Summary of Quarterly Operations
January – March 2009

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 first quarter 2009. 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 (CDMSA). 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.

Beginning with the January 2009 calibrations, the field calibration accuracy criterion for relative humidity changed to ± 10 percent for all relative humidity measurements. Previously, the accuracy measurement criterion for relative humidity was ± 5 percent for values greater than 85 percent and ± 20 percent for values less than or equal to 85 percent. The field calibration precision criterion for relative humidity remains at ± 10 percent. Also as of January 2009, one of the checkpoints for ozone multipoint calibrations changed from 400 parts per billion (ppb) to 450 ppb. The checkpoints for an ozone analyzer multipoint calibration are now at 0 ppb, 450 ppb, 300 ppb, 200 ppb, 100 ppb, and 60 ppb. Additionally, EPA confirmed that the ozone span drift criterion for zero/span checks is ± 7 percent for regulatory ozone measurements.

MACTEC and EPA continued to work together to establish approved ozone monitoring procedures for CASTNET related to Part 58 of Title 40 of the Code of Federal Regulations. Standard operating procedures (SOPs) related to approved ozone monitoring procedures were evaluated and refined.

During March 2009, MACTEC received the final report on the results of analyses of laboratory samples for the intercomparison proficiency test (PT) Study 0093 for Analyses for Rain and Soft Waters from the National Water Research Institute (NWRI) with Environment Canada. Thirty-six laboratories participated in PT Study 0093. MACTEC performed very well with no

flags or bias and achieved a classification of "ideal" on 100 percent of the analyses, and the laboratory received a performance rating of "good." These are the highest ratings that can be received. Out of the 36 participating laboratories, MACTEC and two other laboratories received the best possible percent score of 0.00 (the sum of parameters biased and results flagged). Final results for the 2008 US Geological Survey (USGS) Interlaboratory Comparison samples were received from the USGS on March 23, 2009. MACTEC performed very well either achieving the target value or within a less than 5 percent range for all of the 144 samples analyzed.

Collocated filter pack precision data and completeness data for meteorological measurements are presented for data validated to Level 3 during the quarter. Table 1 lists the quarters of data that were validated to Level 3 during the quarter 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. Table 5 presents the number of analyses in each category that were performed during this quarter.

Sample Receipt Statistics

For the current CASTNET project, which began on July 30, 2003, the Environmental Protection Agency (EPA) requires that 95 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 6 presents the relevant sample receipt statistics for first quarter 2009.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for first quarter 2009. All results are within the criteria listed in Table 4 with the exception of several individual RP results. However, these are considered reasonable since higher relative percent differences generally correlate with lower sample concentrations. A drop in recovery values is depicted in Figure 1 near the end of the quarter. All values are within criteria and return to the

former pattern early in the second quarter after performance of routine instrument maintenance. Additionally, the higher concentration calcium and sulfate values depicted in Figure 3 as offset from the fit line are within the established criterion. Quarterly averages are all within criteria.

Figure 4 presents completeness statistics for continuous measurements validated to Level 3 during the quarter. All parameters met the 90 percent criterion. Precipitation data capture at 90 percent was lower than usual due to equipment problems at five sites.

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. These limits may change as data are collected and analyzed. Figure 5 presents LCS analysis results for first quarter 2009. All recovery values for this quarter were between 90 percent and 110 percent.

Blank Results

Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for first quarter 2009. All results were within criteria (two times the reporting limit) listed in Table 4.

Suspect/Invalid Filter Pack Samples

One filter pack sample was invalidated due to insufficient flow volume. Additionally, nine samples were invalidated due to storm damage or communications problems. The samples and associated site identification are presented in Table 7.

Field Problem Count

Table 8 presents counts of field problems affecting continuous data collection during first quarter 2009. 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

Calibrations were performed at 23 sites during first quarter 2009. All sites and parameters were within the criteria listed in Table 3 with the exception of those listed in Table 9.

Tables and Figures

Table 1. Data Validated to Level 3 during First Quarter 2009

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
E-2/MW-8	April 2008 – September 2008	6	Quarter 2 2008 – Quarter 3 2008	2
E-3/W-10†	May 2008 – October 2008	6	Quarter 3 2008	1
SE-4/MW-6‡	July 2008 – December 2008	6	Quarter 3 2008 – Quarter 4 2008	2

Note: * The sites contained in each calibration group are listed in Table 2.
† Contains ROM206 of the ROM406/206 collocated pair
‡ Contains MCK131/231, KY

