Clean Air Status and Trends Network
Quality Assurance Report

EPA Contract No.:	**68-D-03-052 (Base Program)**
MACTEC Project No.:	**6064068000**
Reporting Period:	**First Quarter 2007 (January - March)**

Summary of Quarterly Operations

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 2007. The results presented for filter pack data collection and field calibrations are generated from data extracted from the CASTNET Data Management Center (DMC) 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 updated annually.

During first quarter 2007, flow problems occurred at several sites, which investigation showed were caused by the Balston® air filters located in the sampling train. In each case, replacement of the existing filter with a new one corrected the problem. These filters are routinely replaced every six months during the semiannual calibration and service visit, though their expected service life is much longer. The underlying cause for the Balston® filters' apparent flow restriction is unknown at this time.

Also during first quarter 2007, all data loggers were reprogrammed to eliminate the frequent assignment of "I" flags to ozone zero/span/precision (z/s/p) data. The "I" flags are assigned when the system is in calibration mode for more than 25 percent of a given hour.

Preliminary results were received for the latest Rain and Soft Waters Proficiency Test (PT) intercomparison study submitted by the analytical laboratory to the National Water Research Institute (NWRI) with Environment Canada. Unfortunately, due to a transcription mistake, two values were transposed. With the values corrected, MACTEC's laboratory either achieved or was extremely close to the assigned value for the samples tested. To prevent mistakes such as these in the future, MACTEC will implement a revised review process for laboratory submissions to intercomparison studies, which is similar to that used for project deliverables to EPA.

An independent audit of CASTNET data operations took place during the week of February 26, 2007. The audit was conducted by an outside company hired by MACTEC and consisted of both a performance evaluation and a technical systems evaluation. The preliminary results of the audit

were generally positive. A full report on audit findings is expected to be received by MACTEC during second quarter 2007.

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 2007.

Data Quality Indicator (DQI) Results

Figures 1 through 3 present the results of RF, CCV, and RP QC sample analyses for first quarter 2007. All results were 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. 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.

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 2007.

Blank Results

Figures 6 through 8 present the results of MB, LB, and FB QC sample analyses for first quarter 2007. All results were within criteria (two times the detection limit) listed in Table 4 with the exception of one Teflon® filter nitrate LB result and one cellulose filter LB result. All values were less than three times the detection limit. No systemic problems were indicated upon review.

Suspect/Invalid Filter Pack Samples

Eleven filter pack samples were invalidated due to insufficient flow volume. These were all due to problems with electronic communications. Data for nearly all samples may be recovered during Level 3 validation. 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. 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 2007. 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 2007

Calibration Group*	Months Available	Number of Months	Complete Quarters	Number of Quarters
1	July 2006 – December 2006	6	Quarter 3 2006 – Quarter 4 2006	2
5†	May 2006– October 2006	6	Quarter 3 2006	1

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

Table 2. Field Calibration Schedule

Calibration Group Number	Months Calibrated	Sites Calibrated			
1	January/July	SND152, AL	BFT142, NC	PNF126, NC	PED108, VA
		GAS153, GA	CND125, NC	ESP127, TN	VPI120, VA
		CDZ171, KY	COW137, NC	SPD111, TN	
2	February/August	CAD150, AR	BEL116, MD	WSP144, NJ	ARE128, PA
		IRL141, FL	BWR139, MD	CTH110, NY	PSU106, PA
		SUM156, FL	CVL151, MS	CHE185, OK	ALC188, TX
3	March/September	ALH157, IL	VIN140, IN	MCK131, KY	DCP114, OH
		BVL130, IL	KNZ184, KS	MCK231, KY	OXF122, OH
		STK138, IL	CKT136, KY	SAN189, NE	PRK134, WI
4	April/October	ABT147, CT	ANA115, MI	CAT175, NY	EGB181, ON
		SAL133, IN	HOX148, MI	HWF187, NY	LYE145, VT
		ASH135, ME	UVL124, MI	LYK123, OH	
		HOW132,ME	WST109, NH		
5	May/November	CON186, CA	QAK172, OH	MKG113, PA	CNT169, WY
		ROM206, CO	KEF112, PA	CDR119, WV	PND165, WY
		GTH161, CO	LRL117, PA	PAR107, WV	

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)	± 5%, rel. hum. > 85% ± 20%, rel. hum. ≤ 85%
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	0.005	0.125
Magnesium (Mg^{2+})	F	ICP-AES	5	95 - 105	0.003	0.075
Calcium (Ca^{2+})	F	ICP-AES	5	95 - 105	0.003	0.075
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 3.0 (MACTEC, 2005).

