NATIONAL AIR TOXICS TRENDS STATIONS QUALITY ASSURANCE ANNUAL REPORT CALENDER YEAR 2008

FINAL

Environmental Protection Agency
Office of Air Quality, Planning and Standards
Air Quality Analysis Division
109 TW Alexander Drive
Research Triangle Park, NC 27711

FORWARD

In the Spring/Summer of 2010, Research Triangle Institute (RTI) prepared a final technical report under Contract No. EP-D-08-047 Work Assignment 02-06. The report was prepared for Dennis Mikel, Work Assignment Manager within the Office of Air Quality Planning and Standards (OAQPS) in Research Triangle Park, North Carolina. The report was written by Larry Michael and Jeff Nichol of RTI. That report was incorporated into this final report

Additional work on this report was provided by AQAD staff.

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FINAL REPORT

Prepared by:
RTI International

For:
U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Analysis Division
109 TW Alexander Drive
Research Triangle Park, NC 27711

Under:
U.S. EPA Contract EP-D-08-047
Work Assignment 02-06, Task 4

ACKNOWLEDGEMENTS

This report was prepared by RTI International, under Work Assignment 02-06, Task 4 for EPA contract EP-D-08-047. Substantial contributions to the determination of the laboratories associated with specific monitoring sites and to the acquisition of proficiency testing results were provided by Dennis Mikel and Mike Jones of U.S. EPA.

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1.0 INTRODUCTION

As mandated under the Government Performance Results Act, the U.S. Environmental Protection Agency (EPA) is focused on reducing risk of cancer and other serious health effects associated with hazardous air pollutants (HAPs) by achieving a 75% reduction in air toxics emissions chemicals, based on 1993 levels. The current inventory of HAPs includes 188 chemicals regulated under the Clean Air Act that have been linked to numerous adverse human health and ecological effects, including cancer, neurological effects, reproductive effects, and developmental effects. Current agency attention is targeting risk reduction associated with human exposure to air toxics.

The National Air Toxics Trends Station (NATTS) network was established to create a database of air quality data to assess progress in reducing ambient concentrations of air toxics and concomitant exposure-associated risk. During 2008, the NATTS network consisted of 28 stations in the contiguous 48 states, with one new site (Richmond, VA) added on January 1, 2008, and one new site (Grayson Lake, KY) substituted for an existing site (Hazard, KY) on July 1, 2008. To ensure the quality of the data collected under the NATTS network, EPA has implemented a Quality System comprising two primary components: (1) Technical Systems Audits (TSAs) and (2) Instrument Performance Audits (IPAs) for both the network stations and the associated sample analysis laboratories. As an integral part of the Quality System, EPA has also instituted quarterly analysis of proficiency testing (PT) samples to provide quantitative assessment of laboratory performance and to ensure that sampling and analysis techniques are consistent with precision, bias, and method detection limits specified by the NATTS Measurement Quality Objectives (MQOs).

This report describes and summarizes the quality assurance (QA) data generated by the NATTS program during calendar year (CY) 2008. For data retrieved from EPA's Air Quality Systems (AQS) database, only data collected in 2008 and posted prior to July 1, 2009, are included. Although this report contains substantive information about air concentrations of 2 different chemicals of interest, it focuses primarily on results for four classes of toxic ambient air constituents (volatile organic compounds [VOCs], carbonyls, polycyclic aromatic hydrocarbons [PAHs], and PM_{10} metals) as represented by seven pollutants: benzene, 1,3-butadiene, formaldehyde, acrolein, naphthalene, chromium (VI), and PM_{10} arsenic. At the request of EPA, these seven pollutants were selected as having particular interest by virtue of associated health risk and the frequency of their occurrence at measurable concentrations. While no group of compounds can provide unequivocal representation of their respective compound groups, these seven analytes were selected by EPA as reasonable representatives of the four main categories of HAPs routinely measured in the NATTS program and thus provide the framework for this summary report. It is presumed that if the NATTS program can meet the Data Quality Objectives (DQOs) for these seven compounds, the additional 20 compounds of concern will be of comparable quality by virtue of the representativeness of the physicochemical properties and the consistency of the collection and analysis methodologies of these four compounds. Because monitoring for PAHs and chromium (VI) is new, or relatively new, at many sites, QA results may be unavailable for some MQOs at some sites.

The comprehensive information in this Quality Assurance Annual Report (QAAR) was compiled from data acquired from numerous sources. The following general categories of information are presented:

- Descriptive background information on the AQS site identities, compounds of interest, and MQOs;
- Assessment of the completeness of the data available in the AQS database;
- Precision estimates, independently, for analytical and overall sampling error computed for as many of the 27 applicable compounds and for as many of the 28 NATTS sites as available for calendar year 2008;
- Evaluation of an analytical laboratory's accuracy (or bias), based on analysis of blind audit PT samples for many of the 27 compounds;
- Additionally, field bias data, which are expressed as the differences between actual and measured sampler flow readings for each of the four different sampler types associated with VOCs, carbonyls, PAHs, and PM_{10} metals, are presented for primary and collocated samplers (where available) at the three sites visited during the IPAs conducted during calendar year 2008;
- Method detection limit (MDL) data are presented for each site and/or analytical laboratory. In contrast to the manner in which these data were compiled in 2007, the AQS database, specifically the ALT_MDL variable, was used as the primary source of MDLs for 2008. However, since this MDL field in AQS is not a required field, it was necessary to augment the information with direct contacts to several NATTS state and local agencies and affiliated laboratories to compile MDL data for the 27 compounds of interest at all sites. This modification improved both acquisition efficiency and the accuracy of the MDL data.

Where possible, all data analyses were performed in SAS, version 9.2. Direct compilation of MDLs from individual laboratories was performed using Microsoft Excel.

2.0 NATTS QUALITY ASSURANCE DATA FOR CALENDAR YEAR 2008

The NATTS network included 28 sites in 2008. Table 1 presents the EPA Regions in which the sites are located, a descriptive location of the sites (site identifier), the urban or rural character of each site, and the unique AQS identification code.

Although a city and state are typically used as the site identifier, the county name is used for the two Florida sites on either side of Tampa Bay and for Harrison County, TX. Historical consistency has been maintained for the Grand Junction, CO, site, where two separate codes are used, one for VOCs and carbonyls (-0018) and the other for metals (-0017). This convention is unique to this site and is used because the organics and metals samplers are present at two separate physical locations at the sampling site.

Table 1. EPA Region Numbers, NATTS Sites, Site Type, and AQS Site Codes.

EPA Region	Site Identifier	Type	AQS Site Code
I	Boston-Roxbury, MA	Urban	25-025-0042
I	Underhill, VT	Rural	50-007-0007
I	Providence, RI	Urban	44-007-0022
II	Bronx, NY	Urban	36-005-0110
II	Rochester, NY	Urban	36-055-1007
III	Washington, DC	Urban	11-001-0043
III	Richmond, VA[a]	Urban	51-087-0014
IV	Chesterfield, SC	Rural	45-025-0001
IV	Decatur, GA	Urban	13-089-0002
IV	Hazard, KY[b]	Rural	21-193-0003
IV	Grayson Lake, KY[a]	Rural	21-043-0500
IV	Hillsborough County, FL	Urban	12-057-3002
IV	Pinellas County, FL	Urban	12-103-0026
V	Dearborn, MI	Urban	26-163-0033
V	Mayville, WI	Rural	55-027-0007
V	Northbrook, IL	Urban	17-031-4201
VI	Deer Park, TX	Urban	48-201-1039
VI	Harrison County, TX	Rural	48-203-0002
VII	St. Louis, MO	Urban	29-510-0085
VIII	Bountiful, UT	Urban	49-011-0004
VIII	Grand Junction, CO	Rural	08-077-0017[c], -0018[d]
IX	Phoenix, AZ	Urban	04-013-9997
IX	San Jose, CA	Urban	06-085-0005
IX	Rubidoux, CA	Urban	06-065-8001
IX	Los Angeles, CA	Urban	06-037-1103
X	La Grande, OR	Rural	41-061-0119
X	Portland, OR[e]	Urban	41-051-0246
X	Seattle, WA	Urban	53-033-0080

[a] Site added July 2008.
[b] Site discontinued June 2008.
[c] Metals only.
[d] VOCs, carbonyls, PAHs, and Cr (VI) only.
[e] Site added January 2008.

The 27 specific HAPs measured in the NATTS program, presented in Table 2 along with their unique AQS identification codes, are compounds that have been identified by EPA as being of significant health concern. These include 16 VOCs, 2 carbonyls, 2 PAHs, 6 PM_{10} metals, and chromium (VI). Succinct abbreviations of each chemical name are provided to facilitate table and figure creation and interpretation throughout this report.

Table 2. The 23 Hazardous Air Pollutants[a] and their AQS Parameter Codes.

Analyte Abbreviation[a]	Compound Name	Exact AQS Label	AQS Code	Compound Group
BENZ[b]	benzene	Benzene	45201	VOC
BUTA[b]	1,3-butadiene	1,3-Butadiene	43218	VOC
CTET	carbon tetrachloride	Carbon Tetrachloride	43804	VOC
CLFRM	chloroform	Chloroform	43803	VOC
EDB	1,2-dibromoethane	Ethylene Dibromide	43843	VOC
DCP	1,2-dichloropropane	1,2-Dichloropropane	43829	VOC
EDC	1,2-dichloroethane	Ethylene Dichloride	43815	VOC
MECL	dichloromethane	Dichloromethane	43802	VOC
TCE1122	1,1,2,2-tetrachloroethane	1,1,2,2-Tetrachloroethane	43818	VOC
PERC	tetrachloroethylene	Tetrachloroethylene	43817	VOC
TCE	trichloroethylene	Trichloroethylene	43824	VOC
VCM	vinyl chloride	Vinyl Chloride	43860	VOC
cDCPEN	cis-1,3-dichloropropene	Cis-1,3-Dichloropropylene	43831	VOC
tDCPEN	trans-1,3-dichloropropene	Trans-1,3-Dichloropropylene	43830	VOC
ACRO[b,c]	acrolein	Acrolein	43505	VOC[c]
ACRY	acrylonitrile	Acrylonitrile	43704	VOC
NAPH[b]	naphthalene	Naphthalene (Tsp) Stp		PAH
BaP	benzo[a]pyrene	Benzo[A]Pyrene (Tsp) Stp		PAH
FORM[b]	formaldehyde	Formaldehyde	43502	Carbonyl
ACET	acetaldehyde	Acetaldehyde	43503	Carbonyl
As[b]	arsenic	Arsenic Pm10 Stp	82103	Metal
Be	beryllium	Beryllium Pm10 Stp	82105	Metal
Cd	cadmium	Cadmium Pm10 Stp	82110	Metal
Pb	lead	Lead Pm10 Stp	82128	Metal
Mn	manganese	Manganese Pm10 Stp	82132	Metal
Ni	nickel	Nickel Pm10 Stp	82136	Metal
CrVI[b]	chromium (VI)	Chromium (VI) Tsp Stp	12115	Metal
As[d]	arsenic	Arsenic Pm10 Lc	85103	Metal
Be[d]	beryllium	Beryllium Pm10 Lc	85105	Metal
Cd[d]	cadmium	Cadmium Pm10 Lc	85110	Metal
Pb[d]	lead	Lead Pm10 Lc	85128	Metal
Mn[d]	manganese	Manganese Pm10 Lc	85132	Metal
Ni[d]	nickel	Nickel Pm10 Lc	85136	Metal
CrVI[d]	chromium (VI)	Chromium (VI) Tsp Lc	14115	Metal

[a] Mercury has been intentionally excluded.
[b] Results presented are representative of completeness.
[c] AQS includes this compound in the VOC group because it is collected in canisters along with other VOCs; it is actually a carbonyl.
[d] Some sites reported results for metal analytes at local conditions (lc), instead of STP (Stp), using these parameter codes. Values included in this report will be at STP only under the assumption that the difference between the two values is negligible.

2.1 Measurement Quality Objectives

MQOs for completeness, precision, laboratory bias, and method detection limits, established for the NATTS network to ensure data quality within the network, were unchanged from 2007. The stated DQO for the NATTS program is "to be able to detect a 15 percent difference (trend) between two consecutive 3-year annual mean concentrations within acceptable levels of decision error" [1]. MQOs for the four compounds of primary importance to the NATTS program (benzene, 1,3-butadiene, formaldehyde, PM_{10} arsenic) are summarized below in Table 3. MQOs for the three additional analytes of interest (acrolein, naphthalene, and chromium (VI)) were not available.

Table 3. Measurement Quality Objectives for the NATTS Program.

Compound	Completeness	Precision (Coefficient of Variation)	Laboratory Bias	Method Detection Limit (MDL)
benzene	> 85%	< 15%	< 25%	0.016 μg/m^3
1,3-butadiene	> 85%	< 15%	< 25%	0.013 μg/m^3
formaldehyde	> 85%	< 15%	< 25%	0.0074 μg/m^3 [a]
arsenic	> 85%	< 15%	< 25%	0.217 ng/m^3 [b]

[a] Assumes a sampling volume of 1,000 L.
[b] Assumes high-volume sampling with a sampling volume of 1,627 m^3 (1.13 m^3/min [40 ft^3/min] for 24 hours) and that one eighth of the sampled area of the filter is extracted for analysis.

As intended by the NATTS network, the MQOs require that

(1) sampling occurs every 6th day;
(2) sampling is successful 85% of the time;
(3) precision, as measured by the coefficient of variation (CV), is within 15% based on duplicate and collocated samples; and
(4) laboratory (measurement) bias is less than 25%, based on laboratory PT results.

Furthermore, actual MDLs, as reported by the laboratories supporting the NATTS sites or their sponsoring federal, state, or municipal agencies, are compared to the target MDLs as listed in the January 2007 edition of the NATTS Technical Assistance Document (TAD) [2].

Data acquired to assess compliance with the above stated MQOs are derived from a variety of sources. These sources are given in Table 4.

Table 4. Data Sources Employed for the Evaluation of MQOs.

Measurement Quality Objective	Data Source
Completeness	AQS
Analytical and Overall Precision	AQS
Bias—Laboratory	Proficiency testing results reported by Alion
Bias—Field	Audits of sampler flow rates conducted by RTI International
MDL	AQS augmented with federal, state, and contract laboratories

Data retrievals from AQS for relevant samples collected in 2008 and uploaded to the AQS database prior to July 1, 2009, were analyzed to assess completeness and to estimate precision from results of replicate analyses and collocated and duplicate sampling. PT samples were distributed by EPA contractor Alion Science, Inc., to participating laboratories for determination of analytical bias. Field bias was evaluated by independent measurement of sampler flow rates with NIST-traceable flowmeters during on-site IPAs. Finally, MDL data were extracted from AQS, where present, and augmented by direct contact with the individual laboratories.

2.2 Completeness of NATTS Data

The AQS database was queried for data records corresponding to relevant samples collected from the 28 NATTS sites during calendar year 2008 and entered into the AQS database prior to July 1, 2009. Data contributed to AQS by participating laboratories after July 1, 2008, are not reflected in the completeness calculations presented in Table 5 below. Specifically, completeness of the 2008 AQS dataset was assessed for seven compounds representative of the entire suite of 27 compounds presented previously in Table 2: benzene, 1,3-butadiene, acrolein, formaldehyde, naphthalene, chromium (VI), and arsenic. Based on the NATTS requirement of a 1- in 6-day sample collection frequency, 60 records for the primary parameter occurrence code (POC) would represent 100% completeness. For purposes of this completeness calculation, nondetects were counted equivalently with measurable values. Conversely, missing values were not counted toward the percentage complete. Completeness statistics for the Hazard and Grayson Lake, KY, sites were adjusted for the fact that each of these sites was operated for only 6 months during 2008.

Completeness statistics were computed for primary samples or, if the primary measurement was missing, for the collocated samples collected at the same location during the same sampling period. To ensure that only a single record was included for each site and date, the maximum value of the measurements was retained across primary and collocated samples. In this way, if one of the measurements was missing and the other was not detected/measured, the maximum would capture the not detected/measured record. If both primary and collocated records contained a missing value, only one record would be tallied for the completeness count. Finally, if both records contained a not detected or measured value, the larger of the two would be captured for the completeness count. Since sample collection at some locations was performed more frequently to meet the requirements of other sampling networks or for other specific purposes, only records that occurred at the required 1- in 6-day sample collection frequency (days 0, 6, 12, 18, 24, 30, etc.), starting with the first collection date for each site in calendar year 2008, were counted. For this and other reasons, it is not possible to discern from the AQS database when makeup samples are collected. The individual enumeration of valid samples from each and every site would be an extremely tedious task and presumes that only NATTS sample records are present in the database for a given parameter occurrence code. Therefore, to account for makeup samples collected near the time of the scheduled collection date, the interval of days since the last collection event was allowed to vary between 4 and 8. No correction was applied for compound-specific missing data (e.g., the value for benzene was missing, but the value for dichloromethane was nonmissing). It is assumed that this discrepancy does not significantly distort the percent completeness.

The results of the completeness assessment are presented for each collection location and representative compound in Table 5 and in Figures 1 through 7. Mean and median completeness values across all NATTS laboratories for a given analyte and across all analytes for a given site, are also presented. In cases where no data were reported, the particular analyte class was not collected at that NATTS site, as indicated by table notes.

Table 5. Percent Completeness of the 2008 AQS Dataset by Site for Four Hazardous Air Pollutants.

	Parameter Code →	**45201**	**43218**	**43505**	**17141**	**43502**	**12115**	**82103**
AQS Site ID	**Site Name**	**BENZ**	**BUTA**	**ACRO**	**NAPH[a]**	**FORM**	**CRVI**	**AS**
25-025-0042	Boston-Roxbury, MA	93	93	93	98	102	102	90
50-007-0007	Underhill, VT	100	102	102	89	102	102	102
44-007-0022	Providence, RI	100	100	100	100	102	100	100
36-005-0110	Bronx, NY	102	102	102	100	102	98	100
36-055-1007	Rochester, NY	102	102	102	100	102	102	100
11-001-0043	Washington, DC	102	102	102	100	102	102	93
51-087-0014	Richmond, VA[b]	103	103	103	100	98	47	90
45-025-0001	Chesterfield, SC	102	102	102	100	102	100	102
13-089-0002	Decatur, GA	102	102	—[c]	103	102	63	102
21-193-0003	Hazard, KY[b]	87	87	87	67	83	87	83
21-043-0500	Grayson Lake, KY[b]	100	100	100	100	100	100	97
12-057-3002	Hillsborough County, FL	102	102	102	100	102	102	102
12-103-0026	Pinellas County, FL	100	100	100	96	102	53	100
26-163-0033	Dearborn, MI	100	100	100	96	97	98	98
55-027-0007	Mayville, WI	90	90	90	100	82	100	87
17-031-4201	Northbrook, IL	103	103	103	100	103	102	102
48-201-1039	Deer Park, TX	97	97	97	86	97	95	102
48-203-0002	Harrison County, TX	100	100	97	—[c]	97	100	102
29-510-0085	St. Louis, MO	97	97	97	100	100	102	102
49-011-0004	Bountiful, UT	92	92	92	34	93	100	97
08-077-0017[e], -0018[f]	Grand Junction, CO	100	72	102	96	100	103	100
04-013-9997	Phoenix, AZ	90	90	90	97	100	100	95
06-085-0005	San Jose, CA	100	100	100	100	98	—[d]	100
06-065-8001	Rubidoux, CA	93	93	93	100	102	—[d]	—[d]
06-037-1103	Los Angeles, CA	98	98	98	97	102	—[d]	—[d]
41-061-0119	La Grande, OR	87	90	—[c]	17	85	80	85
41-051-0246	Portland, OR	82	85	—[c]	35	85	62	85
53-033-0080	Seattle, WA	98	98	98	98	100	100	97
	Mean	97	97	98	89	98	92	97
	Std. Dev.	6	7	5	23	6	17	6
	Median	100	100	100	100	100	100	100

[a] Percent completeness based on specified starting date for each site.