Table 2. Field Calibration Schedule

Calibration Group Number	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**
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
Relative Humidity	Thin Film Capacitor	± 10% (of full scale)	± 10%
Solar Radiation	Pyranometer	± 10% (of reading taken at local noon)	± 10%
Precipitation	Tipping Bucket Rain Gauge	± 10% (of reading)	± 0.05 inch†
Ambient Temperature	Platinum RTD	± 1.0°C	± 0.5°C
Delta Temperature	Platinum RTD	± 0.5°C	± 0.5°C
O_3	UV Absorbance	± 10% (of reading)	± 10%
Filter Pack Flow	Mass Flow Controller	± 10%	± 5%
Surface Wetness	Conductivity Bridge	Undefined	Undefined

Note: °C = degrees Celsius
m/s = meters per second
rel. hum. = relative humidity
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	10	90 - 110	0.020 *	0.5
Sodium (Na^+)	F	ICP-AES	5	95 - 105	0.005	0.125
Potassium (K^+)	F	ICP-AES	5	95 - 105	0.006	0.15
Magnesium (Mg^{2+})	F	ICP-AES	5	95 - 105	0.003	0.075
Calcium (Ca^{2+})	F	ICP-AES	5	95 - 105	0.006	0.15
Chloride (Cl^-)	F	IC	5	95 - 105	0.020	0.5
Nitrate (NO_3^-)	F	IC	5	95 - 105	0.008 *	0.2
Sulfate (SO_4^{2-})	F	IC	5	95 - 105	0.040	1.0

Note: [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 ICP-AES precision RPD criterion changed from 10 percent to 5 percent at the onset of the new contract beginning on July 30, 2003. The precision criterion is applied as described below:
QC conditions: (v1 = initial response; v2 = replicate response; RL = nominal reporting limit)
Condition 1: if (v1 or v2 < RL and the absolute value of (v1 – v2) < RL) = OK
Condition 2: if (v1-v2) < RL and v1 < 5 x RL) = OK
Condition 3: if (v1 > 5*RL and RPD < 5%) = OK
Status: one of the conditions is OK = Precision QC Passes

[2] This column lists laboratory accuracy goals based on reference standards and continuing calibration verification spikes. The goal for the ICP-AES accuracy criterion changed from 90 – 110 percent to 95 – 105 percent for continuing calibration verification spikes at the onset of the new contract beginning on July 30, 2003. The criterion remains 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 4.1 (MACTEC, 2008).

Table 5. QC Analysis Count for First Quarter 2009

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-}	39	179	81	18	26	80
	NO_3^-	39	179	81	18	26	80
	NH_4^+	34	167	78	17	26	80
	Cl^-	39	179	81	18	26	80
	Ca^{2+}	34	169	77	17	26	80
	Mg^{2+}	34	169	77	17	26	80
	Na^+	34	169	77	17	26	80
	K^+	34	169	77	17	26	80
Nylon	SO_4^{2-}	38	170	77	17	24	43
	NO_3^-	38	170	77	17	24	43
Cellulose	SO_4^{2-}	43	168	82	21	28	57

Table 6. Filter Pack Receipt Summary First Quarter 2009

Count of samples received more than 14 days after removal from tower:	11
Count of all samples received:	763
Fraction of samples received within 14 days:	0.986
Average interval in days:	4.79
First receipt date:	1/2/2009
Last receipt date:	3/30/2009

Table 7. Filter Packs Flagged as Suspect or Invalid

Site ID	Sample ID	Reason
ARE128, PA	0906001-06	Insufficient flow
BEL116, MD	0905001-09	Communications
CDZ171, KY	0904001-17	Storm damage
CHE185, OK	0904001-19 0905001-19	Storm damage Storm damage
CVL151, MS	0903001-26 0901001-26	Communications Communications
MCK131, KY	0905001-49	Insufficient flow
MCK231, KY	0905001-50	Insufficient flow
QAK172, OH	0907001-64	Storm damage

Table 8. Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	98
60	14
90	6
Unresolved by date of publication	8

Note: Counts were extracted using the problem tracking system (PTS) feature of the CDMSA. Problems requiring corrective action are flagged by field personnel with a ticket number.

Table 9. Field Calibration Failures by Parameter

Site ID	Parameter(s)
ARE128, PA	Solar Radiation
CKT136, KY	Relative Humidity
CND125, NC	Ozone
COW137, NC	Ozone
CVL151, MS	Delta Temperature Wind Direction
ESP127, TN	Precipitation
PED108, VA	Wind Speed
SND152, AL	Solar Radiation
VPI120, VA	Flow Rate

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 4.1 (MACTEC, 2008).