Table 5. QC Analysis Count for First Quarter 2007

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-}	44	188	81	17	16	43
	NO_3^-	44	188	81	17	16	43
	NH_4^+	38	181	87	19	20	43
	Cl^-	44	188	81	17	16	42
	Ca^{2+}	34	178	82	17	16	42
	Mg^{2+}	34	178	82	17	16	42
	Na^+	34	178	82	17	16	42
	K^+	34	178	82	17	16	43
Nylon	SO_4^{2-}	38	169	79	19	16	43
	NO_3^-	38	169	79	19	16	43
Cellulose	SO_4^{2-}	46	176	68	23	18	61

Table 6. Filter Pack Receipt Summary

Count of samples received more than 14 days after removal from tower:	28
Count of all samples received:	793
Fraction of samples received within 14 days:	0.965
Average interval in days:	5.74
First receipt date:	1/3/2007
Last receipt date:	3/30/2007

Table 7. Filter Packs Flagged as Suspect or Invalid

Site ID	Sample ID
ALH157, IL	0703001-04
CTH110, NY	0710001-25
IRL141, FL	0702001-44 0710001-44
KEF112, PA	0711001-46
LYE145, VT	0701001-50 0706001-50
PNF126, NC	0705001-65
SAN189, NE	0710001-88
SUM156, FL	0706001-77
VPI120, VA	0709001-82

Table 8. Field Problems Affecting Data Collection

Days to Resolution	Problem Count
30	94
60	19
90	6
Unresolved by the end of the quarter	22

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	Ozone
BEL116, MD	Flow Rate
CDZ171, KY	Temperature Solar Radiation Wind Direction
CHE185, OK	Solar Radiation
CND125, NC	Solar Radiation
COW137, NC	Relative Humidity Solar Radiation
GAS153, GA	Wind Direction
PNF126, NC	Relative Humidity Solar Radiation Wind Direction
SPD111, TN	Relative Humidity
SUM156, FL	Solar Radiation
VPI120, VA	Temperature

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 3.0 (MACTEC, 2005).

Figure 1. Reference Standard Results for First Quarter 2007 (percent recovery)