[b] Percent completeness based on 6-month sample collection period.

[c] Not measured for this site.

[d] Not collected at this site.

[e] Metals only.

[f] Carbonyls, VOCs, and PAHs only.

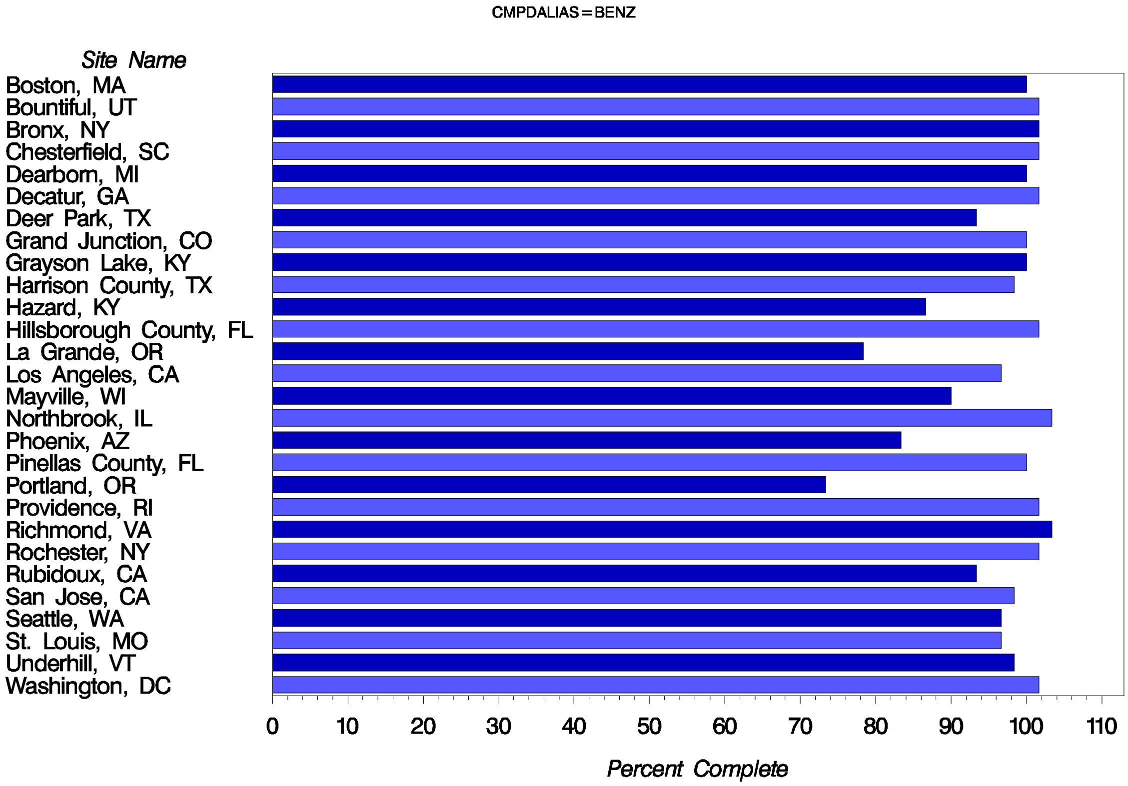

Figure 1. Completeness for Benzene at NATTS Sample Collection Sites in 2008.

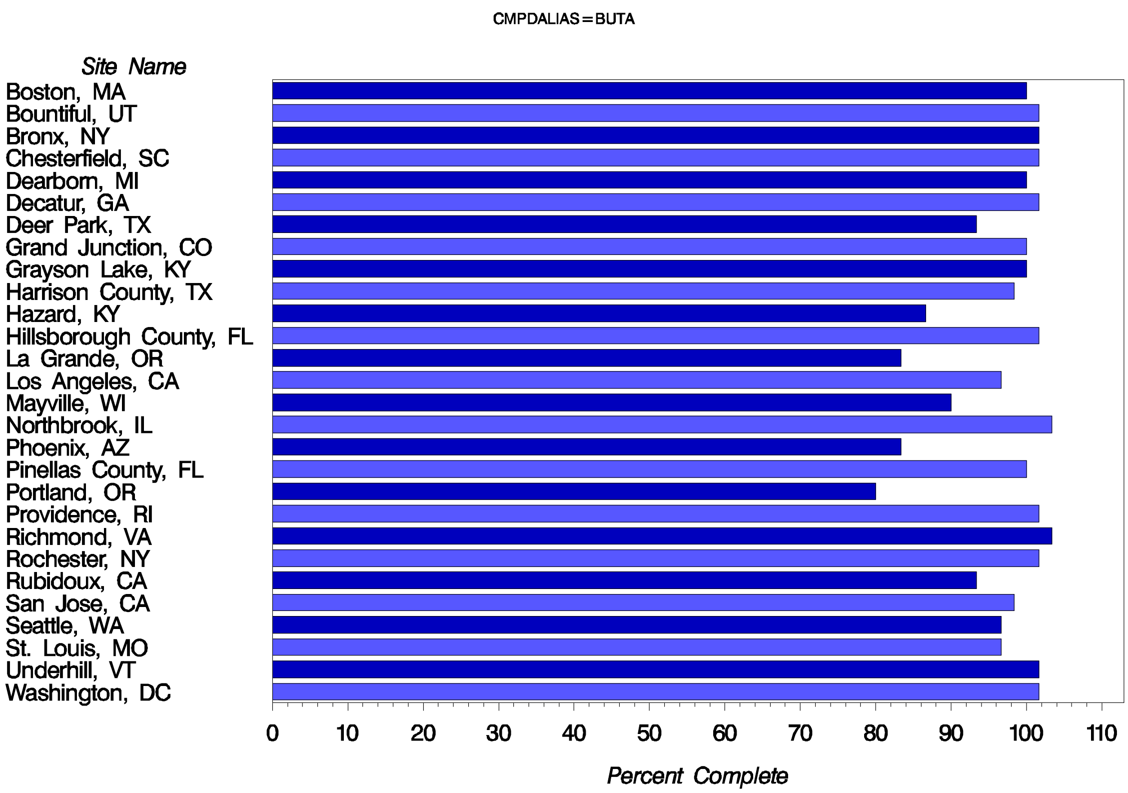

Figure 2. Completeness for 1,3-Butadiene at NATTS Sample Collection Sites in 2008.

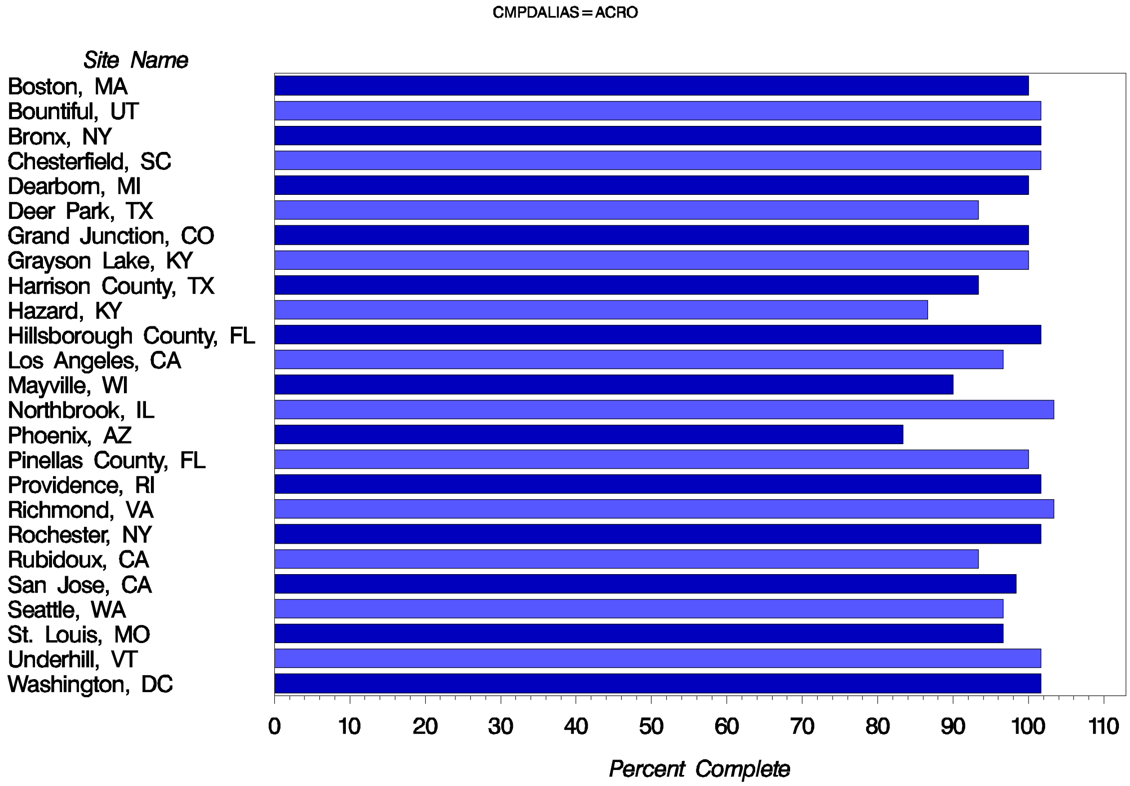

Figure 3. Completeness for Acrolein at NATTS Sample Collection Sites in 2008.

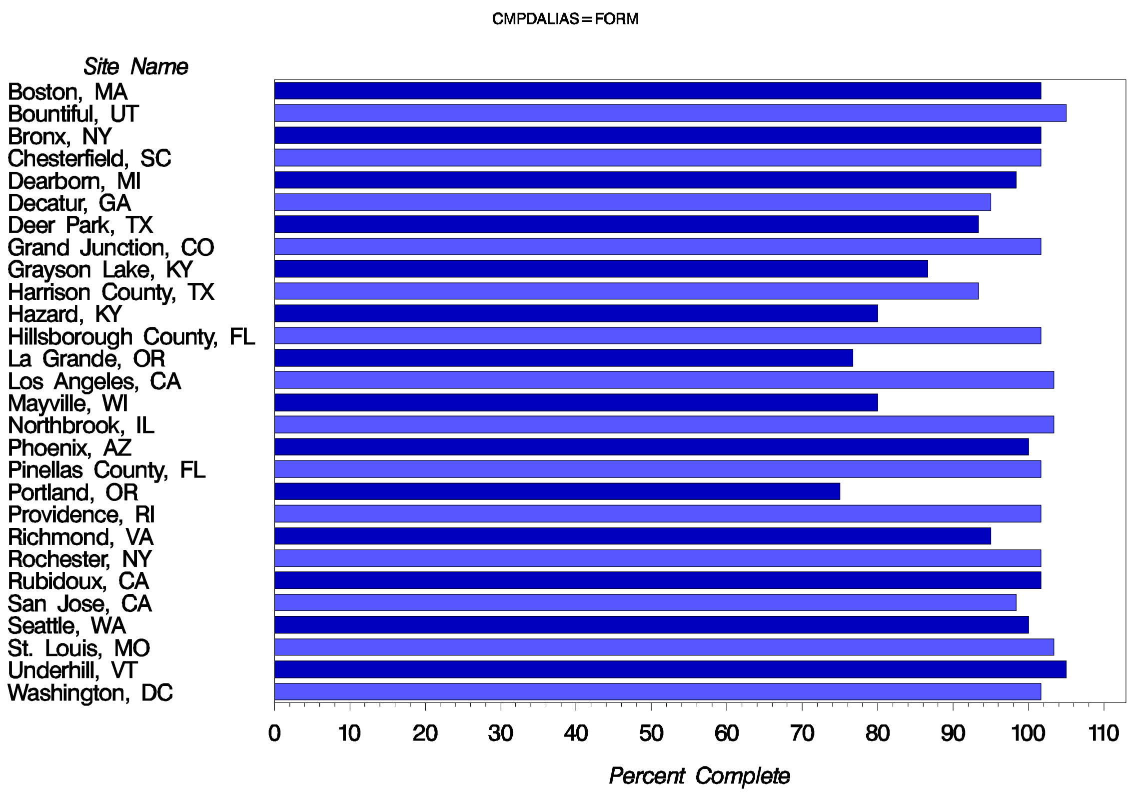

Figure 4. Completeness for Formaldehyde at NATTS Sample Collection Sites in 2008.

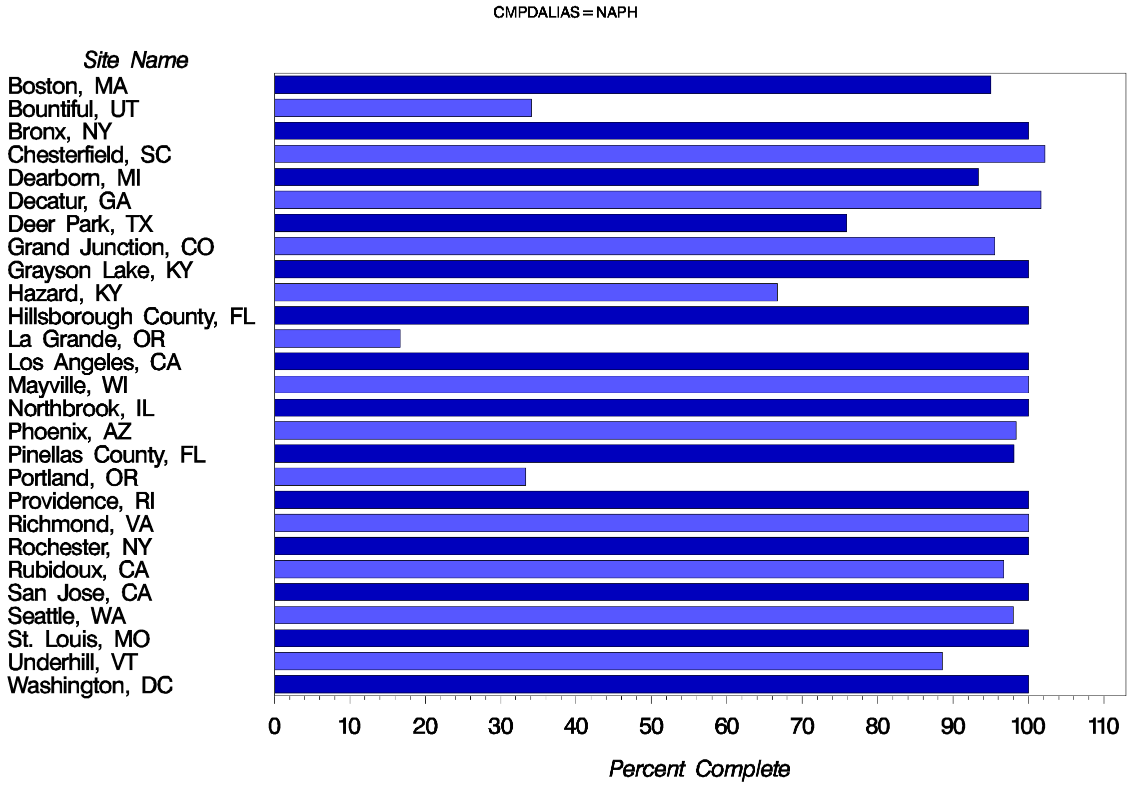

Figure 5. Completeness for Naphthalene at NATTS Sample Collection Sites in 2008.

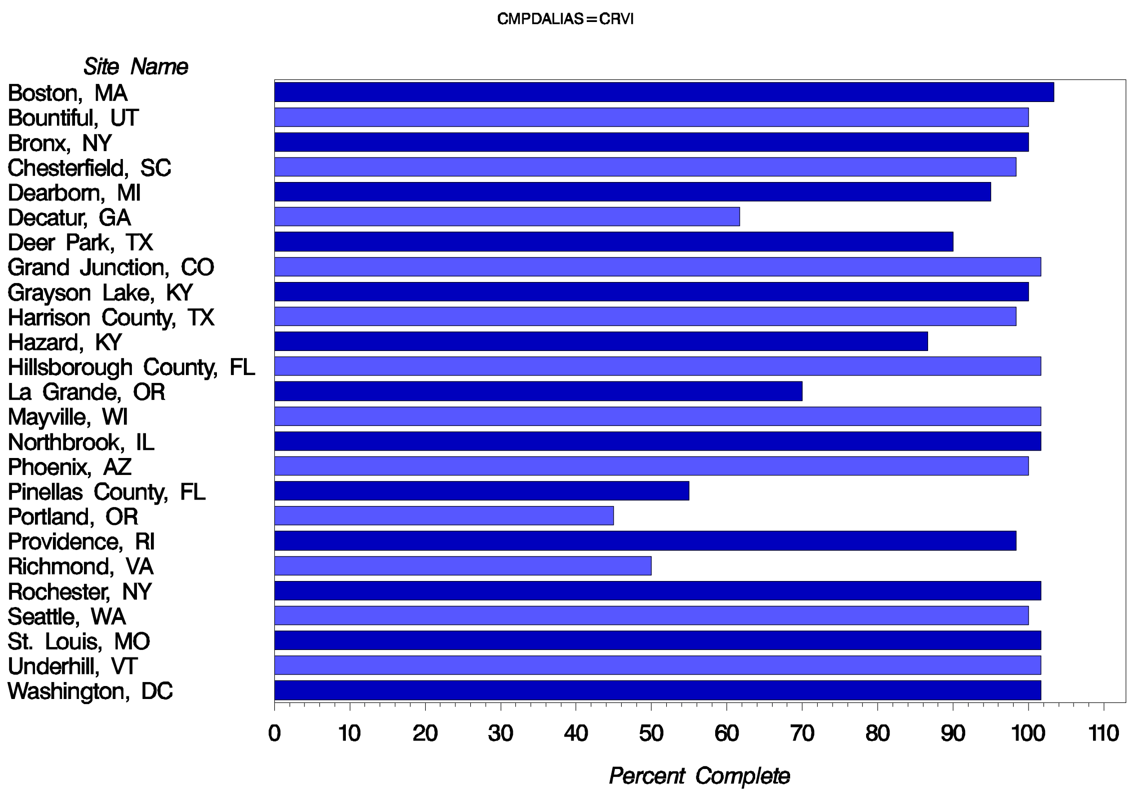

Figure 6. Completeness for Chromium (VI) at NATTS Sample Collection Sites in 2008.

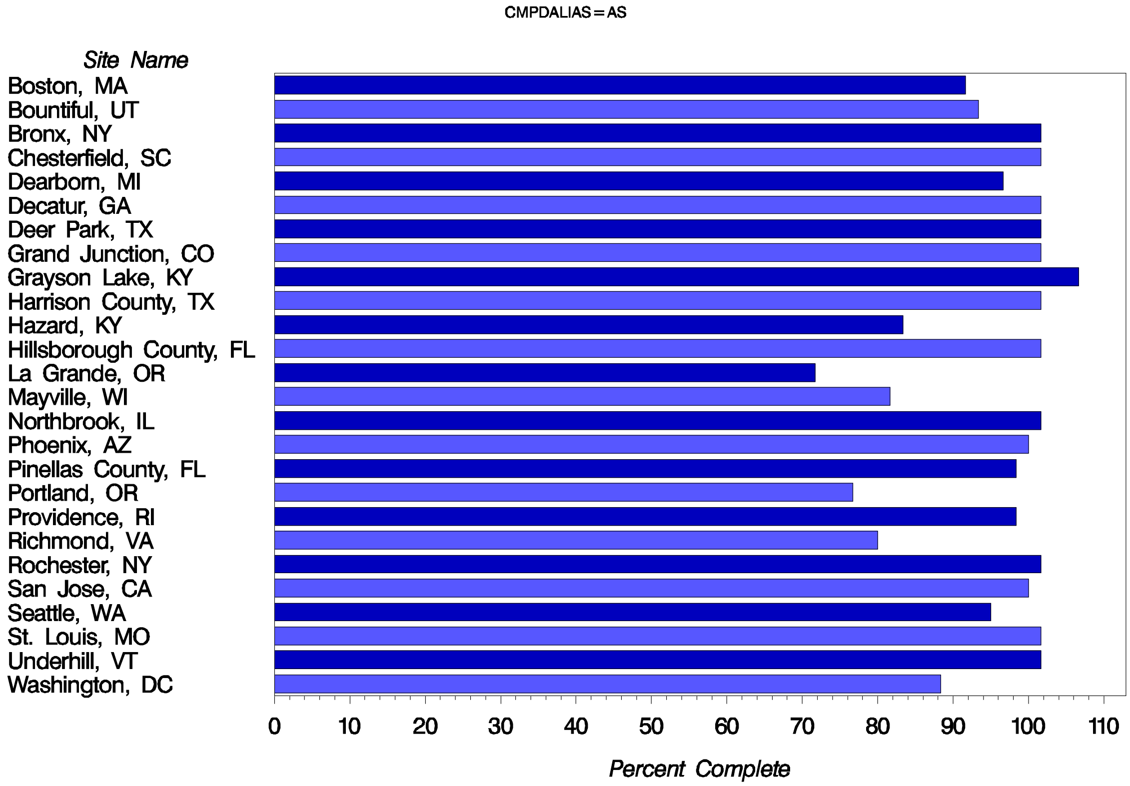

Figure 7. Completeness for Arsenic at NATTS Sample Collection Sites in 2008.