Figure 1. Reference Standard Results for First Quarter 2009 (percent recovery)

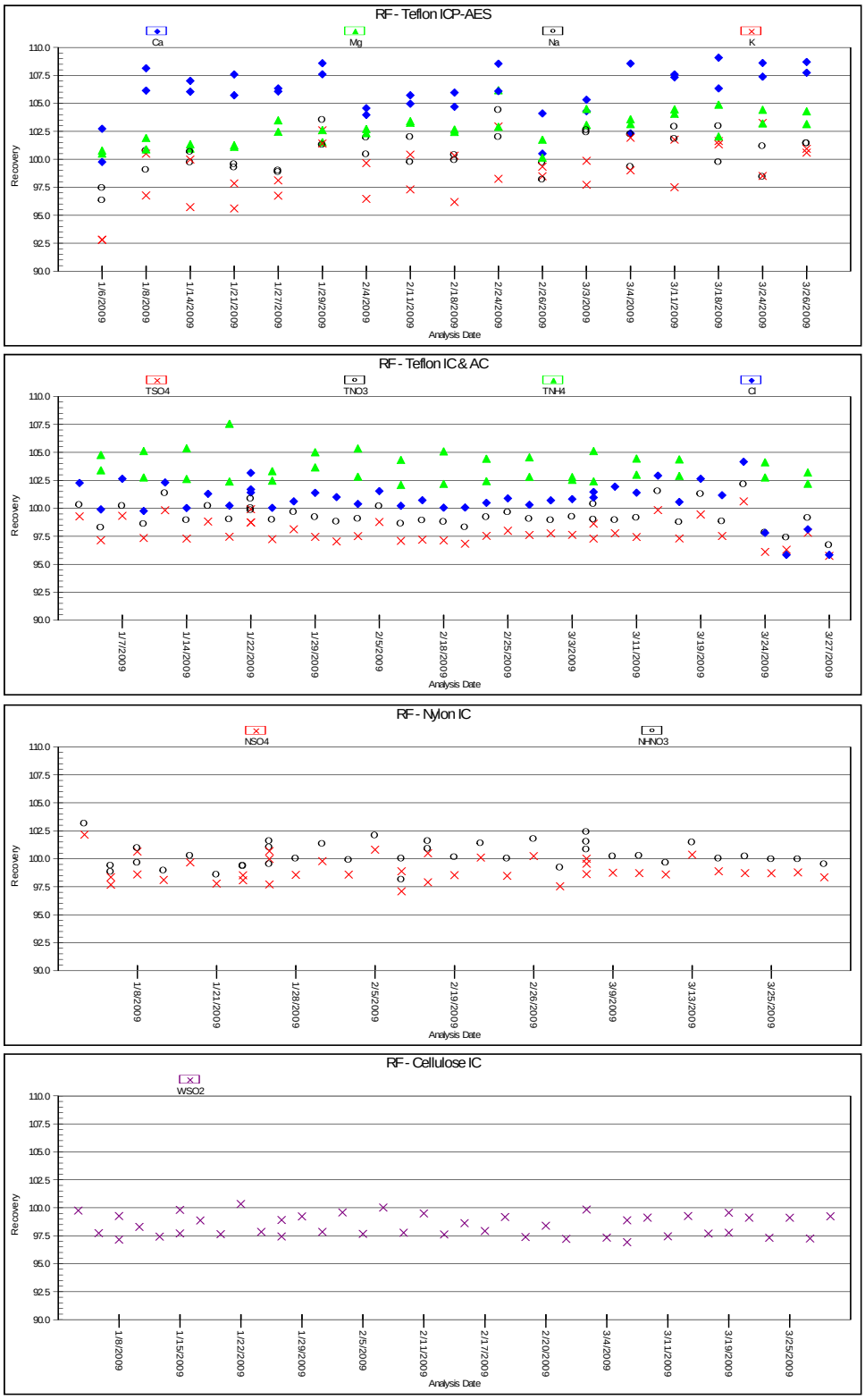
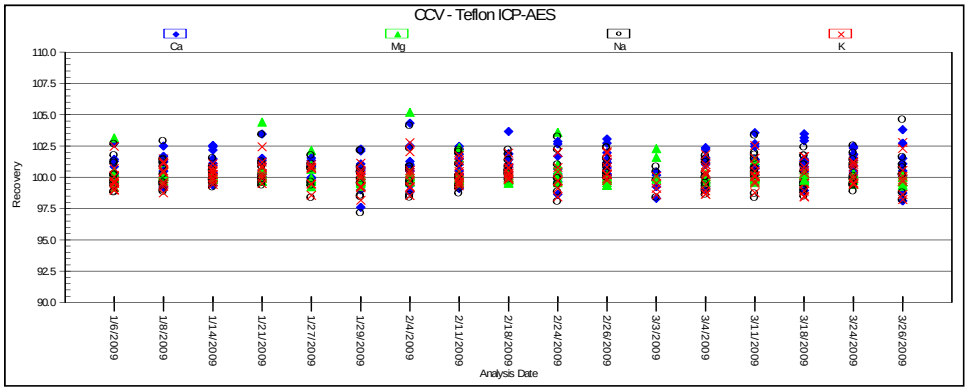
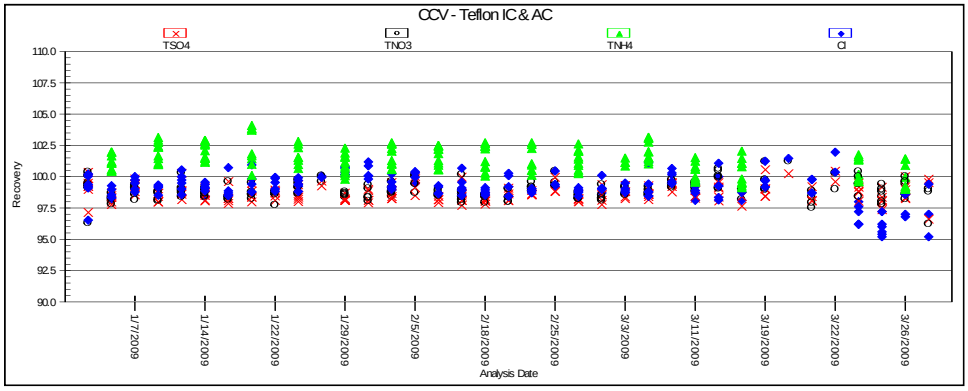
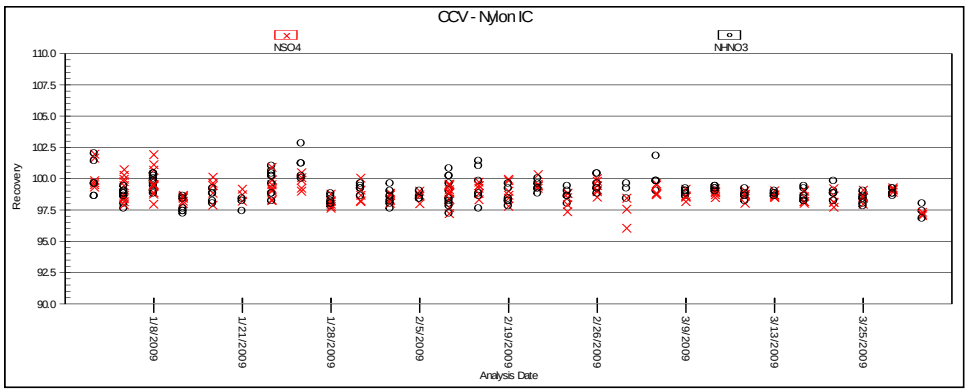