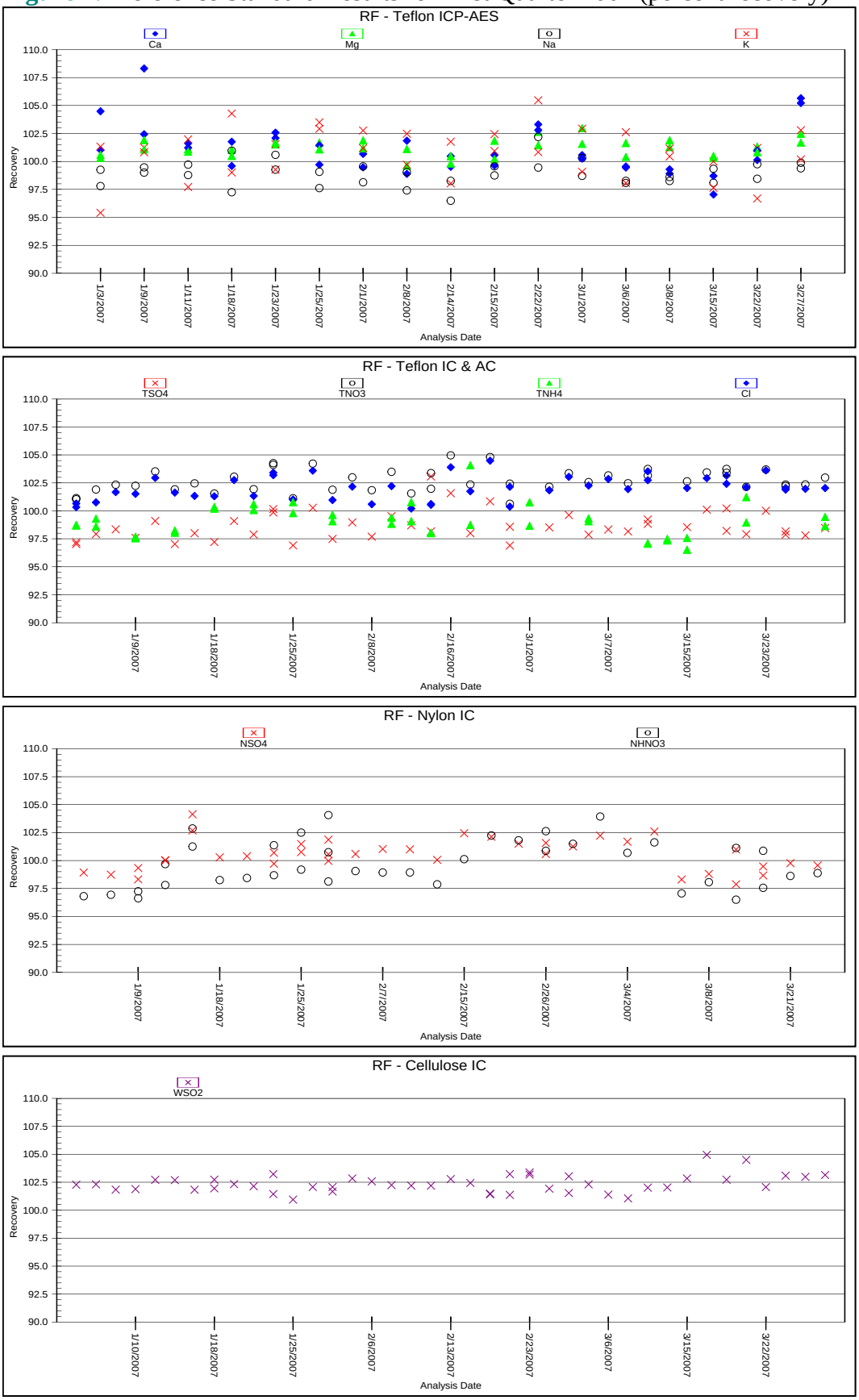
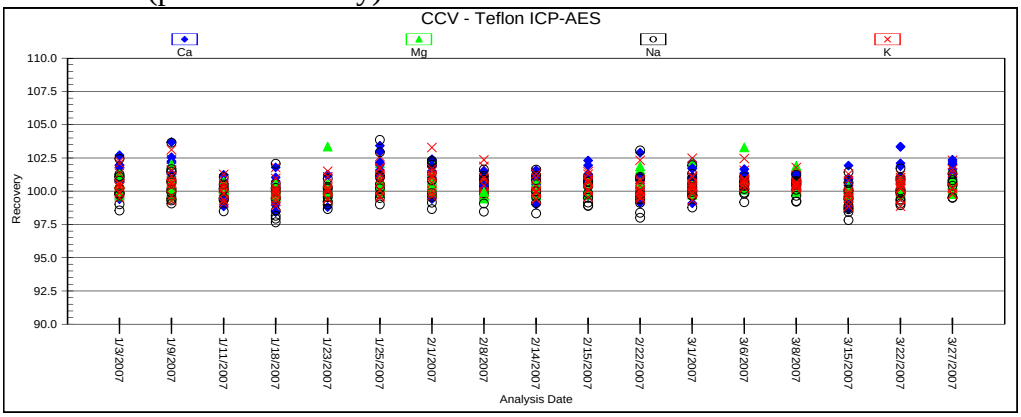
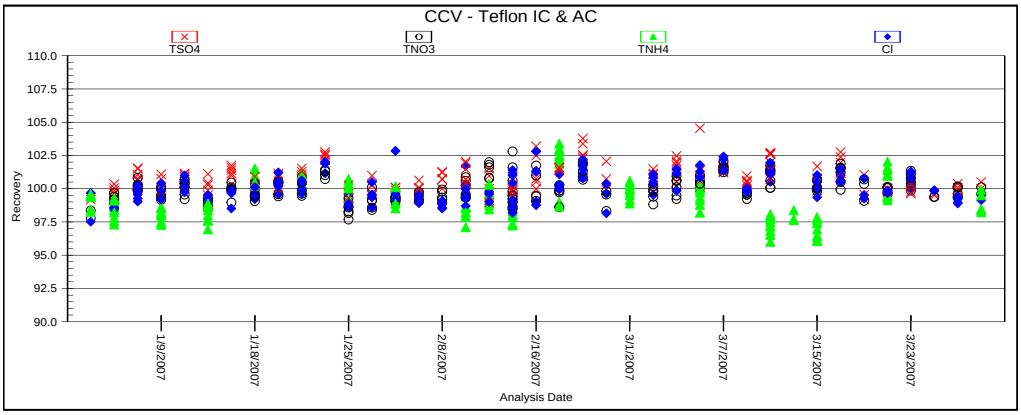
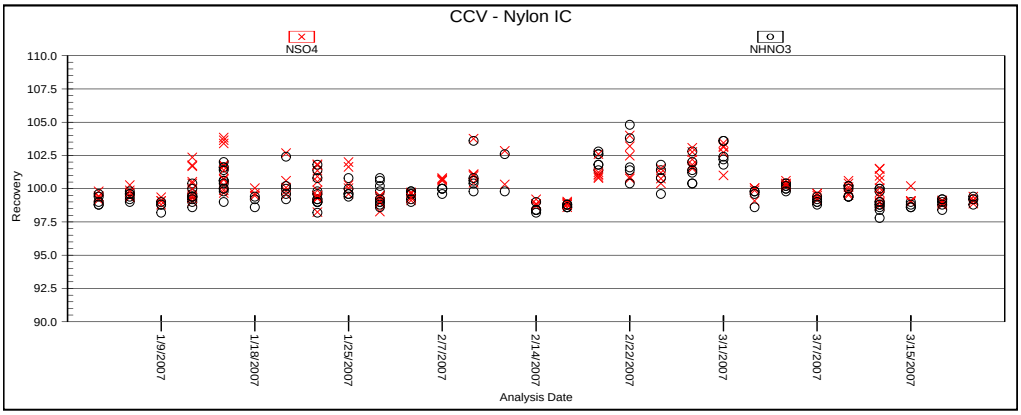