Without notable exception, all sites exhibit consistently high completeness statistics for benzene, 1,3-butadiene, acrolein, formaldehyde, and arsenic and met the MQO of 85% completeness. Completeness for chromium (VI) is variable across sites; most sites achieve or exceed the MQO, but others, including Decatur, GA; Pinellas County, FL; Portland, OR; and Richmond, VA, fall well below the MQO target. After adjustment of the completeness statistic for the beginning of PAH collections at each site, only five sites (Bountiful, UT; Deer Park, TX; Hazard, KY; La Grande, KY; Portland, OR) failed to achieve the MQO of 85% completeness.

2.3 Precision of NATTS Data

Three basic sample types are collected at NATTS sites:

- Primary samples—a single sample that represents a particular sampling event;
- Duplicate samples—a replicate sample, collected simultaneously with the primary sample, that represents a second measurement from the same sample stream (e.g., the inlet stream of an outdoor air monitor) but employs an independent sample collection device (e.g., sampling pump) and collection substrate (e.g., filter) from the primary sample. Duplicate samples provide the basis for assessment of the aggregate variability associated with the collection device, sampling substrate, and sample analysis;
- Collocated samples—a replicate sample, collected simultaneously with the primary sample, that represents a second measurement from a completely independent (but

spatially close, usually 1 to 2 meters away from the primary sampler) sample stream, collection device, and collection substrate from the primary sample. Collocated samples provide the basis for assessment of the total variability associated with all components of the sample collection and analysis scheme and, therein, assume that the air collected by the primary and collocated samplers is absolutely identical in its composition. Samples collected at different sites violate this basic premise of collocation and were excluded from these precision analyses at the direction of EPA.

Precision analyses were performed exclusively on NATTS sites. Assessment of methodological precision for the NATTS data is accomplished from both analytical (i.e., instrumental) and overall (i.e., instrumental + sampling) perspectives. In the former case, analytical precision is a measure of the variability in reported results due exclusively to differences in analytical instrument performance and is estimated by comparing results from the replicate analyses of a single sample, whether that sample be primary, duplicate, or collocated. Overall sampling precision is assessed by comparing the results from primary and collocated samples and accounts for the combined variability associated with sample collection and sample analysis. Despite the differences, albeit subtle, between duplicate and collocated samples, this report reflects overall precision estimates based on both duplicate and collocated samples.

For the purposes of these precision assessments, the AQS database was queried for two distinct record types: RP records and RD records. RP records contain data for various types of replicate samples and analyses associated with a particular sampling date, site, and chemical parameter. Different types of replicates are identified by the value of the precision ID variable (PRECISID) according to the following scheme:

- PRECISID = 1: Collocated sample data
- PRECISID = 2 Replicate analysis of a primary sample
- PRECISID = 3: Replicate analysis of a collocated sample

For this report, analytical precision is computed from the replicate pairs of data coded with either Precision ID 2 or 3. Overall precision is computed using the data in the raw data records as described below.

In addition to the replicate records, raw data (AQS RD) transactions provide a second source of primary and collocated data in AQS. Using the POCs shown for each NATTS site listed in Table 6, it is possible to distinguish among primary, duplicate, and collocated sampling events. For example, primary samples collected at the Chesterfield, SC, NATTS site are assigned a parameter occurrence code of 1, while collocated samples collected at the same site are assigned a parameter occurrence code of 2. This results in the creation of two distinct records for each sampling event at which a collocated sample is collected. Duplicate samples are similarly identified. Because the assignment of a particular POC is made at the discretion of each NATTS site, extensive effort was required to ensure that the POCs for each site were correctly identified. To this end, a representative at each NATTS site was contacted by e-mail and by telephone to determine the specific POC used for each of the primary, duplicate, and collocated samples and for the three chemical classes (i.e., VOCs, carbonyls, and metals). Multiple POCs for a given site, analyte, and sample type reflect a number of factors unique to a site during 2008, largely made for reasons known only to the NATTS site administrators. Overall precision estimates were computed by comparing primary and collocated records for a particular site, chemical parameter, and sample collection date.

Table 6. Parameter Occurrence Codes by NATTS Site and Analyte Type.

			Parameter Occurrence Codes (POCs)[a]														
			VOC			Carbonyls			Metals			Chromium (VI)			PAHs		
Region	Site Identifier	AQS Site Code	P[b]	D[c]	C[d]	P	D	C	P	D	C	P	D	C	P	D	C
I	Boston, MA	25-025-0042	10	11		3	4		6	7		6	7		6		
I	Underhill, VT	50-007-0007	1			1			1			6	7		6		
I	Providence, RI	44-007-0022	2			5		7	1		2	6		7	6		
II	Bronx, NY	36-005-0110	2			2	20	10	1		2	6		7	6		
II	Rochester, NY	36-055-1007	2			2			1			6		7	6		
III	Washington, DC	11-001-0043	4			1,2			1			1		2	1		
III	Richmond, VA	51-087-0014	4	1		2			1			6		7	6		
IV	Chesterfield, SC	45-025-0001	1		2	1		2	1		2	6	7		6		
IV	Decatur, GA[e]	13-089-0002	1,3		2,4	2		3	1		2	6		7	6		7
IV	Hazard, KY	21-193-0003	1	2		1	2		1		2	6		7	6		
IV	Grayson Lake, KY	21-043-0500	1	2		1	2		1	2		6		7	6		
IV	Hillsborough County, FL	12-057-3002	1			6	6		5		6	6		7	6		7
IV	Pinellas County, FL	12-103-0026	1		2	6			5			6		7	6		7
V	Dearborn, MI	26-163-0033	1		2	1		2	1		9	1		2	1		2
V	Mayville, WI	55-027-0007	1	2		1	2		1		2	6		7	6		
V	Northbrook, IL	17-031-4201	6		7	6		7	6			6		7	6		
VI	Deer Park, TX	48-201-1039	2		3	3	5		1			1		2	1	2	6
VI	Harrison County, TX	48-203-0002	1			1			1								
VII	St. Louis, MO	29-510-0085	6			6			6		7	6		7	6		
VIII	Bountiful, UT	49-011-0004	6			6			1		2	6		7	6		
VIII	Grand Junction, CO	08-077-0017, -0018	6			6			3		4	6		7	6		
IX	Phoenix, AZ	04-013-9997	6		7	1,30		2,31	1			6		7	3		
IX	Los Angeles, CA	06-037-1103	4		5	4		5							6		
IX	Rubidoux, CA	06-065-8001	4		5	4		5							6	7	
IX	San Jose, CA	06-085-0005	3,5		5	1,3,4		1	1						1		
X	La Grande, OR	41-061-0119	7			7			7			7			7		
X	Portland, OR	41-051-0246	7		9	7		9	7		9	7			6		7
X	Seattle, WA	53-033-0080	6		7	6		7	6		7	6	7		6	7	

[a] As reported by the NATTS site administrator. Multiple POCs reflect different analytes or changes in assignments during the monitoring year.
[b] P = Primary
[c] D = Duplicate
[d] C = Collocated
[e] Benzene on POCs 3 and 4; all other VOCs on POCs 1 and 2.

Table 7, complemented by Table 8, presents the laboratories performing analysis of specific sample types for each NATTS site. Of particular note is the fact that some laboratories provided analytical chemistry services for multiple NATTS sites. Laboratory codes presented in Table 8 were assigned by Alion Science, Inc., to track PT samples and their results.

Table 7. Laboratories Performing Analyses for the Different Compound Types for Each NATTS Site in 2008.

Site Identifier	VOCs[a]	Carbonyls	Metals	PAHs	Chromium (VI)
Boston-Roxbury, MA	RIDOH	MADEP	ERG	ERG	ERG
Underhill, VT	VTDEC	VTDEC	ERG[b]	ERG	ERG
Providence, RI	RIDOH	RIDOH	RIDOH	ERG	ERG
Bronx, NY	NYSDEC	NYSDEC	RTI	ERG	ERG
Rochester, NY	NYSDEC	NYSDEC	RTI	ERG	ERG
Washington, DC	MDE	PAMSL	WVDEP	ERG	ERG
Richmond, VA[c]	VA DCLS	VA DCLS	VA DCLS	ERG	ERG
Chesterfield, SC	SCDHEC	SCDHEC	SCDHEC	ERG	ERG
Decatur, GA	GADNR	GADNR	GADNR	ERG	ERG
Hazard, KY[d]	KYDES	KYDES	KYDES	ERG	ERG
Grayson Lake, KY[c]	KYDES	KYDES	KYDES	ERG	ERG
Hillsborough County, FL	PCDEM	ERG	EPCHC	ERG	ERG
Pinellas County, FL	PCDEM	ERG	EPCHC	ERG	ERG
Dearborn, MI	ERG	ERG	MIDEQ	ERG	ERG
Mayville, WI	WSLH	WSLH	WSLH	ERG	ERG
Northbrook, IL	ERG	ERG	ERG	ERG	ERG
Deer Park, TX	TCEQ	TCEQ	TCEQ	TCEQ	TCEQ
Harrison County, TX	TCEQ	TCEQ	TCEQ	TCEQ	TCEQ
St. Louis, MO	ERG	ERG	ERG	ERG	ERG
Bountiful, UT	ERG	ERG	ERG	ERG	ERG
Grand Junction, CO	ERG	ERG	IMLAS[e]	ERG	ERG
Phoenix, AZ	ERG	ERG	ERG	ERG	ERG
San Jose, CA	BAAQMD	BAAQMD	ERG	ERG	CARB
Rubidoux, CA	SCAQMD	SCAQMD	SCAQMD	ERG	CARB
Los Angeles, CA	SCAQMD	SCAQMD	SCAQMD	ERG	CARB
La Grande, OR	ODEQ	ODEQ	ODEQ	ODEQ	ODEQ
Portland, OR[f]	ODEQ	ODEQ	ODEQ	ODEQ	ODEQ
Seattle, WA	ERG	ERG	ERG	ERG	ERG

[a] Includes acrolein.
[b] Metals analysis prior to 2008 by VT DEC and Cr^{+6} only.
[c] Site added July 2008.
[d] Site discontinued June 2008.
[e] Switching from IMLAS to CO State Lab effective Jan 2010.
[f] Site added January 2008.

Table 8. Laboratory Abbreviations and Descriptions for NATTS Laboratories.

Laboratory Code(s)	Laboratory Abbreviation	Laboratory Description
01-01-C,V	RIDOH	Rhode Island Department of Health
01-02-C,V	VTDEC	Vermont Department of Environmental Conservation
01-03-C	MADEP	Massachusetts Department of Environmental Protection
01-04-M	USEPAR1	U.S. EPA Region 1 Laboratory
02-01-C,V	NYSDEC	New York State Department of Environmental Conservation
03-01-V	MDE	Maryland Department of the Environment
03-01-C	PAMSL	Philadelphia Air Management Services Laboratory
03-01-M	WVDEP	West Virginia Department of Environmental Protection
04-01-M	EPCHC	Environmental Protection Commission of Hillsborough County
04-01-V	PCDEM	Pinellas County Department of Environmental Management
04-02-C,M,V	SCDHEC	South Carolina Department of Health and Environmental Control
04-03-C,M,V	KYDES	Kentucky Division of Environmental Services
04-04-C,M,V	GADNR	Georgia Department of Natural Resources
05-01-M	MIDEQ	Michigan Department of Environmental Quality
05-03-C,M,V	WSLH	Wisconsin State Laboratory of Hygiene
06-01-C,M,V	TCEQ	Texas Commission on Environmental Quality
08-02-M,V	IMLAS	IML Air Science Laboratory
09-03-C,V	BAAQMD	Bay Area Air Quality Management District
09-06-C,V	SDCAPCD	San Diego County Air Pollution Control District
10-02-C,M,V	ODEQ	Oregon Department of Environmental Quality
11-01-C,M,V; 09-02-V	ERG[a]	Eastern Research Group
11-02-M	RTI	RTI International
—[b]	VA DCLS	Virginia Division of Consolidated Laboratory Services
—[b]	SCAQMD	South Coast Air Quality Management District

[a] ERG provides analytical laboratory support for several NATTS sites.
[b] Did not participate in PT program.

2.3.1 Analytical Precision Results

Analytical precision was computed from the results of the primary and collocated samples and their respective replicate analyses extracted from RP records in the AQS database. This measure of agreement, expressed as the percent coefficient of variation (% CV), is defined algebraically in Eq. 1, below.

$$\%CV = 100 \cdot \sqrt{\frac{\sum_{i=1}^{n}\left[\frac{(p_i - r_i)}{0.5 \cdot (p_i + r_i)}\right]^2}{2n}} \qquad \text{(Eq. 1)}$$

where

p_i = the result of the principal analysis on sample i,

r_i = the result of the replicate analysis on sample i, and

n = the number of principal-replicate analysis pairs.

The analytical precision for all measured HAPs analyzed in samples collected in calendar year 2008 is presented in Table 9 with selected analytes summarized graphically in Figures 8 through 14.

The agreement between replicate analyses of the same samples is highly variable but, with the exception of chromium (VI), largely within the MQO guidelines. Although only reported for three sites, arsenic agreement is below 1.5%. Conversely, more than half of the sites performing replicate analyses of chromium (VI) show agreement exceeding the MQO, with the laboratories analyzing samples for the Hazard, KY; Hillsborough County, FL; and Mayville, WI, sites exhibiting CVs of ≥ 30%. Acrolein shows similar results, with half of the eight reporting sites showing agreement above the MQO. Conversely, agreement between formaldehyde reanalyses is very tight and within the MQO, with only Bountiful, UT, showing a CV above 10%. Examination of the individual data records revealed that the CV for this site is a result of one extreme value. An MQO is not assigned for PAHs, but naphthalene exhibits agreements below 5% for all reporting sites, well below CVs reported for VOCs.

2.3.2 Overall Precision Results

Overall precision was computed from the results of the primary, duplicate, and collocated samples extracted from RD records in the AQS database. This measure of agreement, expressed as the percent coefficient of variation (% CV), is defined algebraically in Eq. 2, below.

$$\%CV = 100 \cdot \sqrt{\frac{\sum_{i=1}^{n}\left[\frac{(p_i - r_i)}{0.5 \cdot (p_i + r_i)}\right]^2}{2n}} \qquad \text{(Eq. 2)}$$

where

p_i = the result of the principal analysis on primary sample i,

r_i = the result of the principal analysis on collocated sample i, and

n = the number of primary-collocated sample pairs.

The overall precision results for samples collected in calendar year 2008 are presented in Table 10 and summarized graphically in Figures 15 through 21. For cases where either the primary or collocated sample yielded a result of zero or had a value below the reported method detection limit, the data pairs were excluded from the overall precision estimate. All data pairs with measurable values were included in the computation.

Table 9. Analytical Precision[a] for Replicate Analyses of 2008 NATTS Data.

AQS Site Code	Site Description	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM	cDCPEN
04-013-9997	Phoenix, AZ	7 (10)	6.4 (10)	6.8 (10)	7.3 (10)	—[b]	—	—	5.8 (10)	—	5.8 (10)	26.5 (8)	—	—
06-065-8001	Rubidoux, CA	—	—	—	—	—	—	—	—	—	—	—	—	—
06-085-0005	San Jose, CA	8.2 (18)	9.2 (5)	5 (18)	6.9 (17)	—	—	—	8.1 (13)	—	3.8 (18)	11.1 (18	—	—
08-077-0017	Grand Junction, CO	—	—	—	—	—	—	—	—	—	—	—	—	—
08-077-0018	Grand Junction, CO	7.7 (9)	5.7 (9)	27.1 (9)	9.4 (9)	—	—	—	8.4 (9)	—	7.6 (9)	7.3 (4)	—	—
11-001-0043	Washington, DC	—	—	—	—	—	—	—	—	—	—	—	—	—
12-057-3002	Hillsborough County, FL	—	—	—	—	—	—	—	—	—	—	—	—	—
12-103-0026	Pinellas County, FL	3.6 (67)	12.9 (67)	4.7 (67)	8.2 (67)	20.6 (29)	44.8 (9)	10.4 (66)	17.2 (67)	19.7 (64)	10.6 (67)	16.3 (46)	24.7 (52)	28.3 (23)
13-089-0002	Decatur, GA	—	—	—	—	—	—	—	—	—	—	—	—	—
17-031-4201	Northbrook, IL	7 (28)	18 (14)	6 (14)	6.8 (14)	—	—	—	4.7 (14)	—	13 (14)	15.7 (7)	40.4 (1)	—
21-193-0003	Hazard, KY	—	—	—	—	—	—	—	—	—	—	—	—	—
25-025-0042	Boston, MA	—	—	—	—	—	—	—	—	—	—	—	—	—
26-163-0033	Dearborn, MI	5.8 (12)	11.2 (12)	4.1 (12)	7.5 (12)	—	—	—	4 (12)	—	4.1 (11)	9.8 (4)	0 (2)	—
29-510-0085	St. Louis, MO	8.5 (10)	9.6 (8)	6.5 (10)	29.5 (10	—	—	—	6.9 (10)	—	5.8 (8)	8.4 (5)	—	—
36-005-0110	Bronx, NY	—	—	—	—	—	—	—	—	—	—	—	—	—
36-055-1007	Rochester, NY	—	—	—	—	—	—	—	—	—	—	—	—	—
41-051-0246	Portland, OR	—	—	—	—	—	—	—	—	—	—	—	—	—
44-007-0022	Providence, RI	—	—	—	—	—	—	—	—	—	—	—	—	—
45-025-0001	Chesterfield, SC	—	—	—	—	—	—	—	—	—	—	—	—	—
49-011-0004	Bountiful, UT	6.6 (20)	8.2 (17)	8.8 (10)	9.5 (9)	—	—	—	5.2 (10)	—	9.1 (10)	7.6 (1)	12.6 (2)	—
50-007-0007	Underhill, VT	—	—	—	—	—	—	—	—	—	—	—	—	—
53-033-0080	Seattle, WA	8.2 (10)	9.7 (10)	6.6 (9)	9.3 (10)	—	—	—	5.7 (10)	—	6.2 (10)	9.9 (5)	—	—
55-027-0007	Mayville, WI	—	—	—	—	—	—	—	—	—	—	—	—	—
	Overall Mean[c]	6.2 (184)	11.8 (152)	8.4 (159)	10.8 (158)	20.6 (29)	44.8 (9)	10.4 (66)	12.2 (155)	19.7 (64)	9 (157)	15.4 (98)	24.3 (57)	28.3 (23)

(continued)

Table 9. Analytical Precision[a] for Replicate Analyses of 2008 NATTS Data (additional analytes). (continued)