Figure 2. Continuing Calibration Spike Results for First Quarter 2009 (percent recovery)







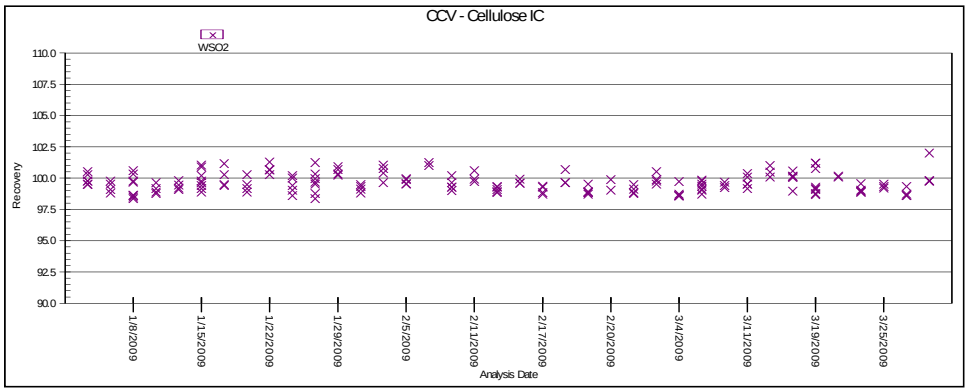


Figure 3. Replicate Sample Analysis Results for First Quarter 2009 (total micrograms)

