	0.500	326	0	0.500	0.000	0.500
Ca^{2+}	0.150	325	5	0.151	0.002	0.282
Mg^{2+}	0.075	325	0	0.075	0.000	0.075
Na^+	0.125	325	0	0.125	0.000	0.125
K^+	0.150	325	13	0.161	0.021	0.885
Nylon- NO_3^--N	0.200	331	0	0.200	0.000	0.200
Nylon - SO_4^{2-}	1.000	331	37	1.141	0.255	7.475
Cellulose - SO_4^{2-}	2.000	298	4	2.043	0.957	9.365
LABORATORY BLANKS						
Teflon®-NH_4^+-N	0.500	102	0	0.500	0.000	0.500
Teflon®- NO_3^--N	0.200	102	0	0.200	0.000	0.200
Teflon®- SO_4^{2-}	1.000	102	0	1.000	0.000	1.000
Cl^-	0.500	102	0	0.500	0.000	0.500
Ca^{2+}	0.150	102	1	0.150	0.000	0.150
Mg^{2+}	0.075	102	0	0.075	0.000	0.075
Na^+	0.125	102	0	0.125	0.000	0.125
K^+	0.150	102	7	0.157	0.013	0.625
Nylon- NO_3^--N	0.200	102	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.000	102	2	1.005	0.009	1.392
Cellulose -SO_4^{2-}	2.000	102	0	2.000	0.000	2.000
METHOD BLANKS						
Teflon®-NH_4^+-N	0.500	67	0	0.500	0.000	0.500
Teflon®- NO_3^--N	0.200	71	0	0.200	0.000	0.200
Teflon®- SO_4^{2-}	1.000	71	0	1.000	0.000	1.000
Cl^-	0.500	71	1	0.500	0.001	0.533
Ca^{2+}	0.150	68	0	0.150	0.000	0.150
Mg^{2+}	0.075	68	0	0.075	0.000	0.075
Na^+	0.125	68	0	0.125	0.000	0.125
K^+	0.150	68	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.200	74	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.000	74	0	1.000	0.000	1.000
Cellulose -SO_4^{2-}	2.000	85	0	2.000	0.000	2.000

Table 12. Summary of Filter Blanks for 2010 (page 2 of 2)

Parameter Name	Detection Limit Total µg	Total Number	Number > Detection Limit	Average Total µg	Average Absolute Deviation	Maximum Total µg
ACCEPTANCE TEST VALUES						
Teflon®-NH_4^+-N	0.500	240	0	0.500	0.000	0.500
Teflon®- NO_3^--N	0.200	240	3	0.201	0.002	0.325
Teflon®- SO_4^{2-}	1.000	240	1	1.000	0.000	1.002
Cl^-	0.500	240	0	0.500	0.000	0.500
Ca^{2+}	0.150	240	1	0.150	0.001	0.229
Mg^{2+}	0.075	240	0	0.075	0.000	0.075
Na^+	0.125	240	1	0.125	0.000	0.185
K^+	0.150	240	0	0.150	0.000	0.150
Nylon- NO_3^--N	0.200	240	0	0.200	0.000	0.200
Nylon -SO_4^{2-}	1.000	240	1	1.001	0.002	1.200
Cellulose -SO_4^{2-}	2.000	288	0	2.000	0.000	2.000

Note: Cellulose filters are not analyzed for ambient NO_3^-. The blank results are used only for QC.