AQS Site Code	Site Description	tDCPE N	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
04-013-9997	Phoenix, AZ	—	9.8 (10)	7.6 (1)	—	—	0.5 (14)	1.3 (14)	—	—	—	—	—	—	4.2 (14)
06-065-8001	Rubidoux, CA	—	—	—	3.1 (24)	3.9 (17)	—	—	—	—	—	—	—	—	
06-085-0005	San Jose, CA	—	—	—	—	—	1.2 (10)	1.4 (10)	—	—	—	—	—	—	
08-077-0017	Grand Junction, CO	—	—	—	—	—	—	—	—	—	—	—	—	—	12.1 (7)
08-077-0018	Grand Junction, CO	—	16 (9)	—	—	—	2 (10)	1.4 (10)	—	—	—	—	—	—	
11-001-0043	Washington, DC	—	—	—	—	—	—	—	—	—	—	—	—	—	2.3 (4)
12-057-3002	Hillsborough County, FL	—	—	—	2.5 (85)	15.2 (22)	2.9 (12)	1.2 (12)	—	—	—	—	—	—	38.6 (5)
12-103-0026	Pinellas County, FL	20.1 (31)	18.5 (67)	40 (67)	—	—	1.6 (10)	1.5 (10)	—	—	—	—	—	—	8.1 (6)
13-089-0002	Decatur, GA	—	—	—	2 (11)	4.8 (4)	—	—	—	—	—	—	—	—	29.7 (7)
17-031-4201	Northbrook, IL	—	6.6 (10)	—	—	—	1.1 (16)	1.1 (16)	—	—	—	—	—	—	9.1 (11)
21-193-0003	Hazard, KY	—	—	—	—	—	—	—	—	—	—	—	—	—	38.4 (3)
25-025-0042	Boston, MA	—	—	—	—	—	—	—	0.7 (64)	45.3 (55)	0.6 (64)	1.4 (64)	2.6 (64)	0.8 (64)	21 (8)
26-163-0033	Dearborn, MI	—	8.6 (11)	—	1.4 (9)	2.4 (9)	0.8 (11)	0.5 (11)	—	—	—	—	—	—	12.4 (10)
29-510-0085	St. Louis, MO	—	33.2 (8)	—	—	—	1.5 (12)	2.7 (12)	0.6 (22)	11 (18)	0.6 (22)	0.6 (22)	5.3 (22)	0.8 (22)	20.6 (11)
36-005-0110	Bronx, NY	—	—	—	—	—	—	—	—	—	—	—	—	—	10.3 (13)
36-055-1007	Rochester, NY	—	—	—	—	—	—	—	—	—	—	—	—	—	19.6 (7)
41-051-0246	Portland, OR	—	—	—	2.8 (4)	2.5 (2)	—	—	—	—	—	—	—	—	
44-007-0022	Providence, RI	—	—	—	—	—	—	—	—	—	—	—	—	—	20.7 (9)
45-025-0001	Chesterfield, SC	—	—	—	—	—	—	—	—	—	—	—	—	—	17.9 (6)
49-011-0004	Bountiful, UT	—	38.6 (10)	—	—	—	11.3 (10)	9.8 (10)	—	—	—	—	—	—	10 (23)
50-007-0007	Underhill, VT	—	—	—	—	—	—	—	1.3 (1)	—	18.4 (1)	11.5 (1)	1.6 (1)	—	19.3 (3)
53-033-0080	Seattle, WA	—	9.7 (10)	—	2 (10)	7.6 (6)	1.9 (16)	1.9 (16)	—	—	—	—	—	—	2.5 (9)
55-027-0007	Mayville, WI	—	—	—	—	—	—	—	—	—	—	—	—	—	39.7 (4)
	Overall Mean [c]	20.1 (31)	19.7 (135)	39.7 (68)	2.5 (143)	9.9 (60)	3.6 (121)	3.2 (121)	0.7 (87)	39.7 (73)	2.1 (87)	1.8 (87)	3.5 (87)	0.8 (86)	17.7 (160)

[a] Expressed as percent coefficient of variation (%CV) with number of contributing data pairs presented in parentheses. Metals results are reported at STP at most sites and local conditions at others.
[b] Sample not collected or analyte not reported.
[c] Across all sites.

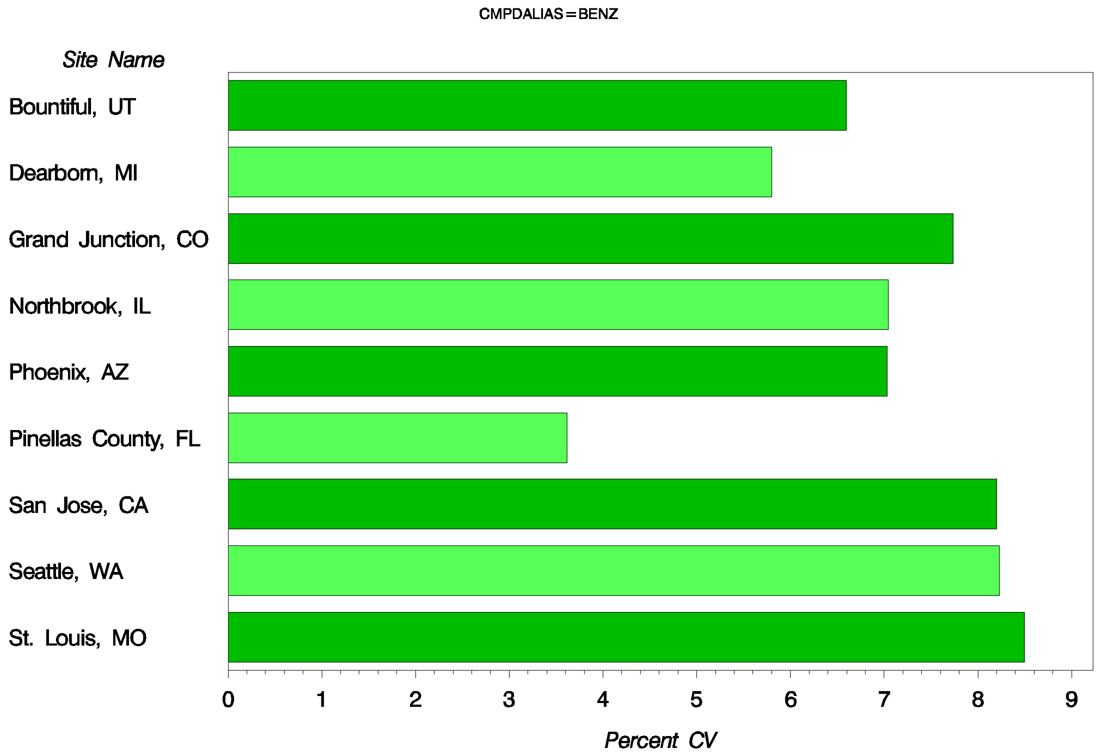

Figure 8. Analytical Precision Summary for Benzene at NATTS Sample Collection Sites in 2008.

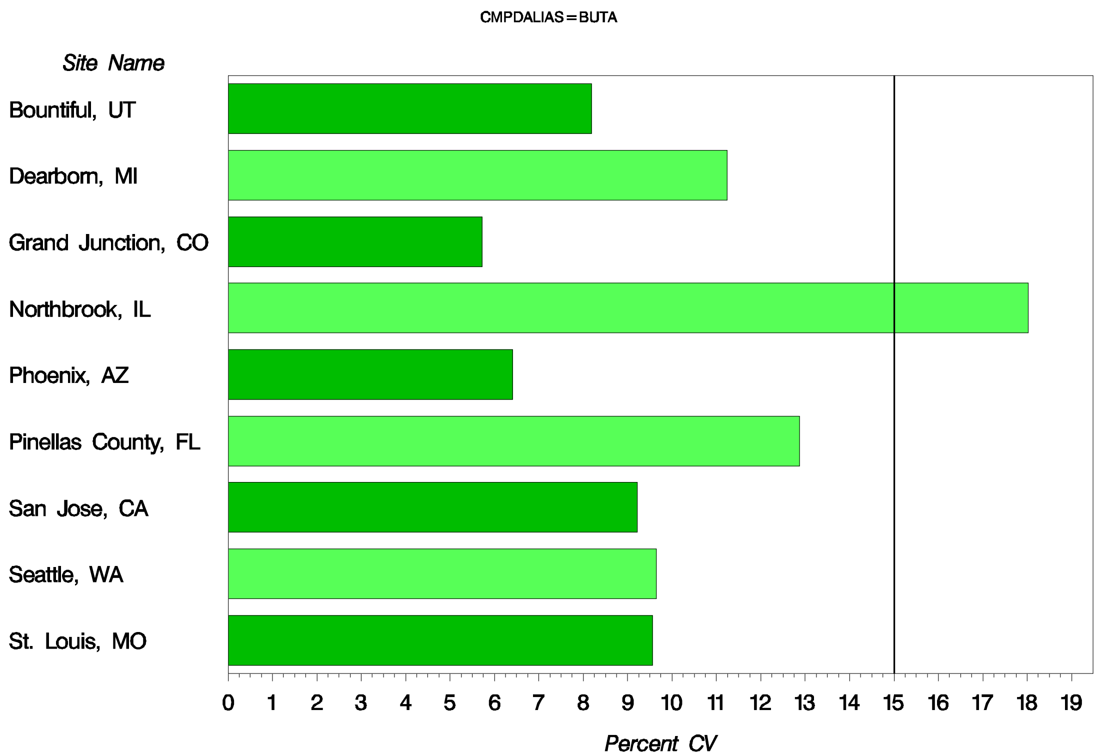

Figure 9. Analytical Precision Summary for 1,3-Butadiene at NATTS Sample Collection Sites in 2008.

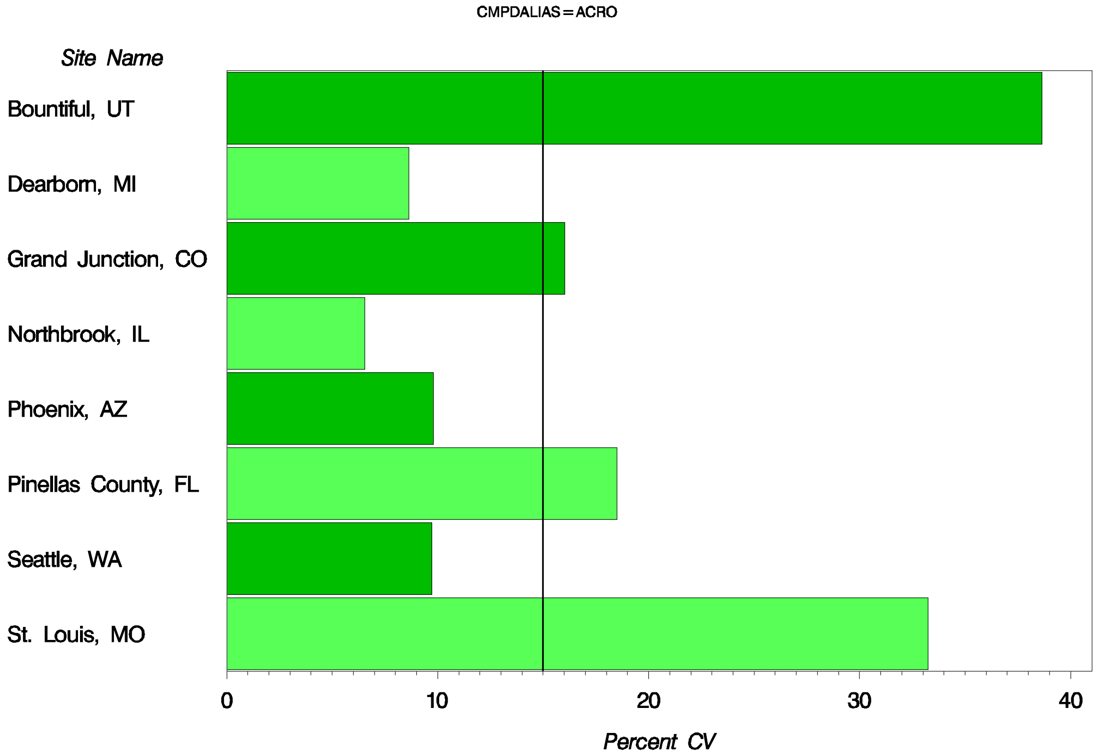

Figure 10. Analytical Precision Summary for Acrolein at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

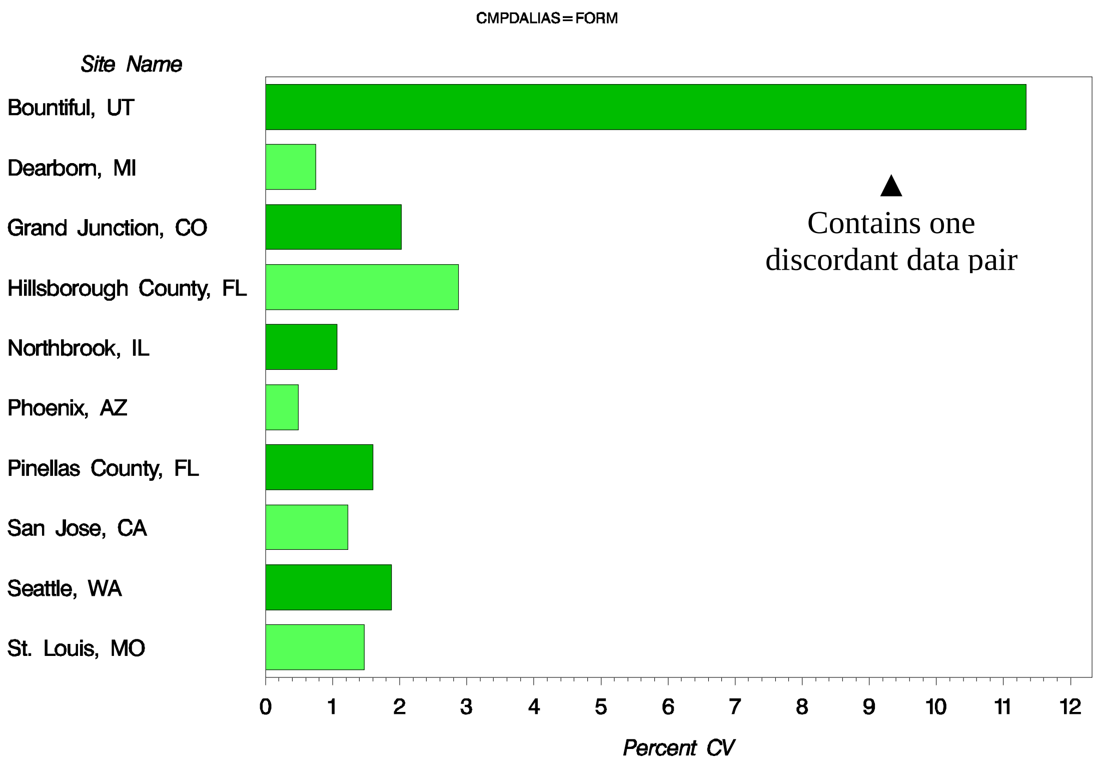

Figure 11. Analytical Precision Summary for Formaldehyde at NATTS Sample Collection Sites in 2008.

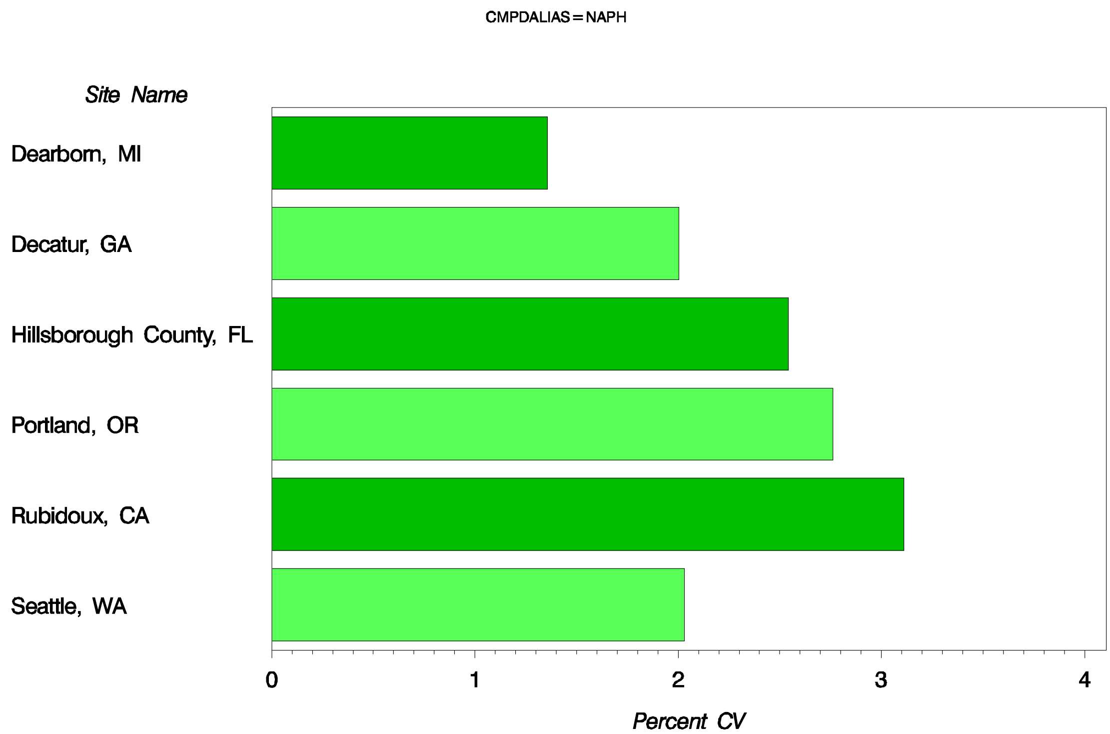

Figure 12. Analytical Precision Summary for Naphthalene at NATTS Sample Collection Sites in 2008.