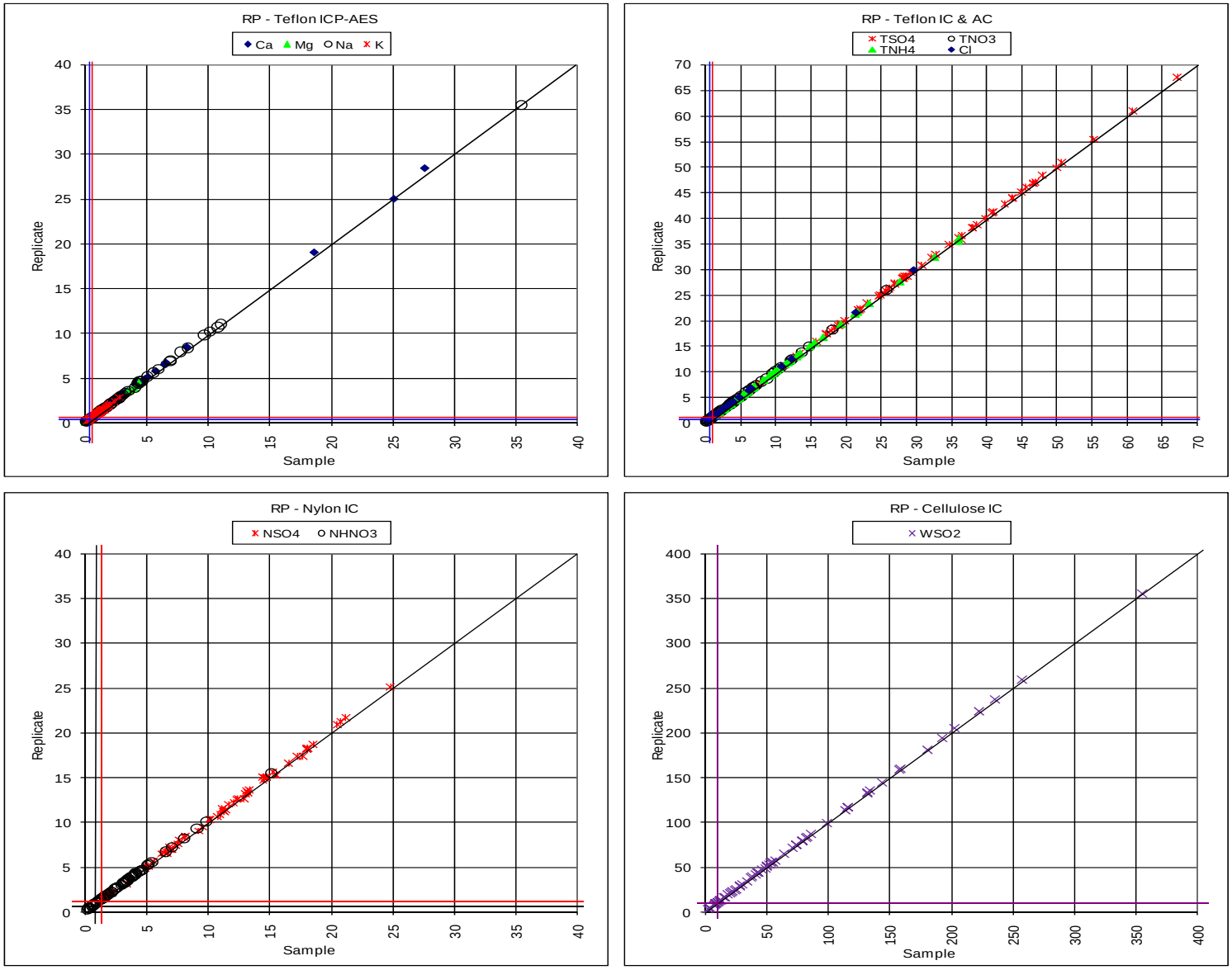
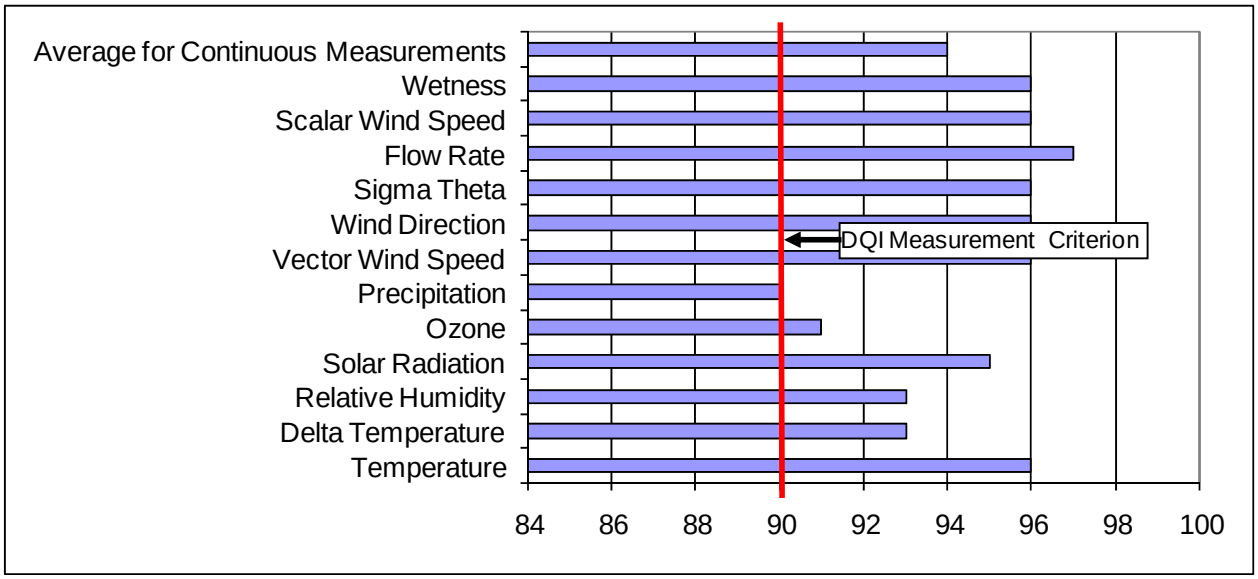
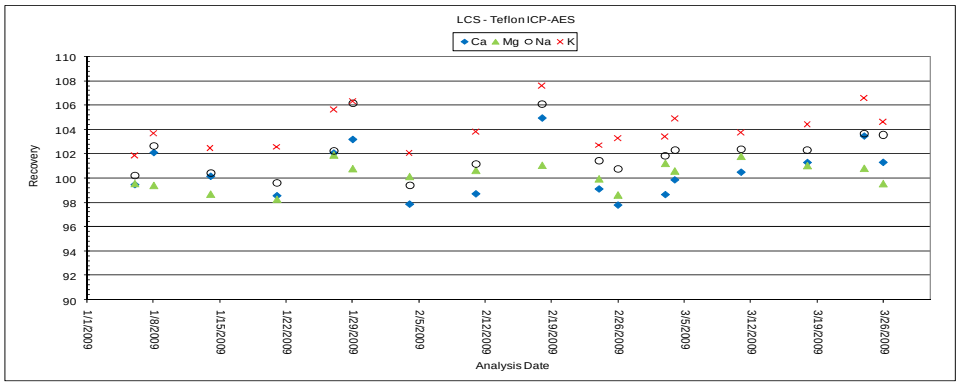