Table 13. Filter Packs Flagged as Suspect or Invalid

Site ID	Sample	Reason
First Quarter 2010		
CAN407, UT	1002001-14	Insufficient flow
CHE185, OK	1010001-19	Insufficient flow
CON186, CA	1004001-23	Power failure
	1005001-23	Power failure
DCP114, OH	1010001-27	Polling problems
IRL141, FL	1006001-41	Insufficient flow
KEF112, PA	1009001-43	Insufficient flow
MOR409, WA	1008001-53	Insufficient flow
OXF122, OH	1007001-54	Insufficient flow
PED108, VA	1007001-57	Insufficient flow
THR422, ND	1004001-75	Insufficient flow
	1005001-75	Insufficient flow
VOY413, MN	1004001-78	Insufficient flow
WST109, NH	1009001-82	Polling problems
Second Quarter 2010		
CKT136, KY	1015001-20	Insufficient flow
CON186, CA	1019001-23	Insufficient flow
SUM156, FL	1023001-74	Insufficient flow
THR422, ND	1019001-75	Insufficient flow
VOY413, MN	1021001-78	Insufficient flow
WNC429, SD	1015001-80	Insufficient flow
	1016001-80	Insufficient flow
	1017001-80	Insufficient flow
	1021001-80	Insufficient flow
	1022001-80	Insufficient flow
Third Quarter 2010		
ARE128, PA	1030001-06	Insufficient flow
	1031001-06	Insufficient flow
BEL116, MD	1030001-09	Insufficient flow
BWR139, MD	1033001-12	Insufficient flow
CTH110, NY	1037001-25	Insufficient flow
GRB411, NV	1032001-34	Insufficient flow
	1033001-34	Insufficient flow
JOT403, CA	1035001-42	Insufficient flow
LYK123, OH	1029001-47	Insufficient flow
PAL190, TX	1033001-55	Insufficient flow
PET427, AZ	1032001-58	Insufficient flow
PNF126, NC	1030001-61	Insufficient flow
PSU106, PA	1032001-63	Insufficient flow
ROM206, CO	1028001-65	Insufficient flow
SAL133, IN	1029001-67	Insufficient flow
VPI120, VA	1031001-79	Insufficient flow
	1032001-79	Insufficient flow
WNC429, SD	1031001-80	Insufficient flow

Site ID	Sample	Reason
Fourth Quarter 2010		
ARE128, PA	1041001-06	Insufficient flow
	1047001-06	Insufficient flow
CHA467, AZ	1048001-18	Insufficient flow
CNT169, WY	1048001-22	Insufficient flow
GAS153, GA	1044001-32	Insufficient flow
MCK131, KY	1043001-49	Insufficient flow
MEV405, CO	1046001-51	Insufficient flow
PAL190, TX	1046001-55	Insufficient flow
PSU106, PA	1047001-63	Insufficient flow
ROM206, CO	1045001-65	Insufficient flow
VOY413, MN	1047001-78	Insufficient flow
WNC429, SD	1041001-80	Insufficient flow

Table 14. Field Problems Affecting Data Collection

Days to Resolution	Problem Count
First Quarter 2010	
30	96
60	7
90	1
Unresolved by End of Quarter	3
Second Quarter 2010	
30	132
60	14
90	1
Unresolved by End of Quarter	12
Third Quarter 2010	
30	146
60	8
90	1
Unresolved by End of Quarter	3
Fourth Quarter 2010	
30	102
60	4
90	0
Unresolved by Date of Publication	10

Table 15. Field Calibration Failures by Parameter for 2010

Site ID	Parameter(s)
First Quarter 2010	
CDZ171, KY	Wind Direction
CKT136, KY	Flow Rate
CND125, NC	Solar Radiation Precipitation
ESP127, TN	Precipitation
GAS153, GA	Solar Radiation
MCK131, KY	Solar Radiation Wind Direction Wind Speed
PSU106, PA	Wind Direction
Second Quarter 2010	
CON186, CA	Solar Radiation
GTH161, CO	Ozone
HOX148, MI	Precipitation
Third Quarter 2010	
PED108, VA	Precipitation
PNF126, NC	Solar Radiation
VPI120, VA	Relative Humidity
Fourth Quarter 2010	
ABT147, CT	Solar Radiation
ANA115, MI	Wind Direction
CAT175, NY	Solar Radiation
GTH161, CO	Ozone
HWF187, NY	Wind Direction
UVL124, MI	Solar Radiation

Note: Per CASTNET project protocols, data are flagged as "suspect" (S) but still considered valid if the calibration criterion is not exceeded by more that its magnitude (i.e., if within 2x the criterion). If ozone or flow calibrations fall within 2x the criteria, these data are adjusted per approved protocol described in the CASTNET QAPP, Revision 6.0 (MACTEC, 2010).

Table 16. Accuracy Results for 2010 Field Measurements

Parameter	Percent Within Criterion
Flow Rate	98.9 percent
Ozone Slope	97.7 percent
Ozone Intercept	100.0 percent
Wind Speed < 5 m/s	100.0 percent
Wind Speed ≥ 5 m/s	98.9 percent
Wind Direction North	96.6 percent
Wind Direction South	96.6 percent
Temperature (0°C)	100.0 percent
Temperature (ambient)	100.0 percent
Delta Temperature (0°C)	100.0 percent
Delta Temperature (ambient)	100.0 percent
*Relative Humidity	98.9 percent
Precipitation	95.5 percent
*Solar Radiation	90.9 percent
Wetness (w/in 0.5 volts)	100.0 percent

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 2x the criterion).