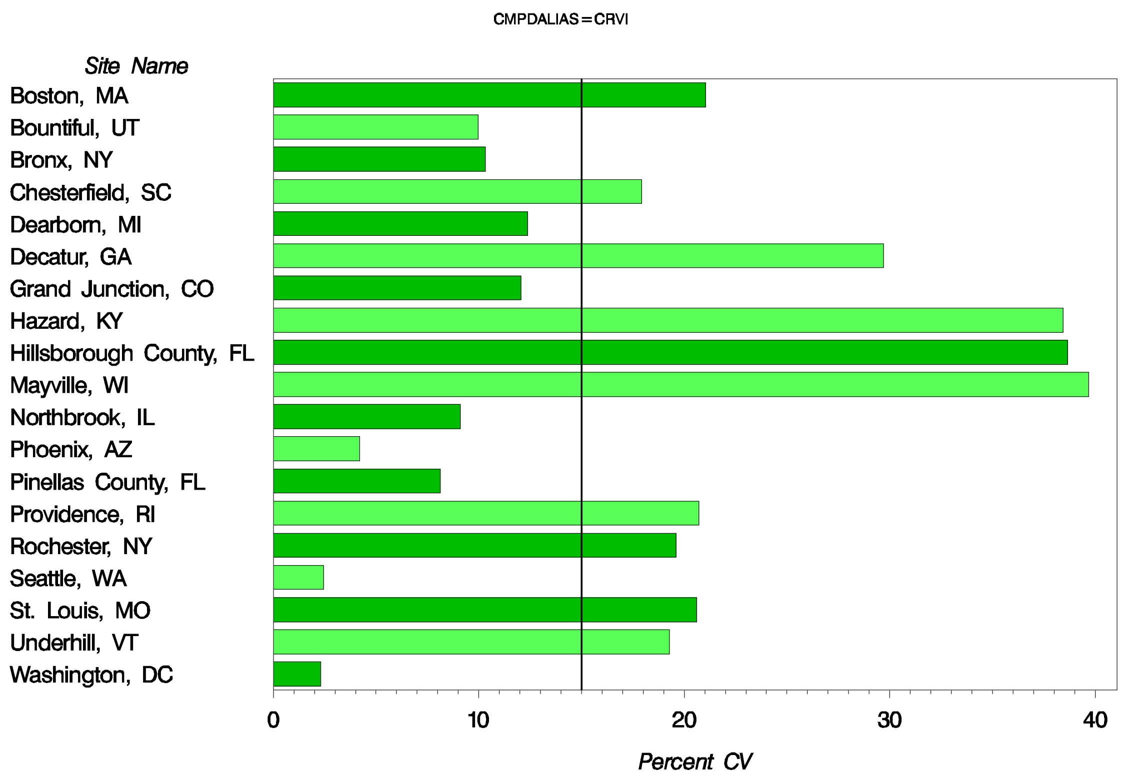

Figure 13. Analytical Precision Summary for Chromium (VI) at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

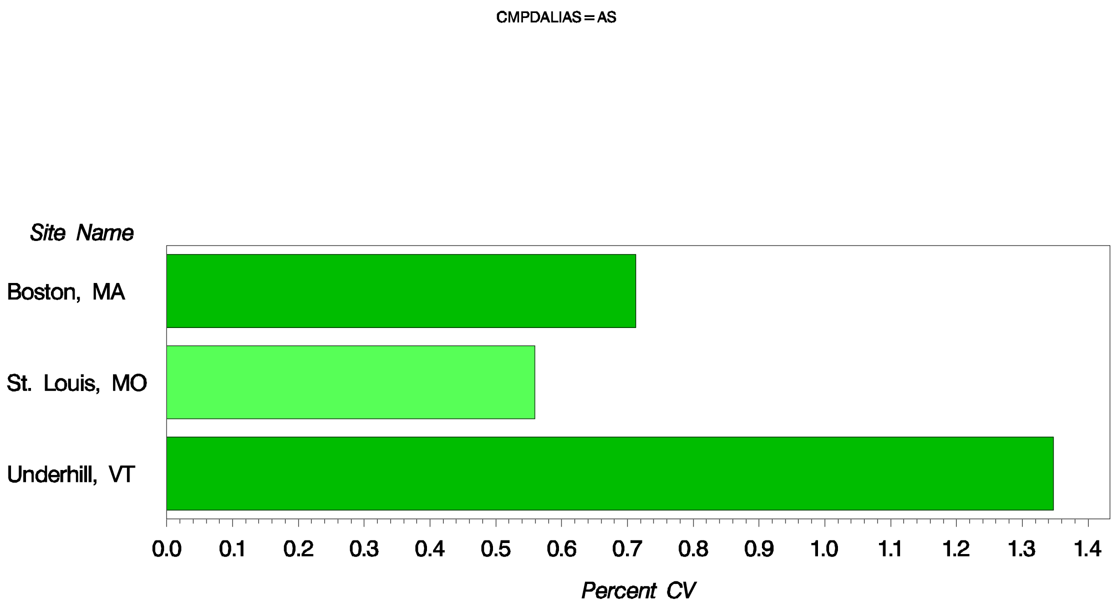

Figure 14. Analytical Precision Summary for Arsenic at NATTS Sample Collection Sites in 2008.

Examination of Figures 15 through 21 reveals that aggregate precision associated with sample collection and analysis varies widely by collection site and analyte. Not unexpectedly, the aggregate variability observed is substantially greater than the analytical variability shown in Figures 8 through 14. It is possible that some of the variability seen for many sites reflects one or more extreme values that are strongly influencing the overall results. Determining this would require a careful review of the distributions of CVs for the individual data pairs for each analyte and site and is considered beyond the scope of this report. For most analytes, some sites achieve the MQOs, and some sites do not, suggesting that the MQO is a reasonable target for this statistic. The fact that many sites exhibit percent CVs above the MQO target level suggests that the collection methodology contributes significantly to the overall variability in the data for a given site and analyte. Without identifying specific sites, the percentages of sites with percent CV above the MQO threshold are 83%, 30%, 78%, 30%, 9%, and 67% for arsenic, chromium (VI), benzene, 1,3-butadiene, acrolein, and formaldehyde, respectively. These percentages are consistent with variations in collection and analysis challenges posed by different analytes, with more problematic analytes (e.g., chromium (VI), butadiene, and acrolein) showing poorer attainment of the MQO. The percent CVs computed across sites by analyte may be somewhat misleading because they may be influenced by large CVs at selected sites. The QA report of the NATTS stations for 2006 [3] warned of the danger of extracting duplicate and collocated results using only the RP records. For that reason—and despite the considerable difficulty in determining the specific primary, duplicate, and collocated POCs for each site—the data presented here are based primarily on the RD records. The sole exception was the duplicate data for VOCs from the Washington D.C. site which were only uploaded to AQS as RP records and were, therefore, extracted as such.

Table 10. Overall Precision[a] for Primary and Collocated Samples from 2008.

AQS Site ID	Site Description	Duplicate Type	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM
04-013-9997	Phoenix, AZ	Collocate	10.7 (5)	8.6 (5)	9 (5)	8.9 (5)	—[b]	—	—	28.7 (5)	—	5.5 (5)	35.5 (4)	—
04-013-9997	Phoenix, AZ	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
06-037-1103	Los Angeles, CA	Collocate	8.3 (29)	36.4 (29)	—	19 (29)	—	—	—	36.9 (29)	—	23.8 (29)	41 (26)	—
06-037-1103	Los Angeles, CA	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
06-065-8001	Rubidoux, CA	Collocate	9.4 (28)	38.7 (28)	—	22.2 (28)	—	—	—	56.6 (28)	—	34.1 (26)	30.6 (8)	—
06-065-8001	Rubidoux, CA	Duplicate	2.1 (1)	20.2 (1)	—	0 (1)	—	—	—	0 (1)	—	47.1 (1)	—	—
06-085-0005	San Jose, CA	Collocate	15.3 (30)	29.6 (7)	—	48.5 (30)	—	—	—	43 (21)	—	42.1 (30)	33.6 (27)	—
06-085-0005	San Jose, CA	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
08-077-0017	Grand Junction, CO	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
08-077-0017	Grand Junction, CO	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
08-077-0018	Grand Junction, CO	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
08-077-0018	Grand Junction, CO	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
11-001-0043	Washington, DC	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
11-001-0043	Washington, DC	Duplicate	0.3 (74)	17.2 (30)	0.2 (30)	0.7 (30)	—	—	—	0.5 (30)	50.0 (4)	0.6 (30)	62.2 (13)	—
12-057-3002	Hillsborough County, FL	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
12-057-3002	Hillsborough County, FL	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
12-103-0026	Pinellas County, FL	Collocate	3.5 (23)	16.6 (23)	6.3 (23)	10.6 (23)	30.2 (9)	36.3 (3)	10.8 (23)	21.9 (23)	18.9 (22)	18.4 (23)	9.6 (14)	19.9 (18)
12-103-0026	Pinellas County, FL	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
13-089-0002	Decatur, GA	Collocate	90.2 (74)	—	12 (25)	10.8 (9)	—	—	—	—	—	23.5 (3)	—	—
13-089-0002	Decatur, GA	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
17-031-4201	Northbrook, IL	Collocate	9.9 (7)	35.5 (6)	8.8 (7)	33 (7)	—	—	—	67.2 (7)	—	36.6 (7)	30.8 (3)	—
17-031-4201	Northbrook, IL	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
21-043-0500	Grayson Lake, KY	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
21-043-0500	Grayson Lake, KY	Duplicate	4 (3)	—	—	—	—	—	—	90.8 (14)	—	—	—	—
21-193-0003	Hazard, KY	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
21-193-0003	Hazard, KY	Duplicate	8.1 (11)	—	—	—	—	—	—	—	—	—	—	—

(continued)

Table 10. Overall Precision[a] for Primary and Collocated Samples from 2008. (continued)

AQS Site ID	Site Description	Duplicate Type	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM
25-025-0042	Boston, MA	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
25-025-0042	Boston, MA	Duplicate	6 (9)	29.3 (19)	2.3 (19)	7.5 (19)	27.2 (3)	22.4 (18)	11.6 (19)	8.6 (19)	0 (4)	10.4 (19)	32.3 (19)	10 (16)
26-163-0033	Dearborn, MI	Collocate	3.5 (6)	8.1 (6)	5.6 (6)	40 (6)	—	—	—	12.6 (6)	—	5.2 (5)	10.5 (2)	20.2 (1)
26-163-0033	Dearborn, MI	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
29-510-0085	St. Louis, MO	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
29-510-0085	St. Louis, MO	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
36-005-0110	Bronx, NY	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
36-005-0110	Bronx, NY	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
36-055-1007	Rochester, NY	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
36-055-1007	Rochester, NY	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
41-051-0246	Portland, OR	Collocate	10.5 (19)	—	0 (2)	—	—	—	—	0.8 (16)	—	—	—	—
41-051-0246	Portland, OR	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
41-061-0119	La Grande, OR	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
41-061-0119	La Grande, OR	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
44-007-0022	Providence, RI	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
44-007-0022	Providence, RI	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
45-025-0001	Chesterfield, SC	Collocate	41.8 (23)	—	37.9 (12)	—	—	—	—	86.6 (4)	—	—	—	—
45-025-0001	Chesterfield, SC	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
48-201-1039	Deer Park, TX	Collocate	9 (58)	31.1 (41)	10.8 (58)	15.9 (56)	9.4 (25)	34.5 (25)	24.1 (42)	14.3 (55)	24 (25)	14.3 (55)	24.1 (34)	21.9 (33)
48-201-1039	Deer Park, TX	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
48-203-0002	Harrison County, TX	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
48-203-0002	Harrison County, TX	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
49-011-0004	Bountiful, UT	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
49-011-0004	Bountiful, UT	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
50-007-0007	Underhill, VT	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
50-007-0007	Underhill, VT	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
51-087-0014	Richmond, VA	Collocate	—	—	—	—	—	—	—	—	—	—	—	—
51-087-0014	Richmond, VA	Duplicate	106 (31)	—	—	—	—	—	—	—	—	—	—	—
53-033-0080	Seattle, WA	Collocate	6.5 (5)	6.5 (5)	2.3 (4)	9.9 (5)	—	—	—	52.3 (5)	—	11 (5)	31.2 (2)	—

(continued)

Table 10. Overall Precision[a] for Primary and Collocated Samples from 2008. (continued)

AQS Site ID	Site Description	Duplicate Type	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM
53-033-0080	Seattle, WA	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
55-027-0007	Mayville, WI	Collocate	1.6 (3)	—	0.5 (1)	0.6 (2)	—	—	—	38.8 (2)	—	1.1 (1)	—	—
55-027-0007	Mayville, WI	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—
	Overall Mean[c]	All Dups.	29.7 (439)	23.1 (200)	7.3 (180)	17.9 (224)	18.5 (37)	30.5 (46)	18.8 (84)	29.0 (265)	22.1 (55)	19.9 (239)	32.3 (152)	19.2 (68)

[a] Expressed as percent coefficient of variation (%CV) with number of contributing data pairs presented in parentheses. Metals results are reported at STP at most sites and local conditions at others.
[b] Sample either not collected or analyte not reported.
[c] Across all sites.

Table 10. Overall Precision[a] for Primary and Collocated Samples from 2008 (additional analytes). (continued)

AQS Site ID	Site Description	Duplicate Type	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
04-013-9997	Phoenix, AZ	Collocate	—	—	19.8 (5)	—[b]	—	—	5.7 (7)	7.3 (7)	—	—	—	—	—	—	13.2 (7)
04-013-9997	Phoenix, AZ	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
06-037-1103	Los Angeles, CA	Collocate	—	—	88.1 (29)	—	—	—	47.8 (26)	44 (26)	—	—	—	—	—	—	13.2 (7)
06-037-1103	Los Angeles, CA	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
06-065-8001	Rubidoux, CA	Collocate	—	—	79.1 (28)	—	—	—	22.2 (28)	31.1 (28)	—	—	—	—	—	—	13.2 (7)
06-065-8001	Rubidoux, CA	Duplicate	—	—	88.7 (1)	—	41.8 (12)	18.4 (8)	—	—	—	—	—	—	—	—	—
06-085-0005	San Jose, CA	Collocate	—	—	49 (26)	—	—	—	28.9 (29)	61.1 (29)	—	—	—	—	—	—	13.2 (7)
06-085-0005	San Jose, CA	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
08-077-0017	Grand Junction, CO	Collocate	—	—	—	—	—	—	—	—	—	—	7.1 (9)	5.4 (29)	6.3 (42)	17.2 (32)	18.9 (3)
08-077-0017	Grand Junction, CO	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

(continued)

Table 10. Overall Precision[a] for Primary and Collocated Samples from 2008 (additional analytes). (continued)

AQS Site ID	Site Description	Duplicate Type	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
08-077-0018	Grand Junction, CO	Collocate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	18.9 (3)
08-077-0018	Grand Junction, CO	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11-001-0043	Washington, DC	Collocate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16.9 (2)
11-001-0043	Washington, DC	Duplicate	—	—	14.6 (30)	68.4 (28)	—	—	—	—	—	—	—	—	—	—	—
12-057-3002	Hillsborough County, FL	Collocate	—	—	—	—	17 (43)	30.8 (8)	—	—	—	—	—	—	—	—	35.4 (2)
12-057-3002	Hillsborough County, FL	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12-103-0026	Pinellas County, FL	Collocate	21 (7)	27.1 (10)	30.1 (23)	—	—	—	—	—	—	—	—	—	—	—	9.3 (3)
12-103-0026	Pinellas County, FL	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
13-089-0002	Decatur, GA	Collocate	—	—	—	—	7 (5)	11.4 (2)	23.2 (23)	17.1 (22)	16.4 (10)	—	31 (19)	21.6 (23)	23.7 (23)	23.3 (23)	29.8 (3)
13-089-0002	Decatur, GA	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17-031-4201	Northbrook, IL	Collocate	—	—	34.2 (5)	—	—	—	20.8 (8)	26.8 (8)	—	—	—	—	—	—	16.1 (6)
17-031-4201	Northbrook, IL	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
21-043-0500	Grayson Lake, KY	Collocate	—	—	—	—	—	—	—	—	6.9 (1)	—	—	28.4 (13)	59.4 (7)	—	—
21-043-0500	Grayson Lake, KY	Duplicate	—	—	—	—	—	—	4.2 (13)	5.8 (11)	—	—	—	—	—	—	—
21-193-0003	Hazard, KY	Collocate	—	—	—	—	—	—	—	—	5.1 (5)	—	2.4 (1)	6.5 (10)	39.5 (9)	17.6 (1)	57.7 (2)
21-193-0003	Hazard, KY	Duplicate	—	—	—	—	—	—	6.4 (13)	—	—	—	—	—	—	—	—
25-025-0042	Boston, MA	Collocate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
25-025-0042	Boston, MA	Duplicate	—	—	24.1 (19)	—	—	—	7 (20)	13.4 (19)	2.5 (32)	42.5 (28)	16.4 (32)	7.8 (32)	6.7 (32)	4.3 (32)	12.2 (4)
26-163-0033	Dearborn, MI	Collocate	—	—	47.8 (5)	—	7.1 (4)	26.8 (4)	9.9 (4)	4 (4)	9.4 (56)	16.9 (54)	11.3 (56)	13.4 (56)	26.1 (56)	32.9 (55)	14.8 (5)

(continued)

Table 10. Overall Precision[a] for Primary and Collocated Samples from 2008 (additional analytes). (continued)

AQS Site ID	Site Description	Duplicate Type	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
26-163-0033	Dearborn, MI	Duplicate	—	—	. (0)	—	—	—	—	—	—	—	—	—	—	—	—
29-510-0085	St. Louis, MO	Collocate	—	—	—	—	—	—	—	—	3.8 (11)	11.7 (9)	19.4 (11	2.4 (11)	6.7 (11)	32.8 (11	33.3 (4)
29-510-0085	St. Louis, MO	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
36-005-0110	Bronx, NY	Collocate	—	—	—	—	—	—	—	—	5.9 (54)	30 (54)	10.6 (54)	4.4 (54)	4.3 (54)	8.3 (54)	19.3 (5)
36-005-0110	Bronx, NY	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
36-055-1007	Rochester, NY	Collocate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	19.3 (3)
36-055-1007	Rochester, NY	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41-051-0246	Portland, OR	Collocate	—	—	—	—	92.7 (7)	81.9 (3)	6.5 (16)	8 (13)	5.1 (14)	12.6 (14)	10.7 (14)	3.5 (14)	4.2 (14)	4.1 (14)	—
41-051-0246	Portland, OR	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41-061-0119	La Grande, OR	Collocate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41-061-0119	La Grande, OR	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
44-007-0022	Providence, RI	Collocate	—	—	—	—	—	—	9.6 (21)	10.8 (21)	9.8 (16)	44 (15)	22.2 (16)	8.4 (16)	10.9 (16)	15 (16)	39.2 (4)
44-007-0022	Providence, RI	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
45-025-0001	Chesterfield, SC	Collocate	—	—	—	—	—	—	12.5 (60)	20.7 (57)	11.6 (51)	5.1 (26)	22.2 (86)	16.4 (78)	16 (94)	81.9 (32)	—
45-025-0001	Chesterfield, SC	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10 (2)
48-201-1039	Deer Park, TX	Collocate	9.2 (26)	0 (26)	79 (54)	—	34.3 (47)	48.9 (24)	—	—	—	—	—	—	—	—	32.2 (25)
48-201-1039	Deer Park, TX	Duplicate	—	—	—	—	11.5 (46)	38.4 (43)	—	—	—	—	—	—	—	—	—
48-203-0002	Harrison County, TX	Collocate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
48-203-0002	Harrison County, TX	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
49-011-0004	Bountiful, UT	Collocate	—	—	—	—	—	—	—	—	3.7 (5)	. (0)	1 (4)	21.2 (5)	4.4 (5)	30.9 (5)	9.3 (12)

(continued)

Table 10. Overall Precision[a] for Primary and Collocated Samples from 2008 (additional analytes). (continued)

AQS Site ID	Site Description	Duplicate Type	cDCPEN	tDCPEN	ACRO	ACRY	NAPH	BaP	FORM	ACET	AS	BE	CD	PB	MN	NI	CRVI
49-011-0004	Bountiful, UT	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50-007-0007	Underhill, VT	Collocate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50-007-0007	Underhill, VT	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23.4 (1)
51-087-0014	Richmond, VA	Collocate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
51-087-0014	Richmond, VA	Duplicate	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
53-033-0080	Seattle, WA	Collocate	—	—	43.2 (5)	—	—	—	13.3 (8)	23.9 (8)	—	—	—	—	—	—	—
53-033-0080	Seattle, WA	Duplicate	—	—	—	—	10.6 (5)	17.7 (3)	—	—	—	—	—	—	—	—	15.9 (5)
55-027-0007	Mayville, WI	Collocate	—	—	8.6 (3)	—	—	—	—	—	17.9 (9)	4.6 (3)	34.7 (9)	23.1 (9)	13 (9)	37.9 (9)	46.3 (2)
55-027-0007	Mayville, WI	Duplicate	—	—	—	—	—	—	9.6 (3)	2.9 (4)	—	—	—	—	—	—	—
	Overall Mean[c]	All Dups.	12.7 (33)	14.3 (36)	54.7 (233)	68.4 (28)	30.4 (169)	40.4 (95)	21.5 (279)	30.2 (257)	9.1 (264)	27 (203)	18.6 (311)	13.6 (350)	18.1 (372)	34.3 (284)	25.6 (124)

[a] Expressed as percent coefficient of variation (%CV) with number of contributing data pairs presented in parentheses. Metals results are reported at STP at most sites and local conditions at others.
[b] Sample either not collected or analyte not reported.
[c] Across all sites.