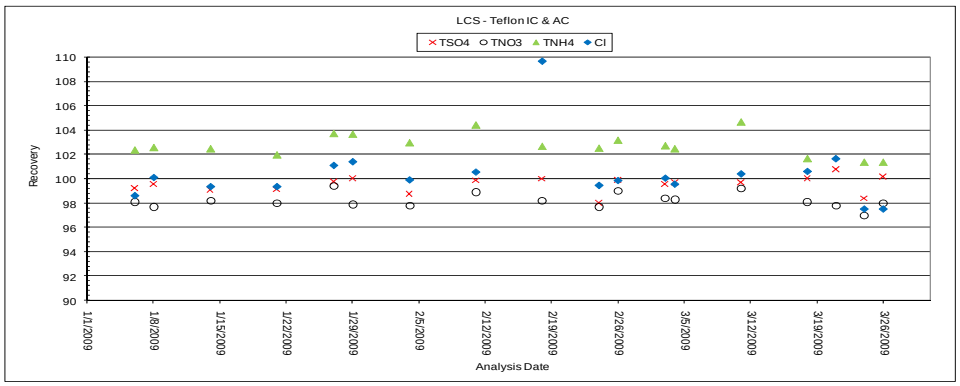
Figure 4. Percent Completeness of Measurements for Second Quarter 2008 through Fourth Quarter 2008*

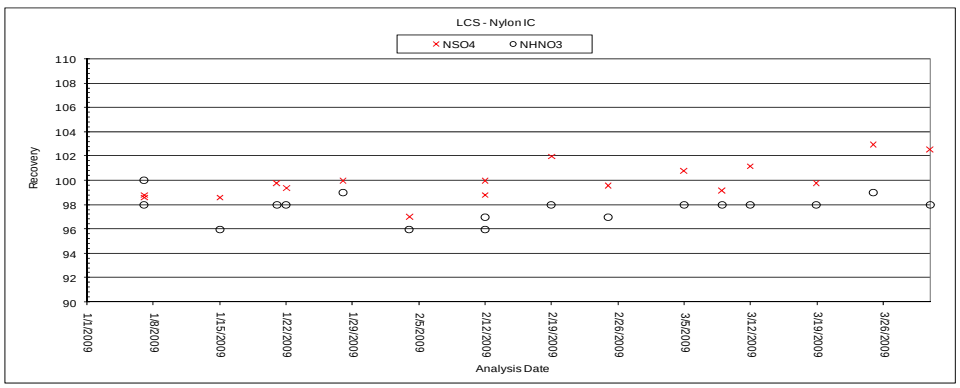


Note: *Presents Level 3 data available during the first quarter of 2009.