Figure 2. Continuing Calibration Verification Spike Results for First Quarter 2007 (percent recovery)







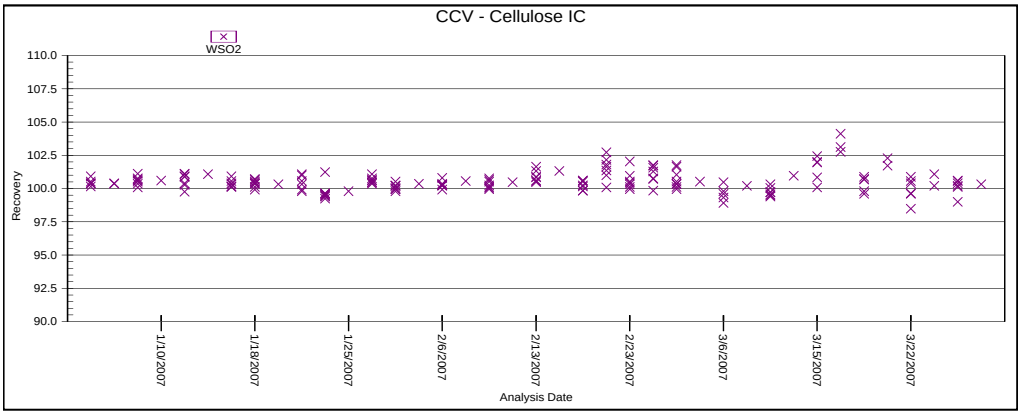


Figure 3. Replicate Sample Analysis Results for First Quarter 2007 (total micrograms)