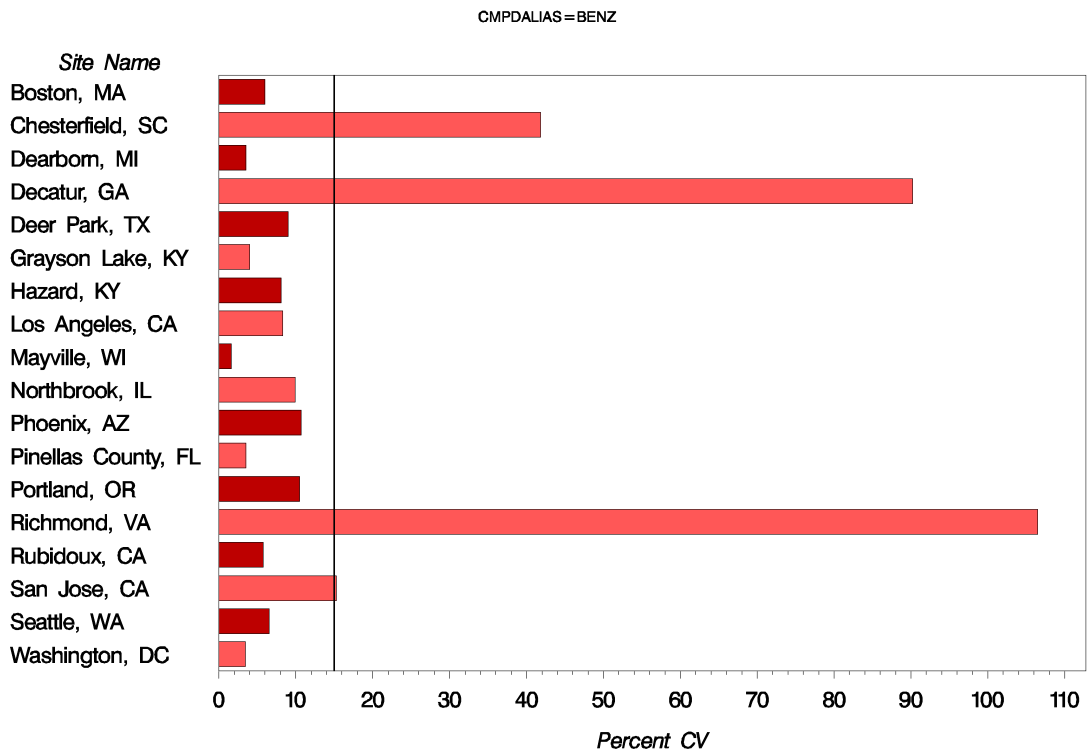

Figure 15. Overall Precision Summary for Benzene at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

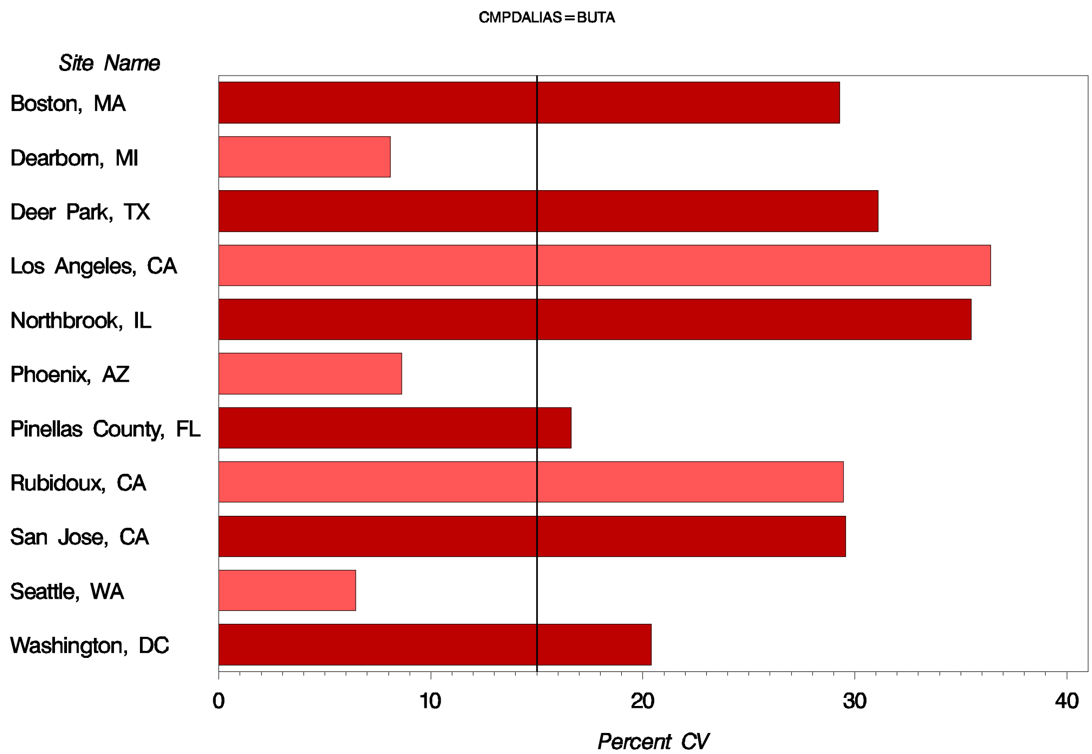

Figure 16. Overall Precision Summary for 1,3-Butadiene at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

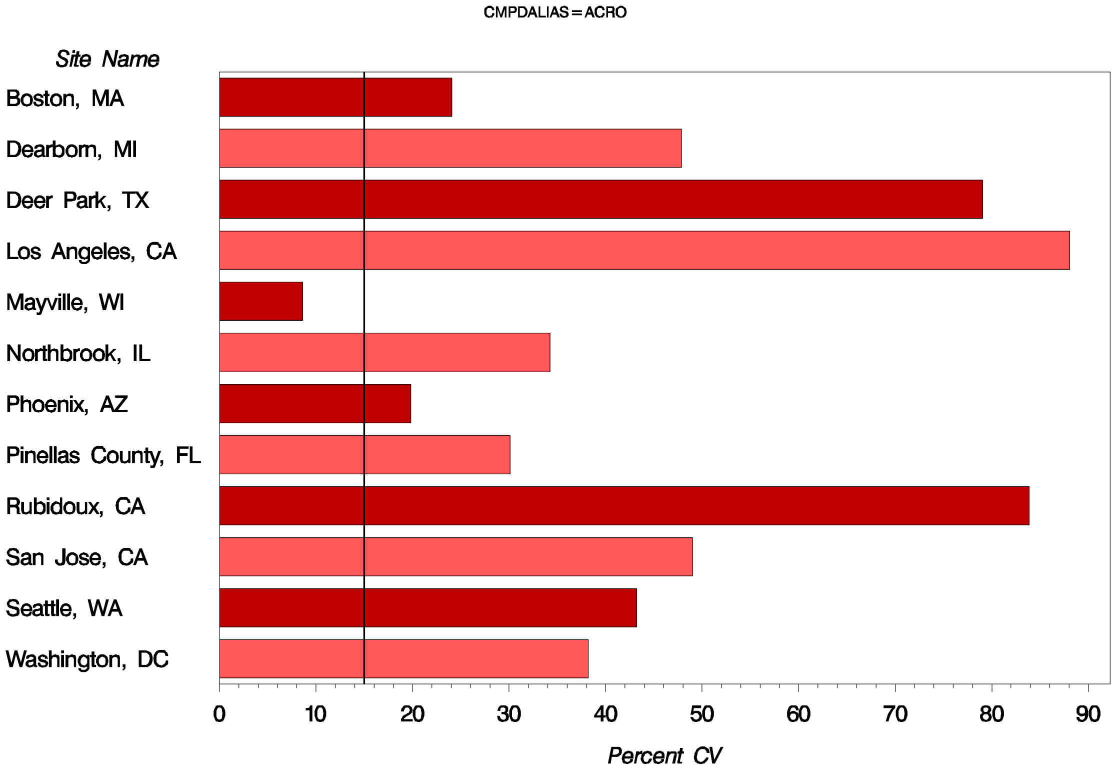

Figure 17. Overall Precision Summary for Acrolein at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

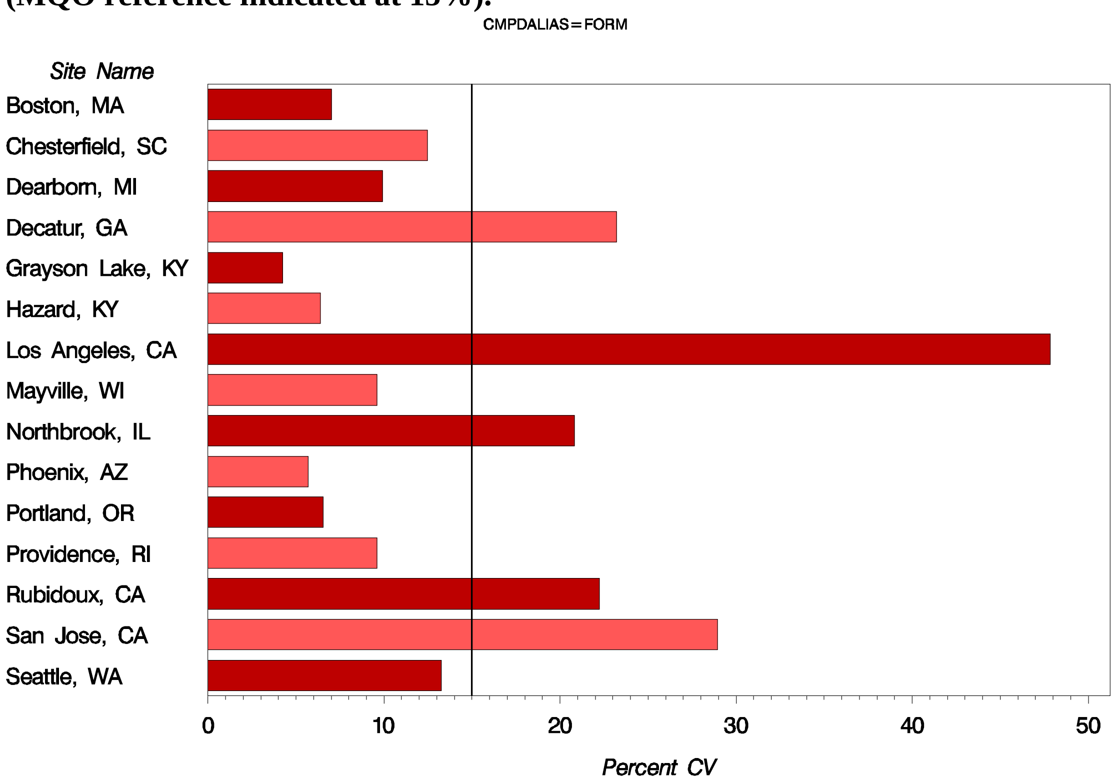

Figure 18. Overall Precision Summary for Formaldehyde at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

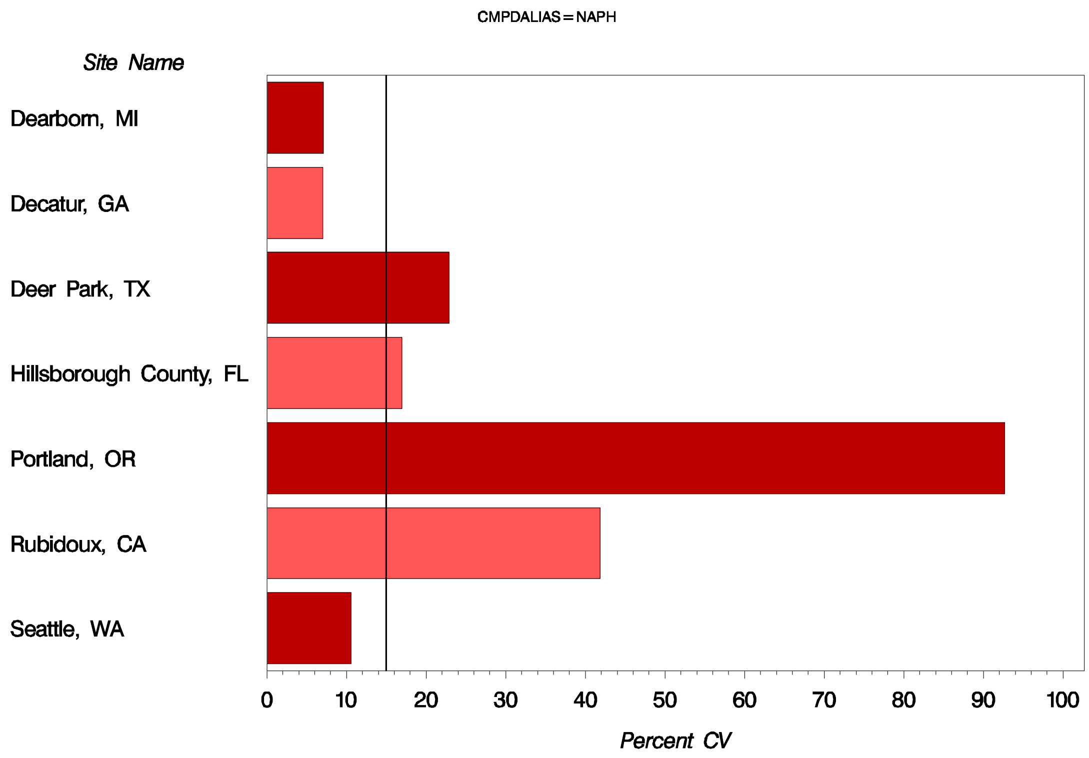

Figure 19. Overall Precision Summary for Naphthalene at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

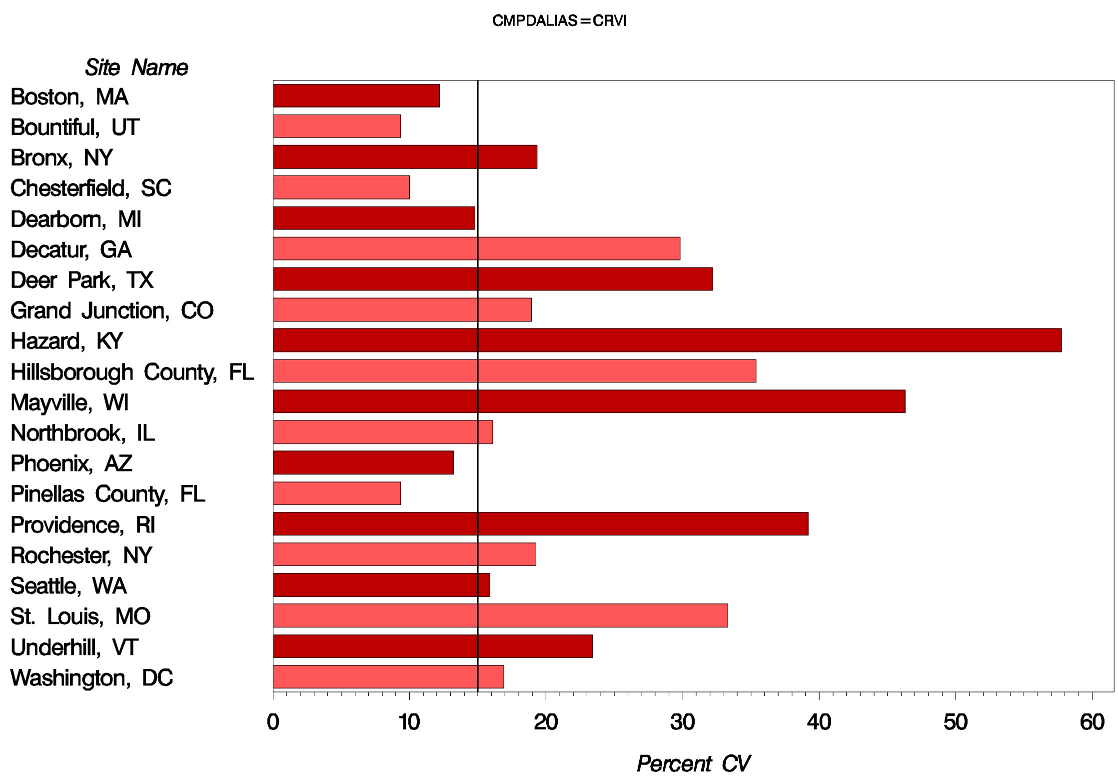

Figure 20. Overall Precision Summary for Chromium (VI) at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

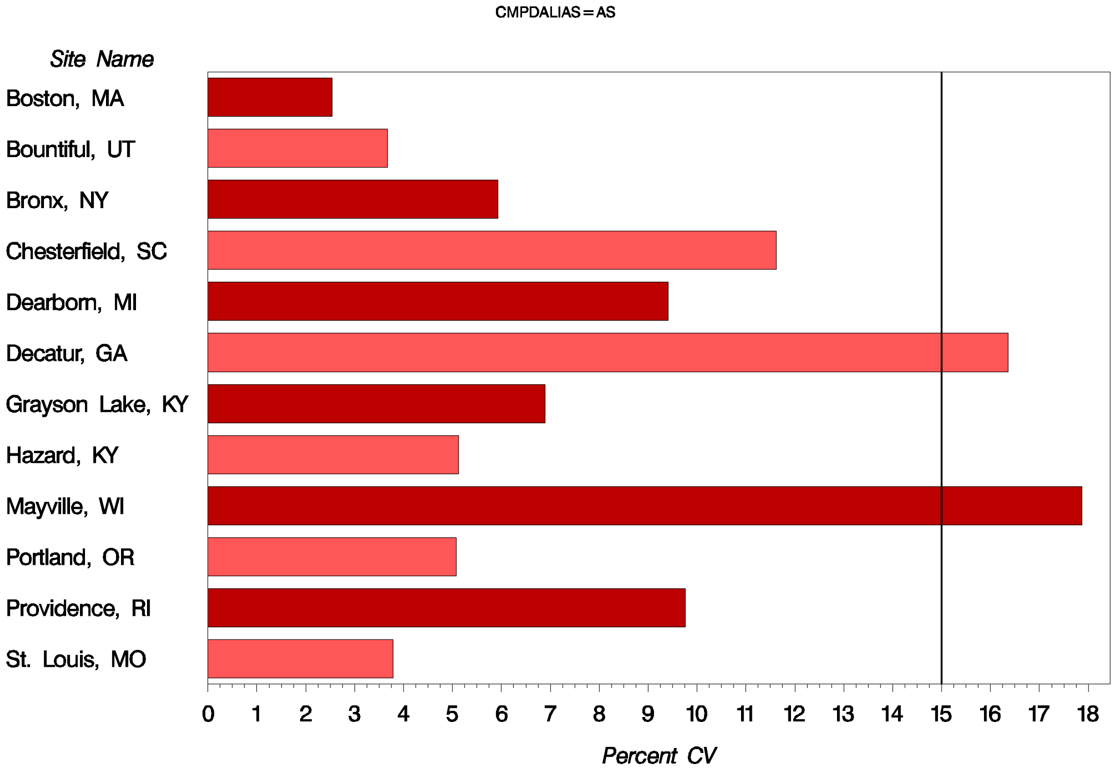

Figure 21. Overall Precision Summary for Arsenic at NATTS Sample Collection Sites in 2008 (MQO reference indicated at 15%).

2.4 Laboratory Bias Data Based on Proficiency Testing (PT) Samples

Primarily because of resource limitations, PT audits of participating NATTS sample analysis laboratories were not conducted quarterly in 2008, as they had been in 2007. Alion Science, Inc., under contract to EPA (Contract No. 68-D03-006), generated "spiked" samples containing known amounts of the HAPs of interest and delivered these spiked samples to each laboratory only once in 2008 for each of the VOC, carbonyl, and metals analyte groups. Following chemical analyses, the participating laboratories returned their results to Alion, which, in turn, prepared reports comparing the laboratory-measured values to the stated (known) values for each proficiency testing sample. During calendar year 2008, four separate PT cycles were conducted for VOCs and metals; two cycles were performed for carbonyls. The results of these PT sample analyses were provided to RTI International by EPA for CY 2008.