Figure 5. Laboratory Control Sample Results for First Quarter 2009 (percent recovery)







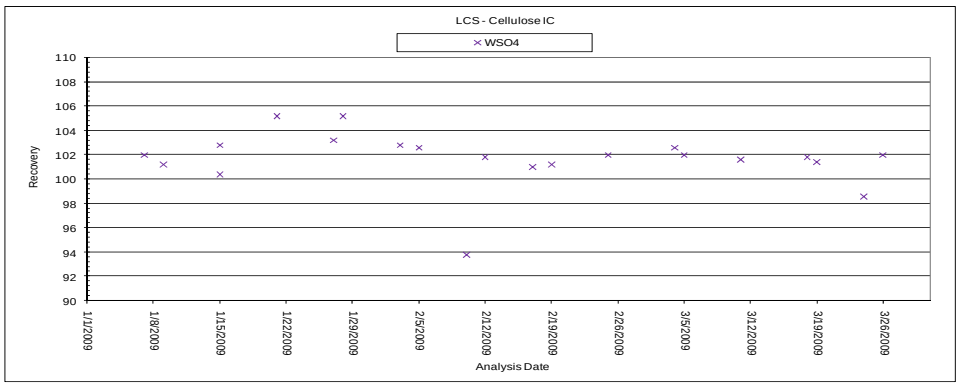


Figure 6. Method Blank Analysis Results for First Quarter 2009 (total micrograms)