Figure 1. Reference Standard Results for Fourth Quarter 2010 (percent recovery)

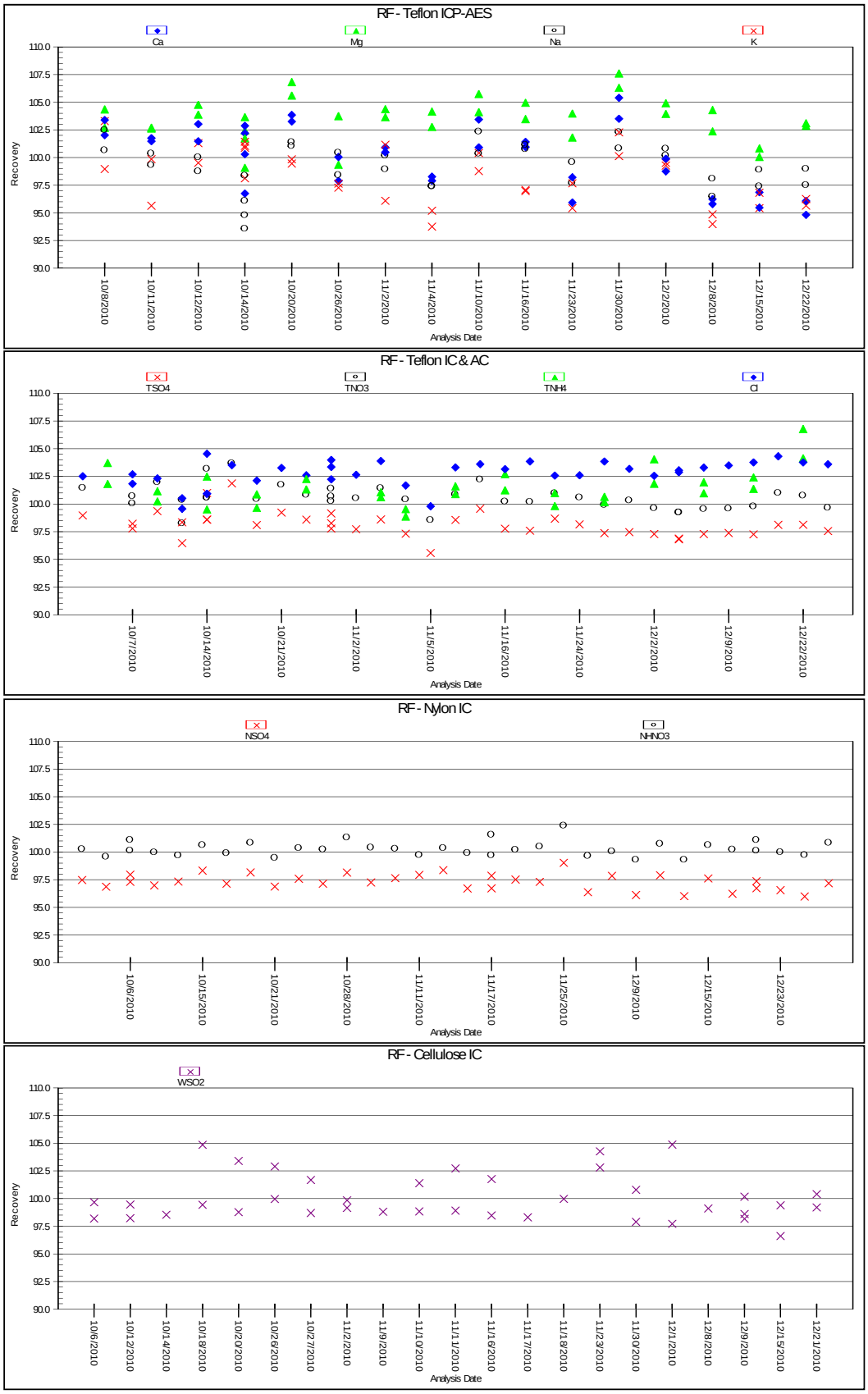


Figure 2. Continuing Calibration Spike Results for Fourth Quarter 2010 (percent recovery)