Laboratory bias is defined as the percentage difference between the laboratory's measured value and the known value for the audit sample:

$$\%Difference = \frac{Measured - Known}{Known} \cdot 100 \qquad \text{(Eq. 3)}$$

Tables 11 through 13 present the results of the PT samples for all compounds analyzed. To reflect overall bias independent of direction, the mean of the absolute value of the bias, along with the minimum and maximum bias values, is presented in the bottom and right-hand summaries for the individual tabulated values. Figure 22 shows boxplots summarizing laboratory bias results for all the participating laboratories across the five compounds for which PT data were compiled: benzene, 1,3-butadiene, acrolein, formaldehyde, and arsenic. In this figure, the bottom and top of the "box" represent the 25th and 75th percentiles, respectively; the horizontal line inside the box represents the median value; the diamond symbol represents the mean; the top and bottom "whiskers" extend to a length of 1.5 times the interquartile range. The inter-quartile range (IQR) is defined as the distance between the 25th and 75th percentiles of the distribution of values. The dashed line in these figures represents the MQO bias goal of 25%. To maintain figure clarity, only labs whose results fell outside of a window defined by 1.5×IQR are identified on the graphical display. Selected results that fell outside of the IQR are identified by their laboratory ID number assigned by Alion; a cross-reference between the NATTS site and assigned laboratory codes is provided above in Tables 7 and 8. A laboratory's results were included in the summary analysis only if the laboratory provided analysis of a particular sample type. Although some individual laboratories report PT sample concentrations that exhibit bias beyond the NATTS MQO, the profound majority of laboratories demonstrate laboratory biases for benzene, 1,3-butadiene, formaldehyde, and arsenic that are well within the MQO limit of ±25%. Interestingly, the biases for VOCs, benzene, and 1,3-butadiene are distributed about zero and show no net positive or negative bias. Across all sites, acrolein and, to a lesser extent, arsenic tend to show a positive (i.e., more measured than spiked) bias, while formaldehyde shows a slight negative (i.e., more spiked than measured) bias.

Table 11. Proficiency Testing Bias Results[a] for Carbonyls in 2008 NATTS Laboratories.

Laboratory Code	Laboratory Description	FORM	ACET	*Mean Abs. Bias (across analytes)*	*Min.*	*Max.*
01-01-C	RI Dept. of Health Laboratories	0.00	2.70	*1.35*	*0.00*	*2.70*
01-02-C	Vermont DEC Environmental Lab	−11.10	2.60	*6.85*	*-11.1*	*2.60*
01-03-C	MADEP	−6.70	−2.70	*4.70*	*-6.70*	*-2.70*
02-01-C	NYSDEC BAQS	−8.00	1.60	*4.80*	*-8.00*	*1.60*
03-01-C	Philadelphia Air Management Services Laboratory	−6.70	10.8	*8.75*	*-6.70*	*10.8*
04-02-C	SC Dept of HEC, Div. of AQ Analysis	−0.70	0.50	*0.6*	*-0.70*	*0.50*
04-03-C	KY Div. of Environmental Services	−8.70	−2.70	*5.70*	*-8.70*	*-2.70*
04-04-C	GADNR,EPD Laboratory	−19.3	−18.9	*19.1*	*-19.3*	*-18.9*
05-01-C	MI DEQ Lab	−13.3	−8.10	*10.7*	*-13.3*	*-8.10*
05-03-C	Wisconsin DNR	−13.3	−2.70	*8.00*	*-13.3*	*-2.70*

(continued)

Table 11. Proficiency Testing Bias Results[a] for Carbonyls in 2008 NATTS Laboratories. (continued)

Laboratory Code	Laboratory Description	FORM	ACET	*Mean Abs. Bias (across analytes)*	*Min.*	*Max.*
06-01-C	Texas CEQ	−10.0	−3.20	*6.60*	*-10.0*	*-3.20*
09-03-C	Bay Area Air Quality Management District	−3.30	−11.4	*7.35*	*-3.30*	*-11.4*
10-02-C	Oregon DEQ Lab	−9.30	−12.4	*10.9*	*-12.4*	*-9.30*
11-01-C	ERG	−4.70	17.80	*11.3*	*-4.70*	*17.8*
	Mean Abs.Bias (across laboratories)	*8.22*	*7.01*	*7.61*	*-19.3*	*17.8*
	Minimum	*-19.3*	*-18.9*	*-19.3*		
	Maximum	*0.00*	*17.8*	*17.8*		

[a] Based on a single proficiency testing sample

Table 12. Proficiency Testing Bias Results for Metals in 2008 NATTS Laboratories.

Laboratory Code	Lab Description	AS	BE	CD	PB	MN	NI	*Mean Abs. Bias (across analytes)*	*Min.*	*Max.*
03-01-M	DEP Division of Air Quality	4.40	0.80	4.30	0.70	−29.2	−2.50	*6.98*	*-29.2*	*4.40*
04-01-M	Environmental Protection Comm. of Hillsborough Co.	−2.80	0.00	1.20	−11.0	−27.8	2.10	*7.48*	*-27.8*	*2.10*
04-02-M	SC Dept of HEC, Div. of AQ Analysis	6.10	−5.50	−4.60	8.80	−16.0	4.20	*7.53*	*-16.0*	*8.80*
04-03-M	KY Div. of Environmental Services	7.60	2.50	4.30	−3.70	1.90	29.4	*8.23*	*-3.70*	*29.4*
04-04-M	GA DNR EPD Laboratory	13.3	−1.70	7.30	14.0	−19.5	8.40	*10.7*	*-19.5*	*14.0*
05-01-M	MI DEQ Lab	−14.4	−11.8	−11.6	−10.3	−19.8	−4.20	*12.0*	*-19.8*	*-4.2*
05-03-M	Wisconsin DNR	−1.10	4.20	0.60	0.70	−28.3	−3.40	*6.38*	*-28.3*	*4.20*
06-01-M	Texas CEQ	27.8	11.8	24.4	4.40	−17.3	−0.80	*14.4*	*-17.3*	*27.8*
08-02-M	IML Air Science	11.1	13.4	17.1	16.2	−16.5	16.80	*15.2*	*-16.5*	*17.1*
10-02-M	Oregon DEQ Lab	22.2	11.8	13.4	3.70	−23.4	0.00	*12.4*	*-23.4*	*22.2*
11-01-M	ERG	8.40	4.80	5.10	4.70	−25.3	8.60	*9.48*	*-25.3*	*8.60*
11-02-M	RTI International	9.10	6.70	7.30	1.50	−27.0	−2.50	*9.02*	*-27.0*	*9.10*
	Mean Abs.Bias (across laboratories)	*10.69*	*6.25*	*8.43*	*6.64*	*21.0*	*6.91*	*9.99*	*-29.2*	*29.4*
	Minimum	*-14.4*	*-11.8*	*-11.6*	*-11.0*	*-29.2*	*-4.2*	*-29.2*		
	Maximum	*27.8*	*13.4*	*24.4*	*16.2*	*1.9*	*29.4*	*29.4*		

Table 13. Performance Testing Bias Results for VOCs in 2008 NATTS Laboratories.

Laboratory Code	Lab Description	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE1122	PERC	TCE	VCM	c-CPEN	t-CPEN	ACRO	*Mean Abs. Bias (across analytes)*	*Min.*	*Max.*
01-01-V	RI Dept. of Health Laboratories	1.50	−1.40	24.2	−2.90	2.20	4.50	5.30	27.3	16.1	7.60	4.20	2.80	14.8	16.7	16.1	9.84	-2.90	27.3
01-02-V	Vermont DEC Environmental Lab	−9.20	−7.20	−4.40	−20.3	−3.30	−10.6	−3.20	−13.1	24.7	−13.6	−9.50	−16.9	−23.0	20.0	13.7	12.8	-23.0	24.7
03-01-V	Maryland Department of the Environment	−1.50	8.80	6.60	−10.1	−6.60	3.00	−2.10	11.1	−6.50	−1.50	1.10	−8.50	4.90	5.00	11.1	5.89	-10.1	11.1
04-01-V	Pinellas County DEM AQ	1.80	17.1	0.00	−7.00	−5.20	1.70	−1.40	−0.70	3.10	−15.9	−4.70	−11.4	0.70	4.00	45.0	7.98	-15.9	45.0
04-02-V	SC Dept of HEC, Div. of AQ Analysis	−7.70	−14.3	−13.2	−11.6	−2.20	−3.00	7.40	−8.10	11.8	−16.7	−16.8	−31.0	−6.60	−1.70	78.4	15.4	-31.0	78.,4
04-03-V	KY Div. of Environmental Services	−4.30	5.70	2.00	−5.70	8.20	0.00	18.9	0.60	9.70	−3.90	7.40	2.30	−3.30	1.50	7.90	5.43	-5.70	18.9
04-04-V	GA DNR EPD Laboratory	−15.40	1.00	5.50	−13.0	−5.50	−9.10	−3.20	−8.10	−15.1	−4.50	−6.30	−15.5	−11.5	−8.30	0.00	8.13	-15.5	5.5
05-03-V	Wisconsin DNR	4.60	−0.80	20.8	−10.3	2.30	17.3	−0.10	37.6	9.00	1.70	10.9	−6.60	10.5	21.5	17.4	11.4	-10.3	37.6
06-01-V	Texas CEQ	21.50	−0.60	33.0	−1.40	−20.9	−22.7	6.30	11.1	17.2	−39.4	6.30	−4.20	9.80	23.3	−15.8	15.6	-39.4	33.0
09-03-V	Bay Area Air Quality Management District	−15.4	−14.1	-- [a]	−20.3	6.60	--	9.50	11.1	--	--	--	−1.40	--	--	24.0	6.83	-20.3	24.0
10-02-V	Oregon DEQ Lab	−36.9	−4.30	−9.10	−36.1	−13.1	−40.0	13.7	0.30	−21.6	−24.5	−23.3	−42.0	−25.2	−13.2	--	20.2	-42.0	13.7
11-01-V	ERG	−1.50	7.80	16.5	4.30	4.40	3.00	6.30	11.1	−4.30	0.00	--	−14.1	6.60	8.30	10.0	7.01	-14.1	
	Mean Abs. Bias (across laboratories)	10.1	6.93	11.3	11.9	6.71	9.58	6.45	11.7	11.6	10.8	8.23	13.1	9.74	10.3	20.0	10.6	-42.0	78.4
	Minimum	-36.9.	-14.3	-13.2	-36.1	-20.9	-40.0	-3.20	-13.1	-21.6	-39.4	-23.3	-42.0	-25.2	-13.2	-15.8	-42.0		
	Maximum	21.5	17.1	33.0	4.3	8.2	17.3	18.9	37.6	24.7	7.60	10.9	2.80	14.8	23.3	78.4	78.4		

[a] Analyte not reported.

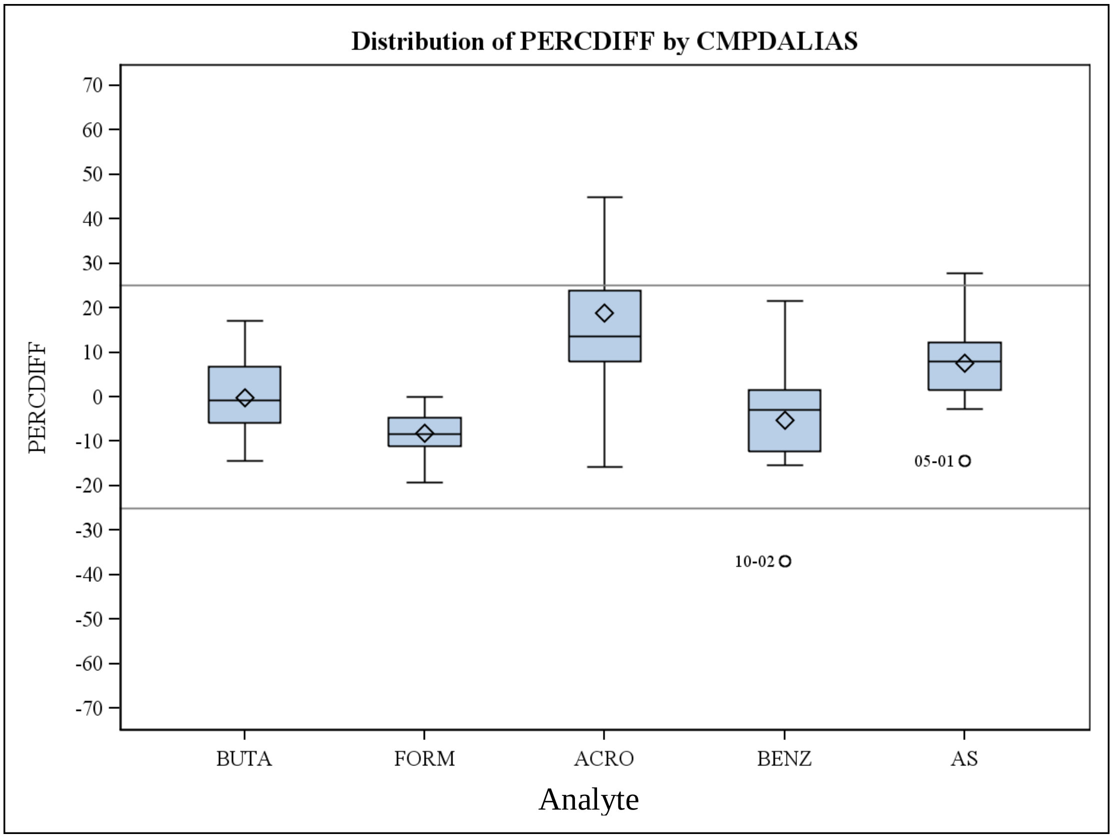

Figure 22. Distribution of Laboratory Bias by Analyte for Proficiency Testing Data from 2008.

Participation in the laboratory PT program during 2008 by all NATTS-affiliated laboratories is shown in Table 14. These percentages are somewhat attenuated by the fact that two new NATTS sites and their laboratories were added in 2008.

Table 14. Proficiency Testing Program Participation for 2008.

Compound Class	Percent Participation
Carbonyls	80
Metals	87
VOCs	80

2.5 Flow Audit Results from Instrument Performance Audits

Three NATTS field sites (LaGrande, OR; Portland, OR; Richmond, VA) were audited during calendar year 2008 for canister, carbonyl, PM_{10}, Cr (VI), and PAH samplers. The IPA involves independent measurements of flow rates on all resident sampler types at the NATTS site using certified flow, temperature, and pressure instruments.

Sampler flows were measured using a calibrated volumetric flow measurement device with flow rates subsequently corrected to the standard conditions of 25 EC and 1 atm. Comparison of the site-recorded and similarly corrected flow rate to the audited flow rate afforded calculation of field bias. For this purpose, field bias is defined as the percentage difference between the corrected site flow (Fs_c) and the corrected audit flow (Fa_c):

$$\%Difference = \frac{Fs_C - Fa_C}{Fa_C} \cdot 100 \qquad \text{(Eq. 4)}$$

The results from the flow audits conducted at three sites during calendar year 2008, along with the relevant sampling techniques, are shown in Table 15. The specific sampler audited (i.e., primary or collocated) is identified in column 3. If present during the audit, collocated samplers were also audited. Since canister and carbonyl samplers may have multiple flow channels to facilitate duplicate sampling, all active channels were also subjected to a flow audit. PM_{10} samplers have only primary channels.

A graphical summary of the flow audit results is presented in Figure 23. All but one (canister sampler at LaGrande, OR) of the 15 flow rate measurements were within ±10% of the audit flow rate.

Accuracy of flow rates for carbonyl and PM_{10} samplers is critical for determining sample concentration. Conversely, since only an aliquot of the canister volume is analyzed, the accuracy of canister sampler flow rates is less important. However, a constant flow rate across the 24-hour sampling interval is critical to achieving a linearly representative integrated sample. The field bias audit of a VOC sampler flow rate is a random check of this time-integrated value.

Table 15. Flow Audit Results from 2008 Instrument Performance Audits.

Site Identifier	Method	Sampler	Channel	Measurements	Percentage Difference
La Grande, OR	Canister[a]	Primary	1	Site: 15 cc/min (actual) RTI: 18.4 cc/min (actual)	−18.5
	Carbonyl[b]	Primary	1	Site: 1.030 L/min (actual) RTI: 1.059 L/min (actual)	−2.7
	PM_{10}[c]	Primary	NA	Site: 39.00 ft^3/min (STP) RTI: 40.53 ft^3/min (STP)	−3.8
	Cr (VI)	Primary	NA	Site: 15.0 L/min (actual) RTI: 15.08 L/min (actual)	−0.5
	PAH	Primary	NA	Site: 7.51 ft^3/min (STP) RTI: 7.59 ft^3/min (STP)	−1.1
Portland, OR	Canister	Primary	1	Not performed[d]	NA
	Carbonyl	Primary	1	Site: 1.078 L/min (actual) RTI: 1.037 L/min (actual)	4.0
	PM_{10}	Primary	NA	Site: 42.48 ft^3/min STP) RTI: 41.42 ft^3/min (STP)	2.6

(Continued)

Table 15. Flow Audit Results from 2008 Instrument Performance Audits. (Continued)

	PM_{10}	Duplicate/Collocated	NA	Site: 41.01 ft^3/min (STP) RTI: 40.52 ft^3/min (STP)	1.2
	Cr (VI)	Primary	NA	Site: 14.9 L/min (actual) RTI: 15.59 L/min (actual)	−4.4
	Cr (VI)	Duplicate/Collocated	NA	Site: 15.0 L/min (actual) RTI: 15.55 L/min (actual)	−3.5
	PAH	Primary	NA	Site: 7.40 ft^3/min (STP) RTI: 7.63 ft^3/min (STP)	−3.0
	PAH	Duplicate/Collocated	NA	Site: 7.79 ft^3/min (STP) RTI: 7.93 ft^3/min (STP)	−1.8
Richmond, VA	Canister	Primary	1	Site: 4.92 mL/min (actual) RTI: Flow too low to detect	NA
	Canister	Duplicate/Collocated	2	Site: 4.95 mL/min (actual) RTI: Flow too low to detect	NA
	Carbonyl	Primary	1	Site: 0.251 L/min (actual) RTI: 0.254 L/min (actual)	−1.2
	Carbonyl	Primary	2	Site: 0.2499 L/min (actual) RTI: 0.2501 L/min (actual)	−0.1
	PM_{10}	Primary	NA	Site: 39.00 ft^3/min (STP) RTI: 40.53 ft^3/min (STP)	−3.8
	PAH	Primary	NA	Not collected[e]	NA

[a] VOC sampler.
[b] Carbonyl cartridge.
[c] Filter sample for PM_{10} metals.
[d] Audit not performed for this sampler type.
[e] Sample type not collected at this location.

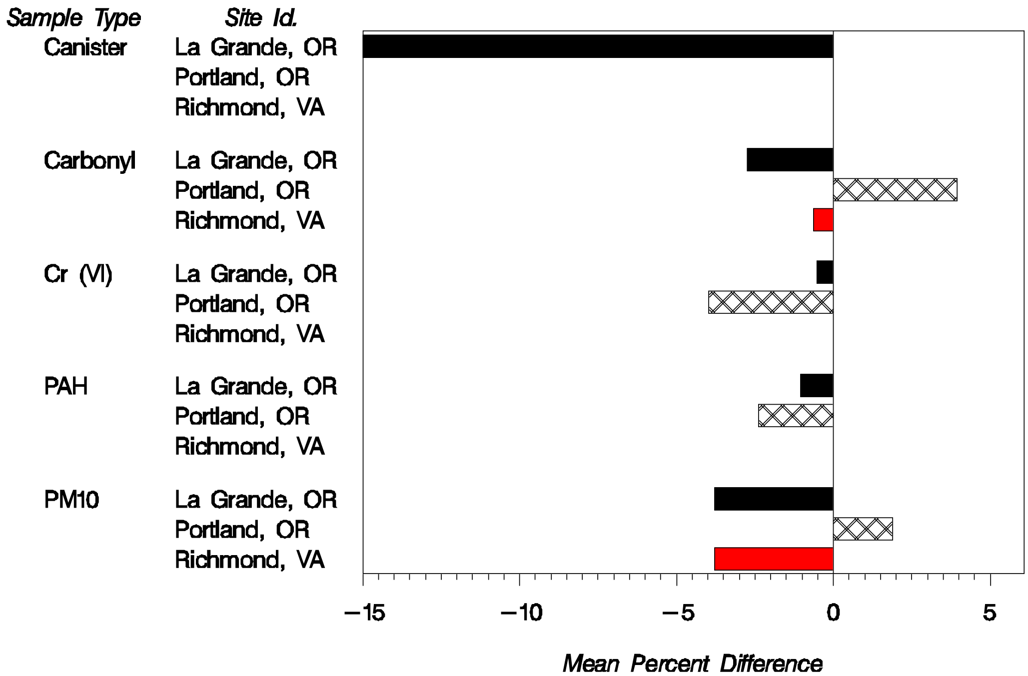

Figure 23. Summary of Instrument Performance Flow Audit Results for 2008.