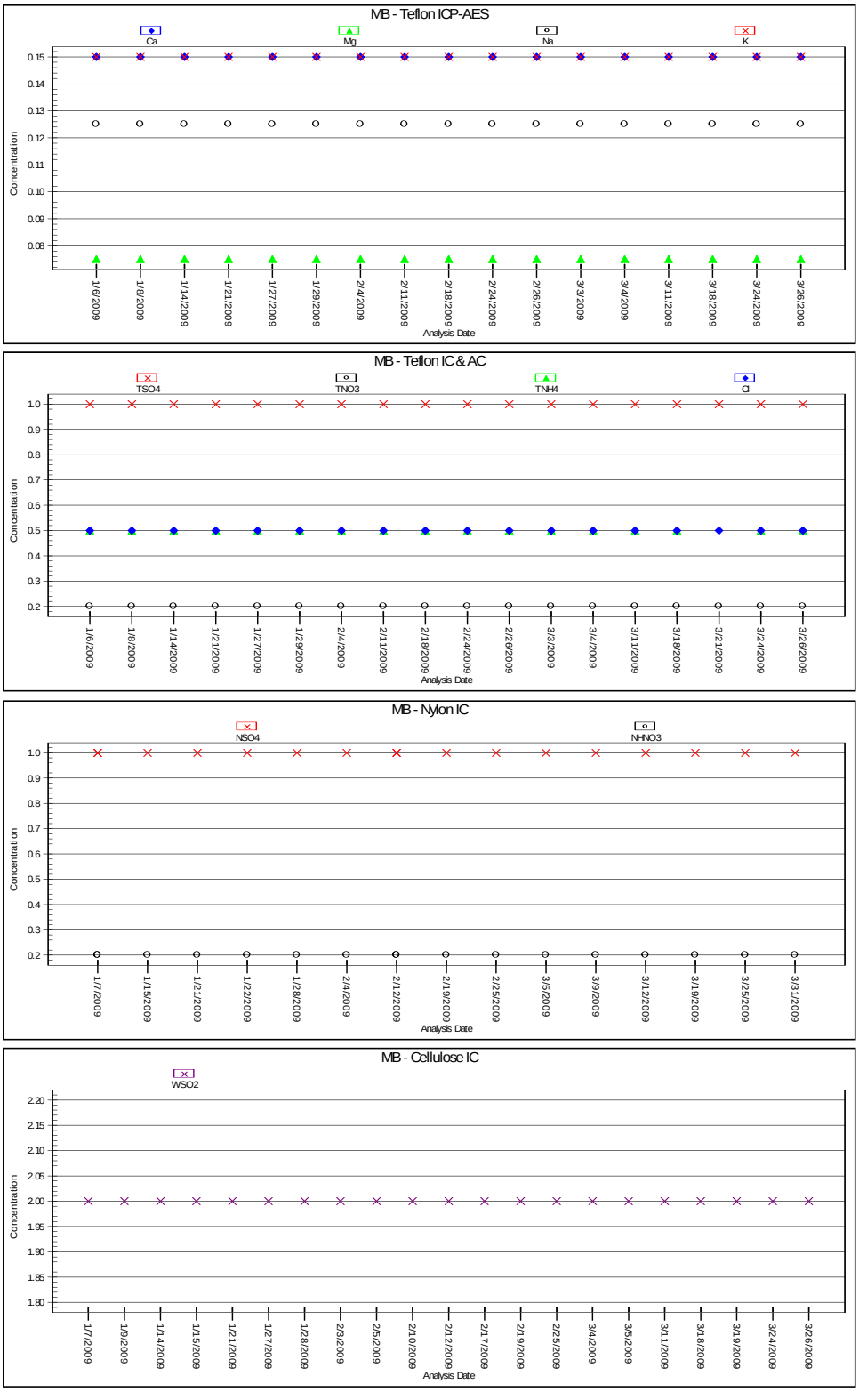


Figure 7. Laboratory Blank Analysis Results for First Quarter 2009 (total micrograms)

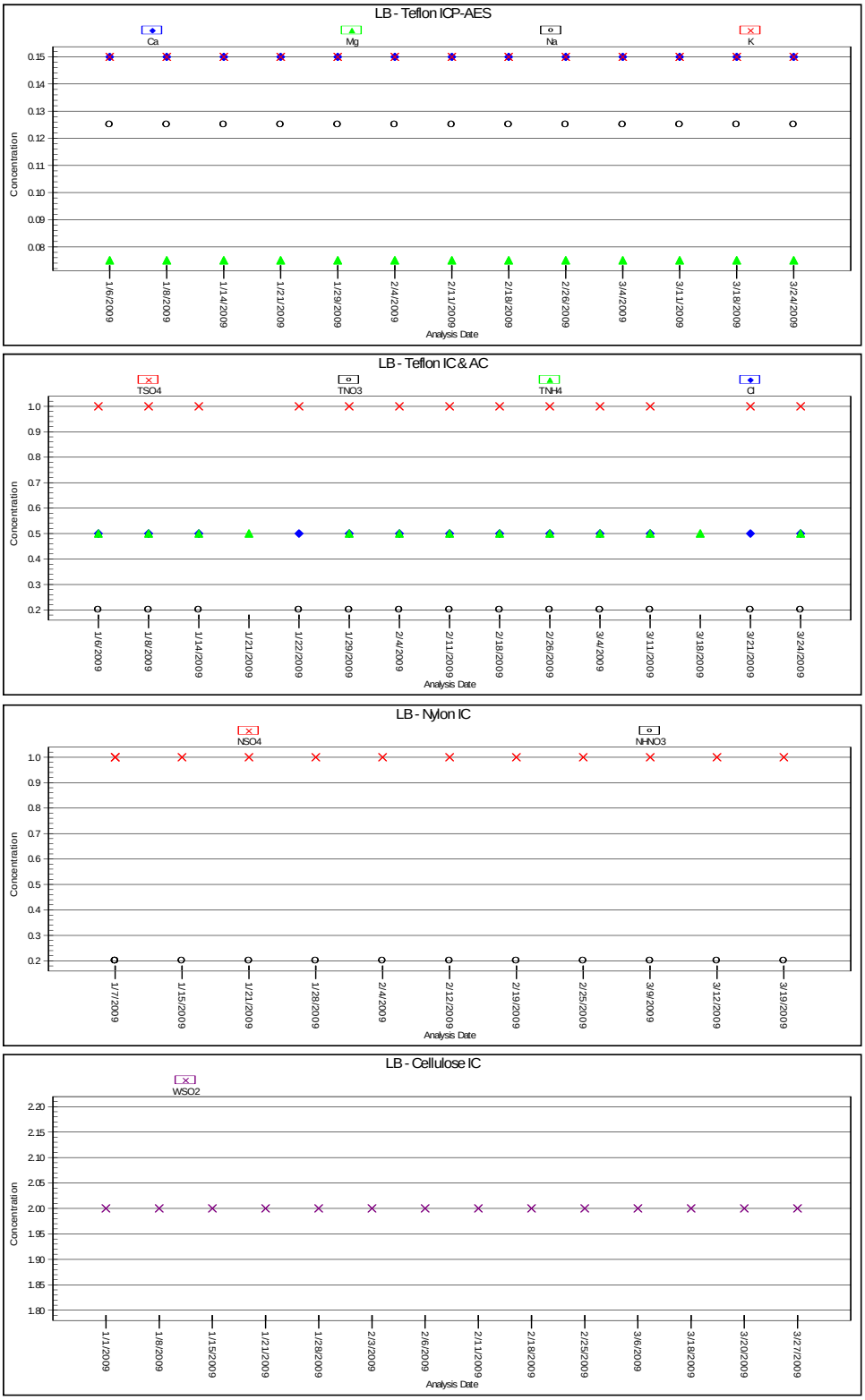


Figure 8. Field Blank Analysis Results for First Quarter 2009 (total micrograms)