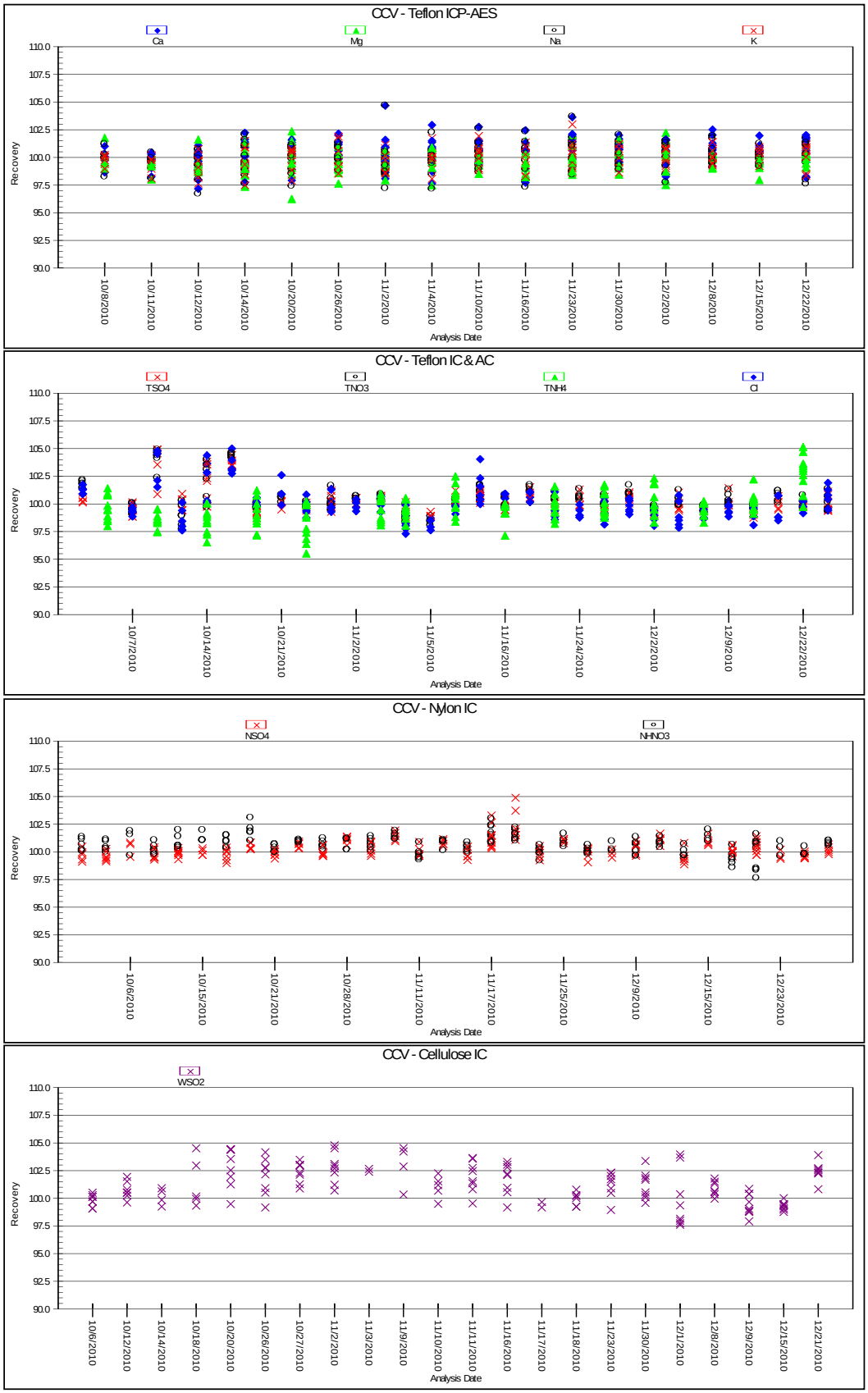


Figure 3. Replicate Sample Analysis Results for Fourth Quarter 2010 (total micrograms)