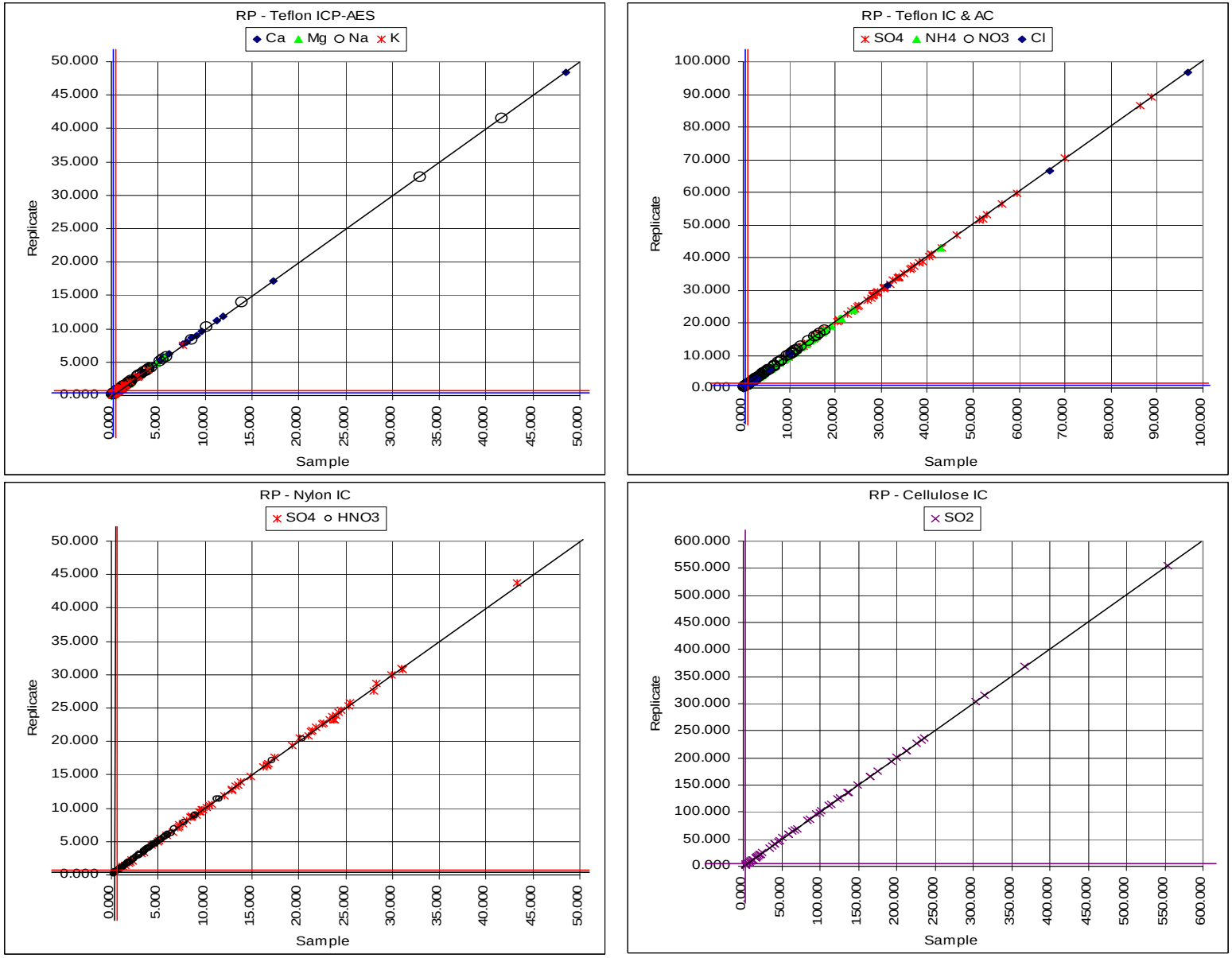
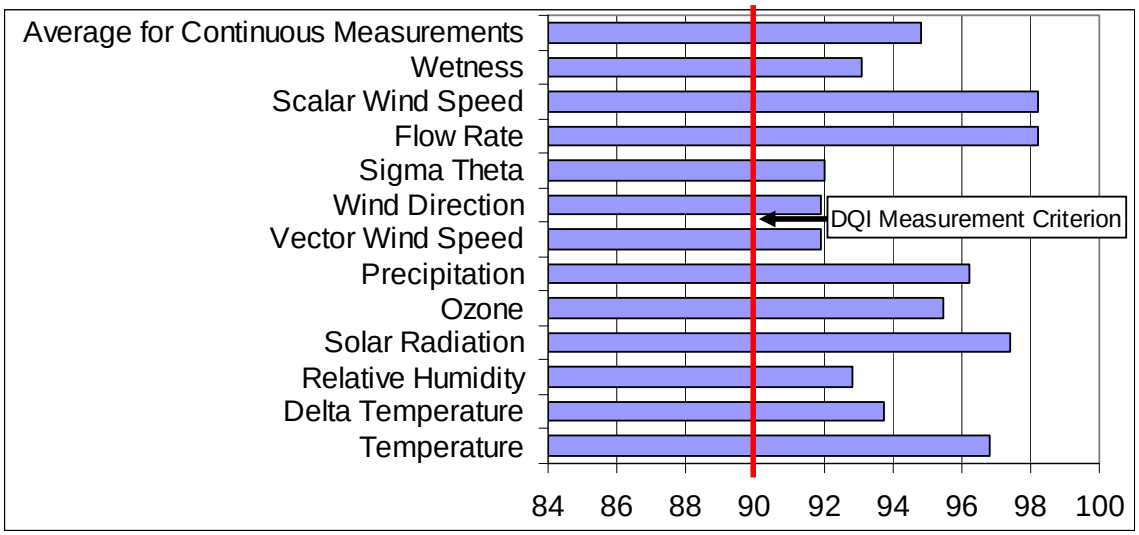