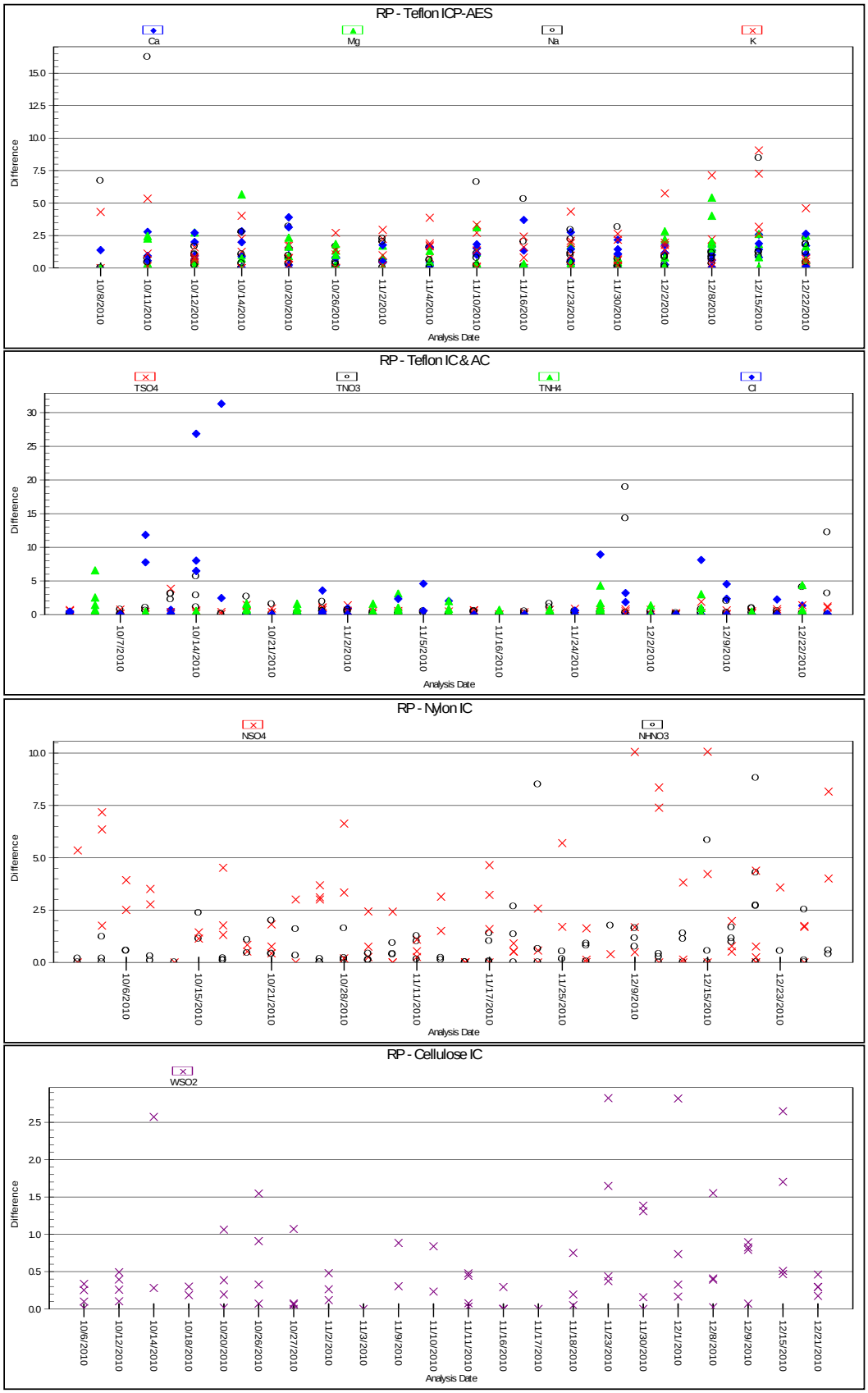
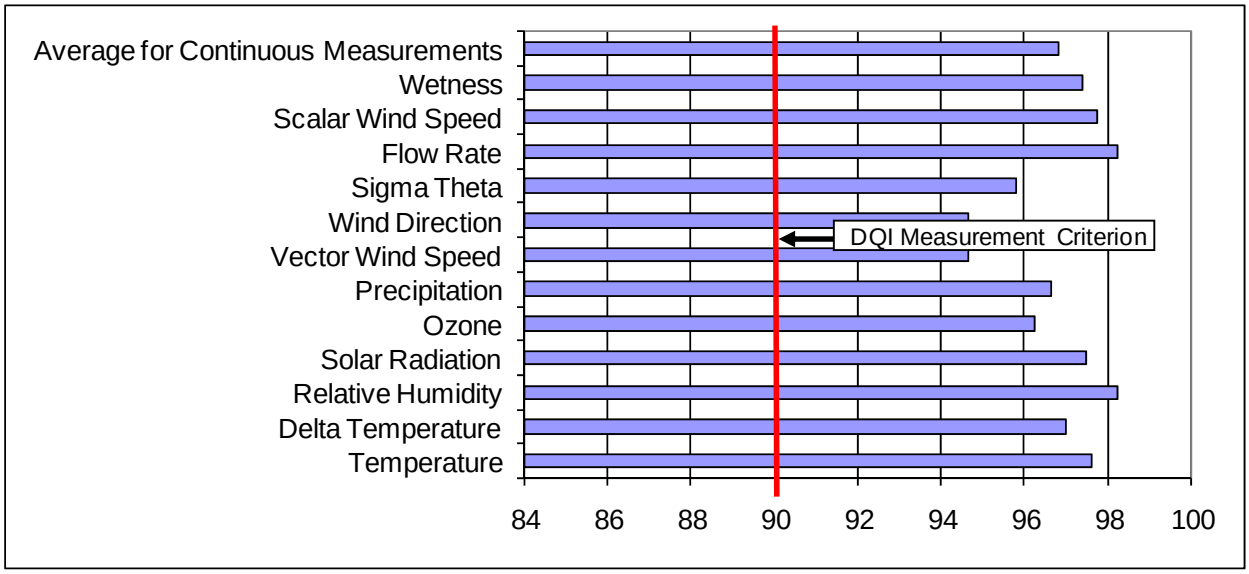


Figure 4. Percent Completeness of Measurements for Fourth Quarter 2009 through Fourth Quarter 2010*



Note: *Presents Level 3 data available during the fourth quarter of 2010.

Figure 5. Laboratory Control Sample Results for Fourth Quarter 2010 (percent recovery)

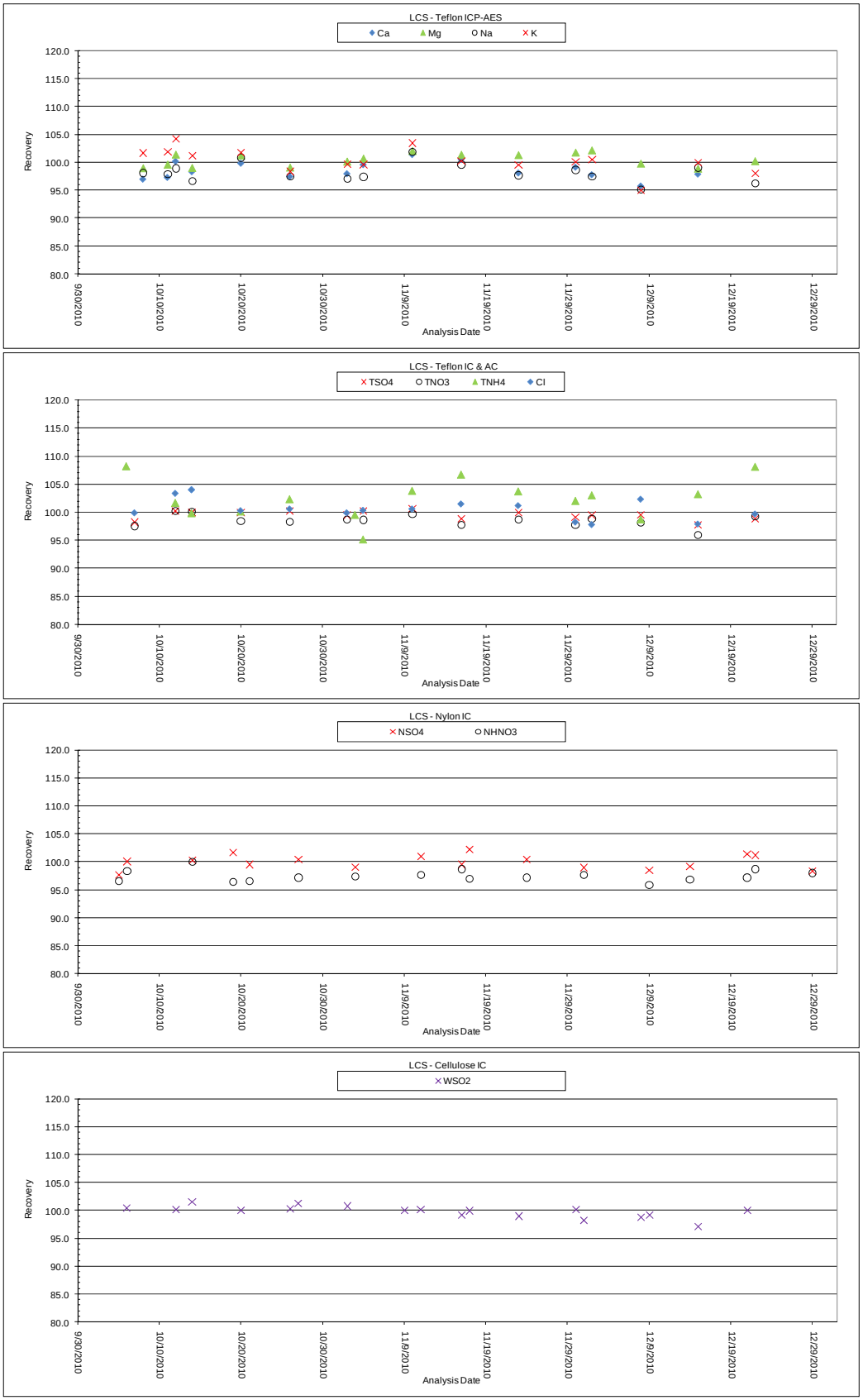


Figure 6. Method Blank Analysis Results for Fourth Quarter 2010 (total micrograms)

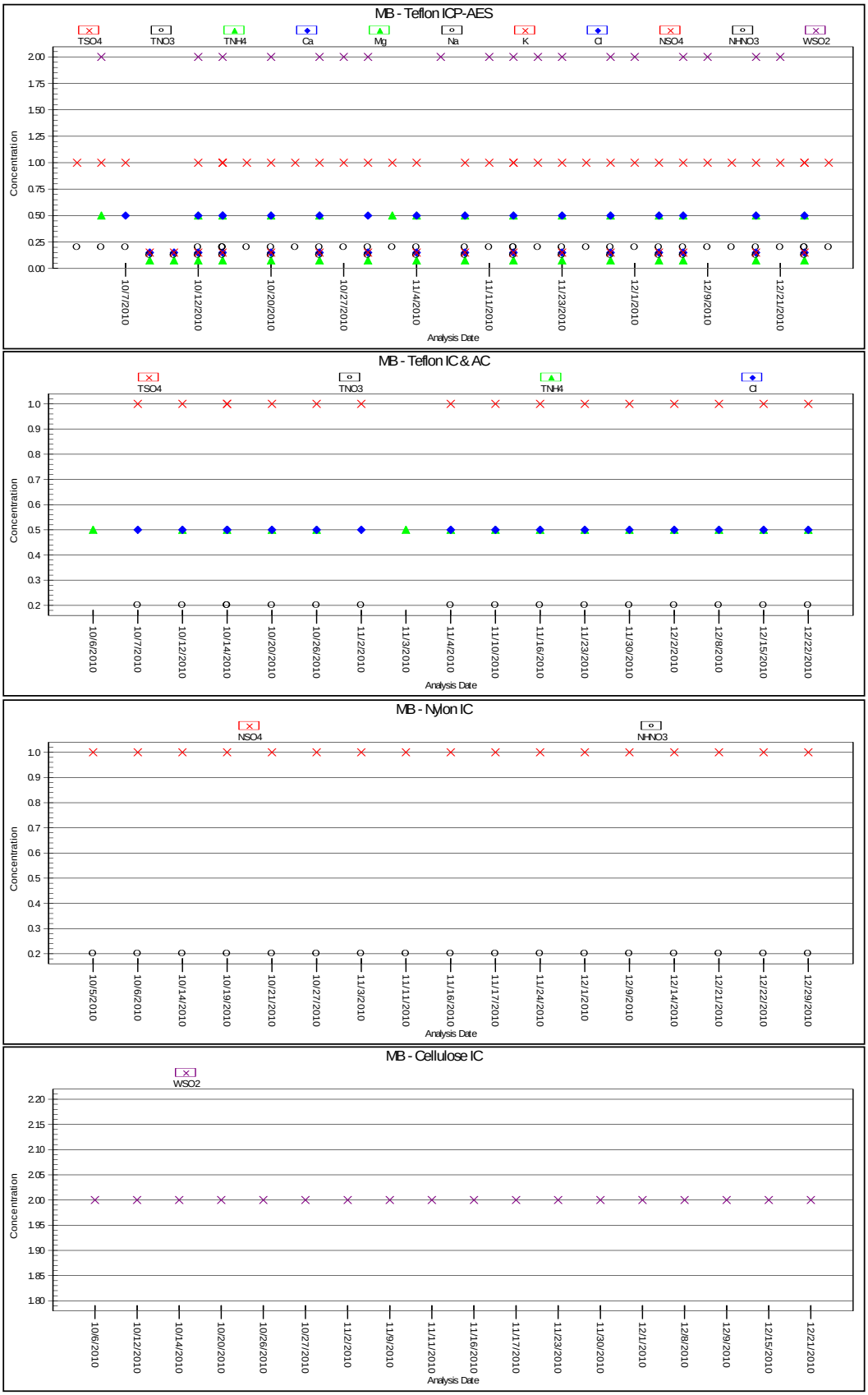


Figure 7. Laboratory Blank Analysis Results for Fourth Quarter 2010 (total micrograms)