Figure 4. Percent Completeness of Measurements for Third Quarter 2006 through Fourth Quarter 2006*



Note: *Presents Level 3 data available during the first quarter of 2007.

Figure 5. Laboratory Control Sample Results for First Quarter 2007 (percent recovery)

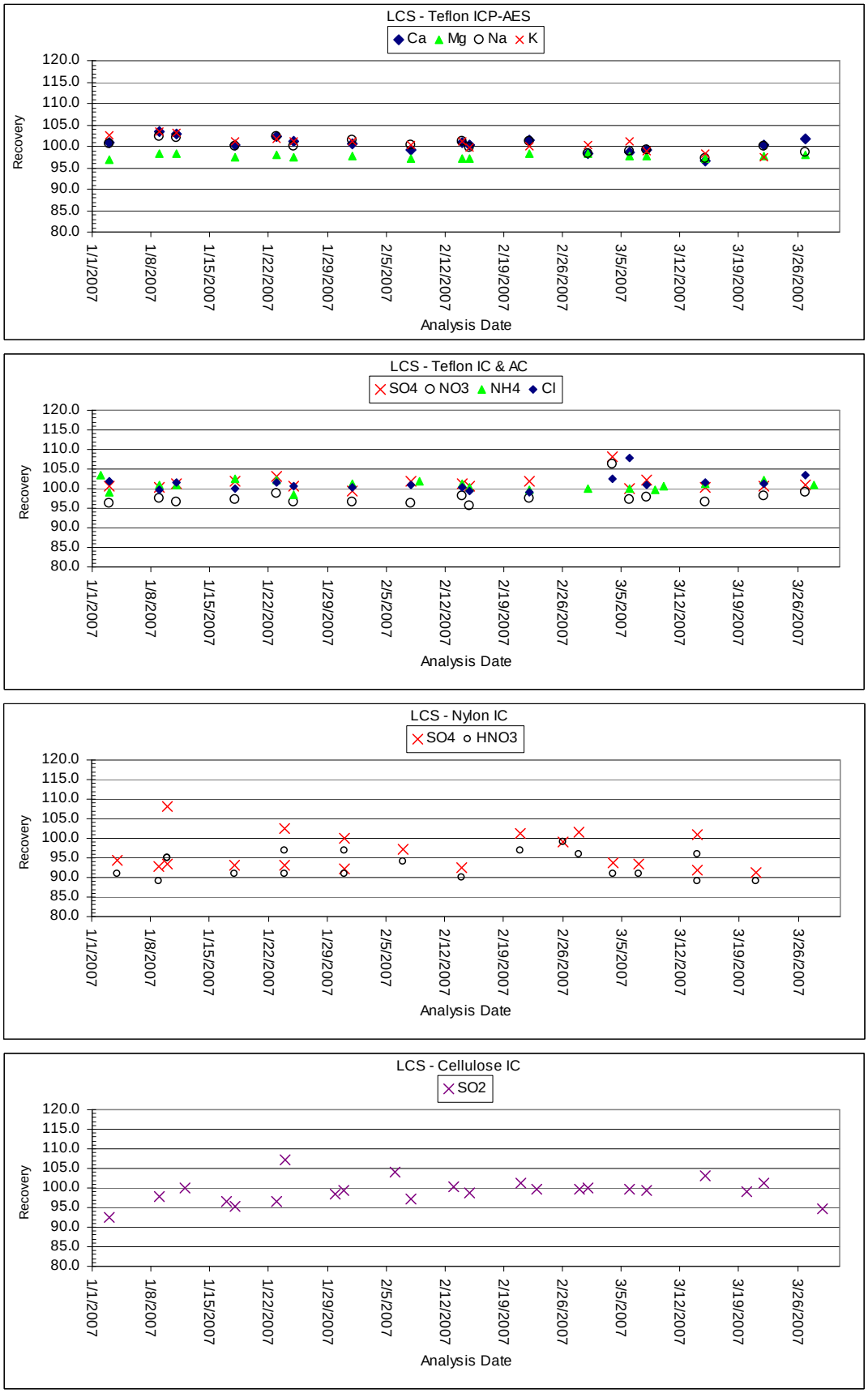


Figure 6. Method Blank Analysis Results for First Quarter 2007 (total micrograms)

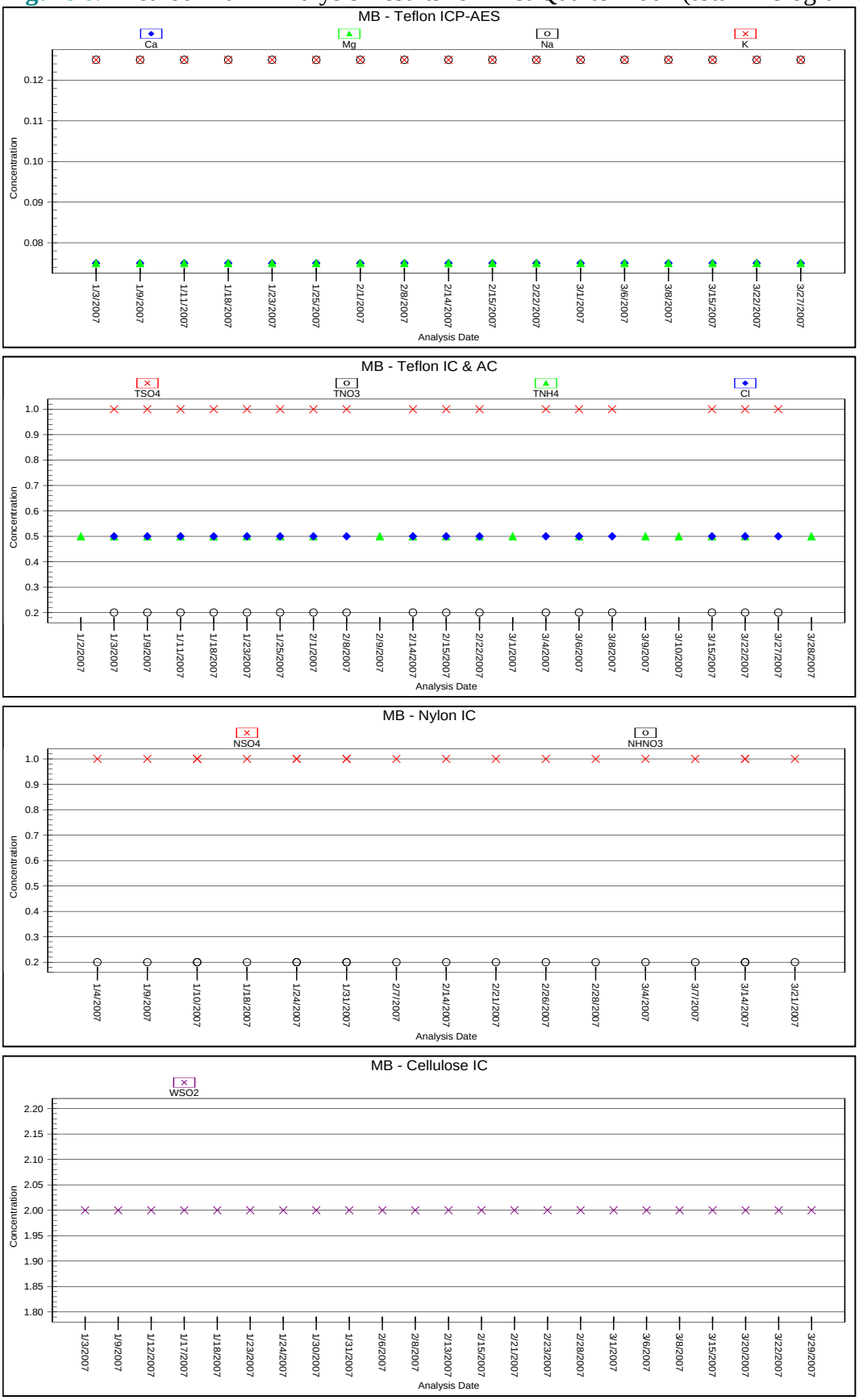


Figure 7. Laboratory Blank Analysis Results for First Quarter 2007 (total micrograms)

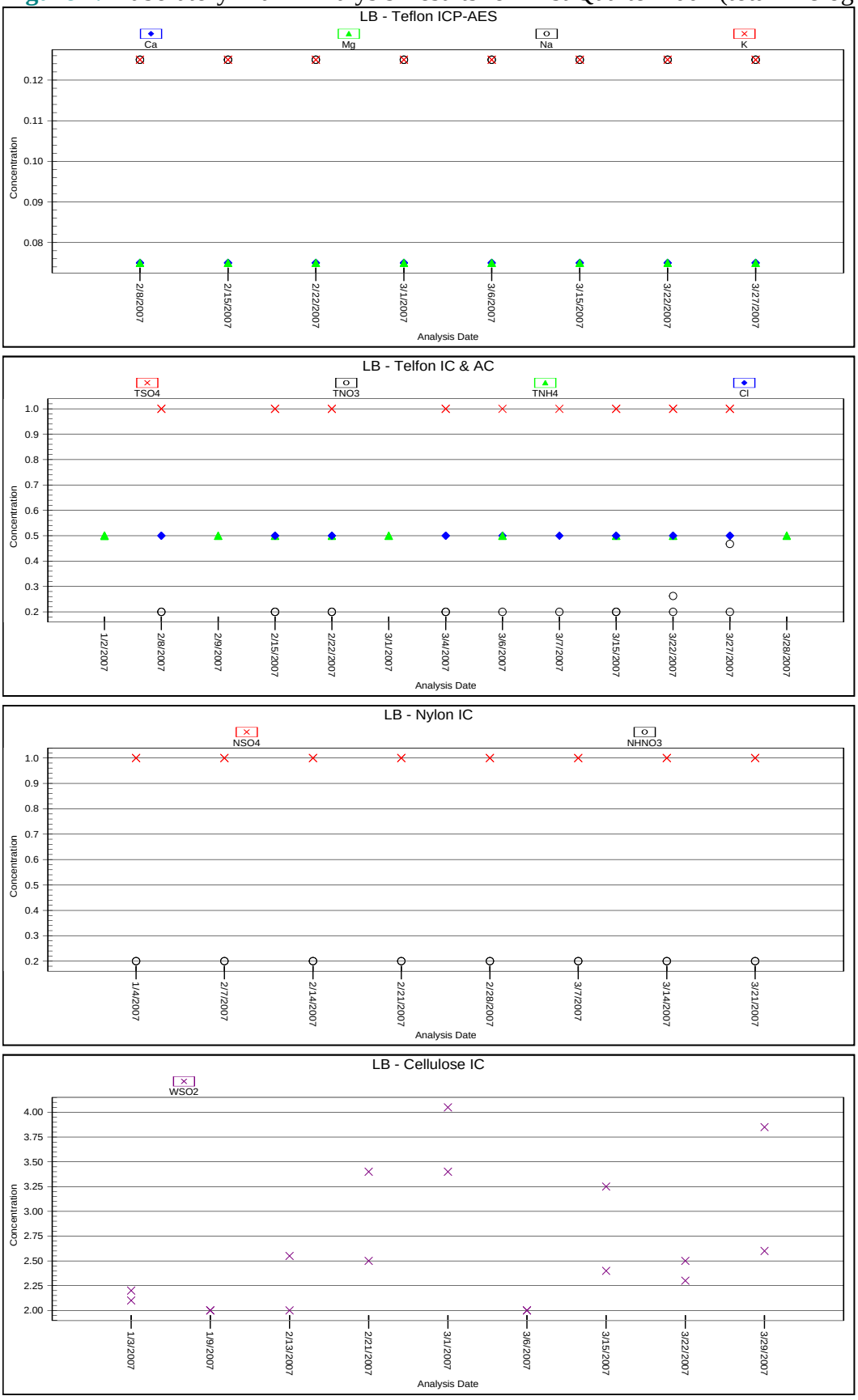


Figure 8. Field Blank Analysis Results for First Quarter 2007 (total micrograms)