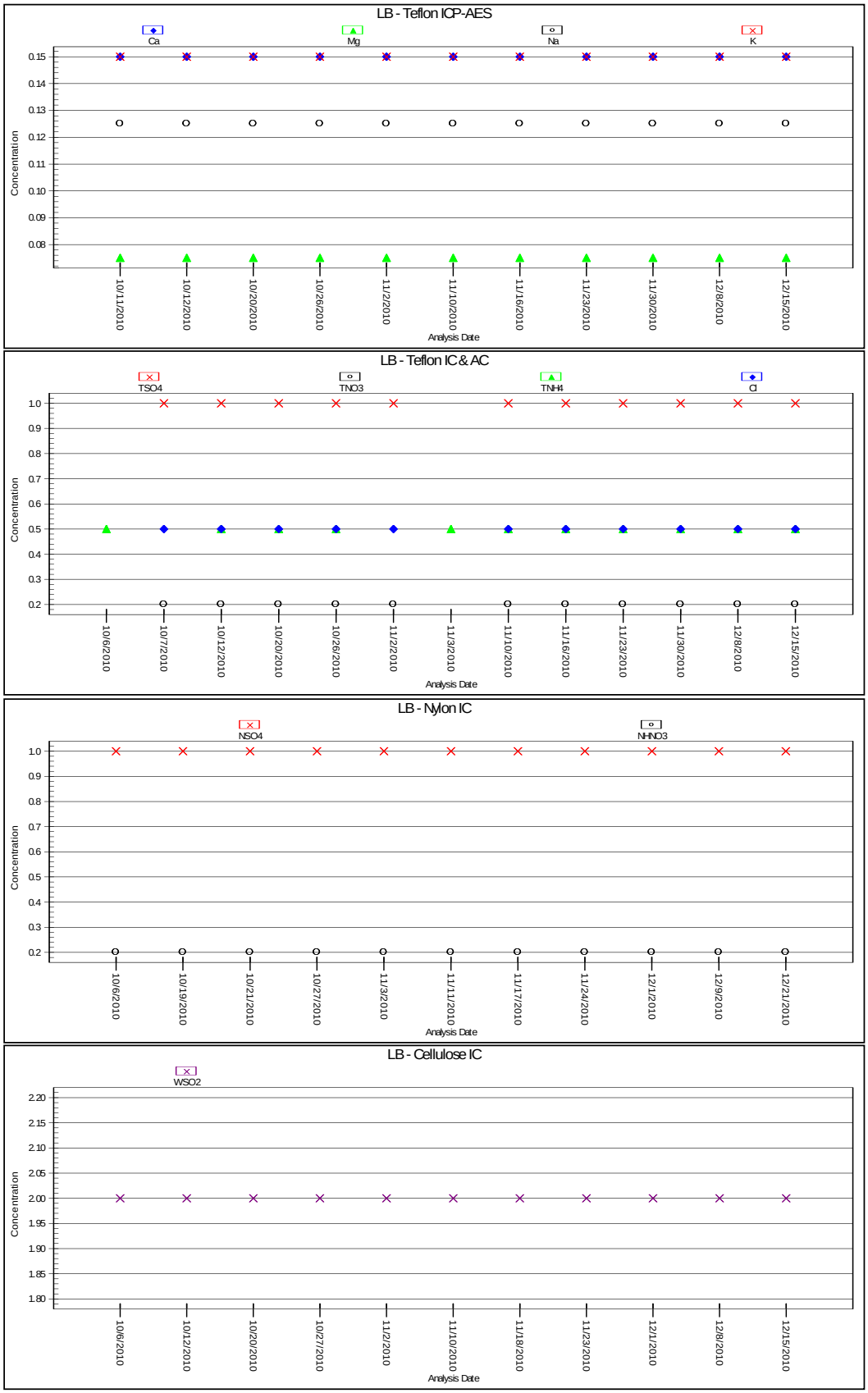


Figure 8. Field Blank Analysis Results for Fourth Quarter 2010 (total micrograms)