2.6 Method Detection Limit Data

During compilation of 2007 QA data, significant effort was invested in acquiring the method detection limit (MDL) data through direct contacts with each contributing laboratory. This was a very labor-intensive and often frustrating exercise. For the 2008 results, the AQS database, specifically the ALT_MDL variable in the RD record types, served as the primary source of laboratory-based MDL data. Since this is not a required field in AQS, approximately 85% of the MDL data were acquired from this source. The remainder of the MDL data were requested from direct contact with each laboratory known to be providing analytical services. Multiple e-mail requests with some laboratory contacts were needed to obtain the full complement of MDL data. In one case, Washington, DC, the MDLs provided in 2007 were also used in 2008 because no further data were provided. After careful review of the received materials from each laboratory, the spreadsheet information was compiled into a database from which subsequent data analyses could be performed.

For this report and by generally accepted conventions, MDLs are defined as the detection threshold for a given analyte based on the mathematical combination of all aspects of the sample collection and analysis process. Thus, they reflect, among other factors, the collected sample volume for each sample, the size of the subsample subjected to analysis, and any sample dilutions that may be associated with the analysis methodology. Using the AQS database as the primary source of the MDL information does not, in and of itself, ensure consistency of the data, but consistency of the 2008 data is considered vastly improved over the same data obtained for 2007 results. There is, however, no unequivocal way to discern from the existing data if the MDLs provided reflect the MDL (i.e., taking into account sampling and analysis components) or if they reflect only instrumental detection limits. These concerns notwithstanding, the MDL results presented in this report are mean values computed from either individual AQS-posted values or directly from laboratory contacts and are presented under the assumption that each laboratory reported actual *method* detection limits that incorporated both instrumental and sampling considerations. In cases where the data were acquired by direct laboratory contact and units conversions were needed, a consistent value of $\mu g/m^3$ was computed. The MDL data for individual sites, in addition to the mean across all sites reporting data, are shown in Table 16.

Box and whisker plots and complementary scatter plots, shown in Figures 24 through 26, illustrate the MDLs for VOCs, carbonyls, and metals, respectively. The measurement quality objectives for benzene, 1,3-butadiene, formaldehyde, and arsenic are added to each plot for reference. Labs whose results fell outside of a window defined by 1.5×IQR are identified by blue stars on the graphical display. The inter-quartile range (IQR) is defined as the distance between the 25^{th} and 75^{th} percentiles of the distribution of values.

Table 16. Method Detection Limits by Site and Overall for Calendar Year 2008 (VOCs and Carbonyls: µg/m^3; Metals: ng/m^3).

Site Name	AQS Site Code	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE_1122	PERC	TCE	VCM	c-DCPEN
Phoenix, AZ	04-013-9997	0.035	0.025	0.004	0.007	0.007	0.010	0.009	0.018	0.009	0.006	0.004	0.005	0.007
Los Angeles, CA	06-037-1103	0.050	0.040	—[a]	0.020	—[a]	—[a]	—[a]	0.100	—[a]	0.010	0.020	—[a]	0.100
Rubidoux, CA	06-065-8001	0.050	0.040	—[a]	0.020	—[a]	—[a]	—[a]	0.100	—[a]	0.010	0.020	—[a]	0.100
San Jose, CA	06-085-0005	0.030	0.047	0.010	0.013	0.010	—[a]	0.100	0.100	—[a]	0.007	0.013	0.100	0.100
Grand Junction, CO	08-077-0017	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
Grand Junction, CO	08-077-0018	0.010	0.005[b]	0.004	0.007	0.007	0.010	0.009	0.018	0.009	0.006	0.004	0.005	0.007
Washington, DC	11-001-0043	0.020	0.030	0.020	0.030	0.020	0.030	0.040	0.040	0.030	0.030	0.010	0.020	0.020
Hillsborough County, FL	12-057-3002	0.015[b]	0.030	0.018	0.019	0.015	0.019	0.018	0.082	0.018	0.017	0.018	0.031	0.017
Pinellas County, FL	12-103-0026	0.015[b]	0.030	0.018	0.019	0.015	0.019	0.018	0.082	0.018	0.017	0.018	0.031	0.017
Decatur, GA	13-089-0002	0.096	0.023	0.010	0.016	0.020	0.017	0.021	2.000	0.016	0.019	0.027	0.020	0.020
Northbrook, IL	17-031-4201	0.125	0.098	0.004	0.007	0.007	0.010	0.009	0.018	0.009	0.006	0.004	0.005	0.007
Grayson Lake, KY	21-043-0500	0.711	0.492	1.400	1.085	1.711	1.026	0.900	0.773	1.527	1.508	1.195	0.569	1.009
Hazard, KY	21-193-0003	1.290	0.894	2.518	1.955	3.075	1.851	1.622	1.390	2.745	2.711	2.151	1.024	1.818
Boston, MA	25-025-0042	0.012	0.016	0.014	0.014	0.019	0.012	0.017	0.015	0.046	0.021	0.021	0.017	0.013
Dearborn, MI	26-163-0033	0.010[b]	0.005[b]	0.004	0.007	0.007	0.010	0.009	0.018	0.009	0.006	0.004	0.005	0.007
St. Louis, MO	29-510-0085	0.010[b]	0.005[b]	0.004	0.007	0.007	0.010	0.009	0.018	0.009	0.006	0.004	0.005	0.007
Bronx, NY	36-005-0110	0.008[b]	0.019	0.009	0.007	0.007	0.015	0.011	0.008	0.011	0.008	0.007	0.015	0.009
Rochester, NY	36-055-1007	0.008[b]	0.019	0.009	0.007	0.007	0.015	0.011	0.008	0.011	0.008	0.007	0.015	0.009
Portland, OR	41-051-0246	0.042	0.106	0.054	0.053	—[a]	0.053	0.082	0.083	0.053	0.053	0.053	0.063	0.054
La Grande, OR	41-061-0119	0.040	0.100	0.050	0.050	—[a]	0.050	0.079	0.079	0.050	0.050	0.050	0.060	0.050
Providence, RI	44-007-0022	0.008[b]	0.004	0.012	0.016	0.013	0.007	0.022	0.014	0.014	0.013	0.013	0.012	0.012
Chesterfield, SC	45-025-0001	0.479	0.411	1.290	0.903	1.191	0.633	1.271	0.545	0.913	1.648	0.962	0.419	0.599
Deer Park, TX	48-201-1039	0.864	0.599	1.702	1.028	1.540	0.787	1.095	0.487	1.376	1.631	1.562	0.435	0.910
Harris County, TX	48-203-0002	0.864	0.599	1.702	1.028	1.540	0.787	1.095	0.487	1.376	1.631	1.562	0.435	0.910
Bountiful, UT	49-011-0004	0.124	0.097	0.004	0.007	0.007	0.010	0.009	0.018	0.009	0.006	0.004	0.005	0.007
Underhill, VT	50-007-0007	0.150	0.147	0.311	0.276	0.545	0.250	0.240	0.179	0.685	0.379	0.277	0.124	0.209
Richmond, VA	51-087-0014	0.060	0.020	0.020	0.020	0.010	0.020	0.020	0.020	0.010	0.020	0.020	0.030	0.020

(continued)

Table 16. Method Detection Limits by Site and Overall for Calendar Year 2008 (VOCs and Carbonyls: µg/m^3; Metals: ng/m^3). (continued)

Site Name	AQS Site Code	BENZ	BUTA	CTET	CLFRM	EDB	DCP	EDC	MECL	TCE_1122	PERC	TCE	VCM	c-DCPEN
Seattle, WA	53-033-0080	0.010[b]	0.005[b]	0.004	0.007	0.007	0.010	0.009	0.018	0.009	0.006	0.004	0.005	0.007
Mayville, WI	55-027-0007	0.320	0.221	0.631	0.488	0.767	0.463	0.404	0.347	0.686	0.679	0.538	0.256	0.454
Geometric Mean		0.053	0.047	0.035	0.037	0.041	0.044	0.050	0.070	0.051	0.038	0.033	0.036	0.043
Arithmetic Mean		0.195	0.147	0.378	0.254	0.440	0.245	0.274	0.252	0.386	0.375	0.306	0.143	0.232
Standard Deviation		0.334	0.231	0.708	0.489	0.802	0.452	0.480	0.461	0.699	0.728	0.597	0.245	0.435
Median		0.041	0.035	0.016	0.019	0.014	0.019	0.021	0.080	0.018	0.017	0.019	0.025	0.020

[a] Meets MQO.

Table 16. Method Detection Limits by Site and Overall for Calendar Year 2008 (VOCs and Carbonyls: µg/m^3; Metals: ng/m^3) (additional analytes) (continued).

Site Name	AQS Site Code	t-DCPEN	ACRY	ACRO	FORM	ACET	NAPH	BaP	AS	BE	CD	PB	MN	NI	CRVI
Phoenix, AZ	04-013-9997	0.007	0.009	0.020	0.043	0.051	0.705	0.109	0.052[b]	0.100	0.063	0.260	0.094	0.269	0.007
Los Angeles, CA	06-037-1103	0.100	0.300	0.300	0.100	0.100	0.644	0.099	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
Rubidoux, CA	06-065-8001	0.100	0.300	0.300	0.100	0.100	0.530	0.082	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
San Jose, CA	06-085-0005	0.100	0.228	0.189	0.100	0.054	0.635	0.098	0.010[b]	0.011	0.010	0.103	0.024	0.112	.
Grand Junction, CO	08-077-0017	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	0.005[b]	0.000	0.000	0.000	0.000	0.000	0.007
Grand Junction, CO	08-077-0018	0.007	0.009	0.020	0.010	0.012	0.625	0.096	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]	—[a]
Washington, DC	11-001-0043	0.010	0.030	0.050	0.123	1.083	0.652	0.100	0.130[b]	0.040	0.010	0.010	0.060	0.000	0.007
Hillsborough County, FL	12-057-3002	0.016	0.021	0.068	0.011	0.013	0.619	0.095	0.380	0.150	0.150	0.790	0.210	1.850	0.007
Pinellas County, FL	12-103-0026	0.016	0.021	0.068	0.009	0.011	0.526	0.081	0.380	0.150	0.150	0.790	0.210	1.850	0.007
Decatur, GA	13-089-0002	0.023	—[a]	0.024	1.179	1.179	0.464	0.068	0.000	0.000	0.000	0.000	0.000	0.000	0.007
Northbrook, IL	17-031-4201	0.007	0.009	0.020	0.006[b]	0.007	0.501	0.077	0.010[b]	0.012	0.008	0.107	0.024	0.110	0.007
Grayson Lake, KY	21-043-0500	1.009	—[a]	2.546	0.100	0.092	0.519	0.080	0.815	0.407	0.407	0.407	0.407	0.407	0.007
Hazard, KY	21-193-0003	1.818	—[a]	5.564	0.160	0.064	0.738	0.114	0.695	0.430	0.406	0.426	0.283	0.419	0.009
Boston, MA	25-025-0042	0.014	—[a]	—[a]	0.049	0.036	0.575	0.089	0.010[b]	0.013	0.008	0.099	0.021	0.108	0.007

(continued)

Table 16. Method Detection Limits by Site and Overall for Calendar Year 2008 (VOCs and Carbonyls: µg/m^3; Metals: ng/m^3) (additional analytes) (additional analytes). (continued)

Site Name	AQS Site Code	t-DCPEN	ACRY	ACRO	FORM	ACET	NAPH	BaP	AS	BE	CD	PB	MN	NI	CRVI
Dearborn, MI	26-163-0033	0.007	0.009	0.020	0.009	0.010	0.576	0.089	0.148[b]	0.209	0.142	0.199	0.352	0.137	0.007
St. Louis, MO	29-510-0085	0.007	0.009	0.020	0.009	0.011	0.628	0.097	0.010[b]	0.012	0.008	0.308	0.045	0.110	0.007
Bronx, NY	36-005-0110	0.012	—[a]	0.030	0.011	0.010	0.564	0.087	0.521	0.521	0.313	0.260	0.521	0.521	0.007
Rochester, NY	36-055-1007	0.012	—[a]	0.030	0.011	0.010	0.498	0.077	0.521	0.521	0.313	0.260	0.521	0.521	0.007
Portland, OR	41-051-0246	0.054	0.082	—[a]	0.110	0.030	1.700	0.203	0.034[b]	0.004	0.034	0.336	0.336	0.335	0.034
La Grande, OR	41-061-0119	0.050	0.079	—[a]	0.124	0.030	1.893	0.234	0.036[b]	0.004	0.036	0.365	0.365	0.365	0.037
Providence, RI	44-007-0022	0.009	0.097	0.067	0.040	0.020	0.499	0.077	0.013[b]	0.006	0.005	0.002	0.010	0.007	0.007
Chesterfield, SC	45-025-0001	0.708	—[a]	0.275	0.228	0.173	0.709	0.109	0.031[b]	0.001	0.001	0.003	0.002	0.003	0.007
Deer Park, TX	48-201-1039	0.910	—[a]	0.230	0.074	0.145	0.569	0.088	0.013[b]	0.001	0.001	0.003	0.002	0.003	—[a]
Harris County, TX	48-203-0002	0.910	—[a]	0.230	0.074	0.145	—[a]	—[a]	0.013[b]	0.001	0.001	0.003	0.002	0.003	—[a]
Bountiful, UT	49-011-0004	0.007	0.009	0.020	0.011	0.013	0.666	0.102	0.000	0.000	0.000	0.000	0.000	0.000	0.007
Underhill, VT	50-007-0007	0.259	0.130	0.135	0.015	0.024	0.015	0.024	0.009[b]	0.002	0.029	0.056	0.057	0.132	0.008
Richmond, VA	51-087-0014	0.030	0.020	0.030	0.059	0.053	0.711	0.110	0.100[b]	0.010	0.100	0.100	0.100	0.200	0.007
Seattle, WA	53-033-0080	0.007	0.009	0.020	0.013	0.016	0.502	0.077	0.010[b]	0.013	0.008	0.094	0.023	0.107	0.007
Mayville, WI	55-027-0007	0.452	—[a]	—[a]	0.390	0.078	0.505	0.078	0.040[b]	0.014	0.016	0.006	0.021	0.131	0.007
Geometric Mean		0.044	0.033	0.081	0.044	0.041	0.637	0.096	0.031	0.012	0.013	0.039	0.029	0.057	0.008
Arithmetic Mean		0.238	0.076	0.428	0.113	0.127	0.681	0.100	0.153	0.101	0.085	0.192	0.142	0.296	0.009
Standard Deviation		0.439	0.100	1.207	0.225	0.288	0.332	0.036	0.239	0.171	0.130	0.226	0.174	0.487	0.008
Median		0.019	0.021	0.059	0.054	0.033	0.619	0.095	0.032	0.012	0.013	0.101	0.051	0.121	0.007

[a] Not reported.
[b] Meets MQO.

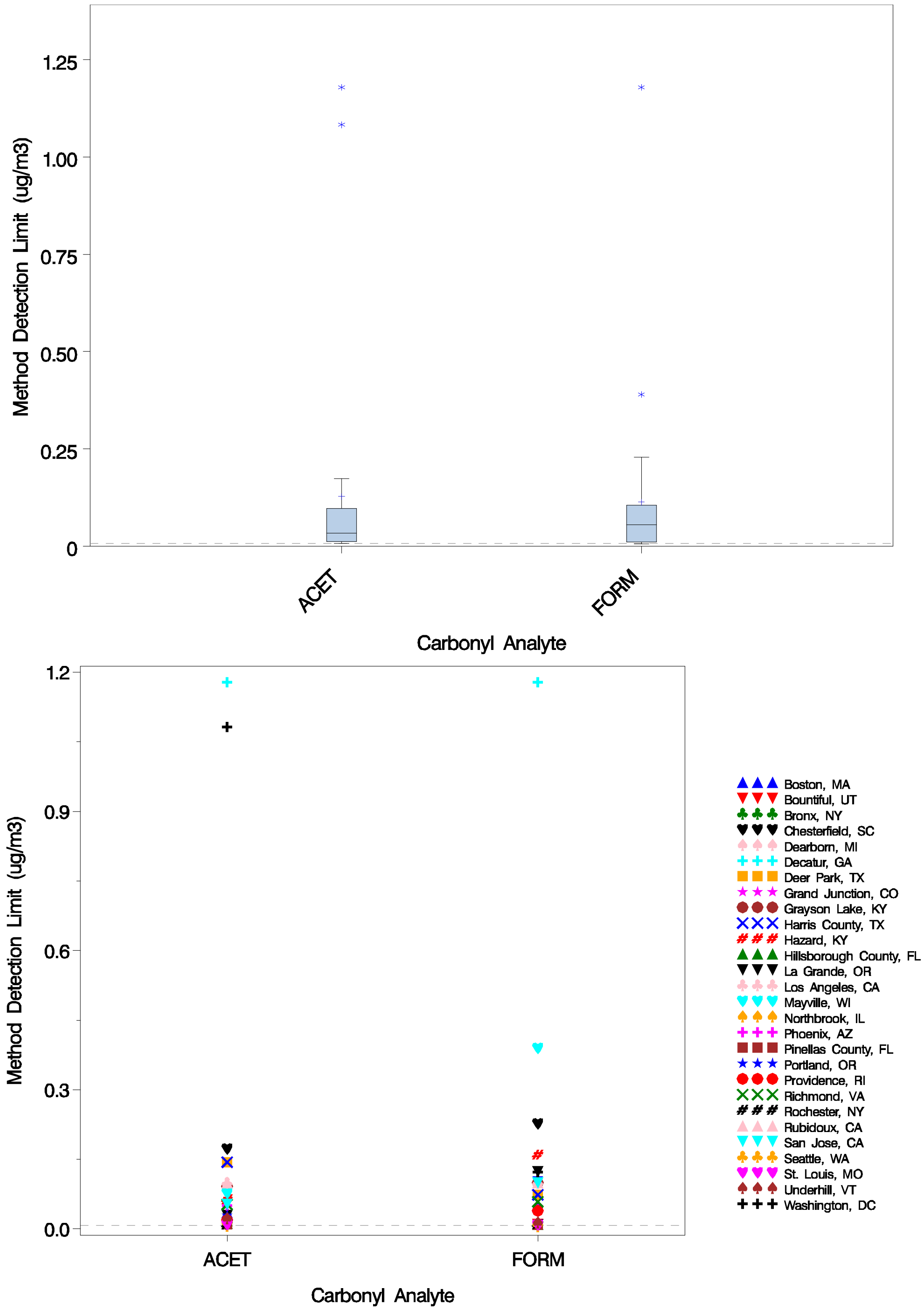

Figure 24. Distribution of Method Detection Limits for Carbonyls for 2008 NATTS Data (dotted line indicates MQO target MDL for formaldehyde; > 1.5 × IQR are identified as blue stars in top display).

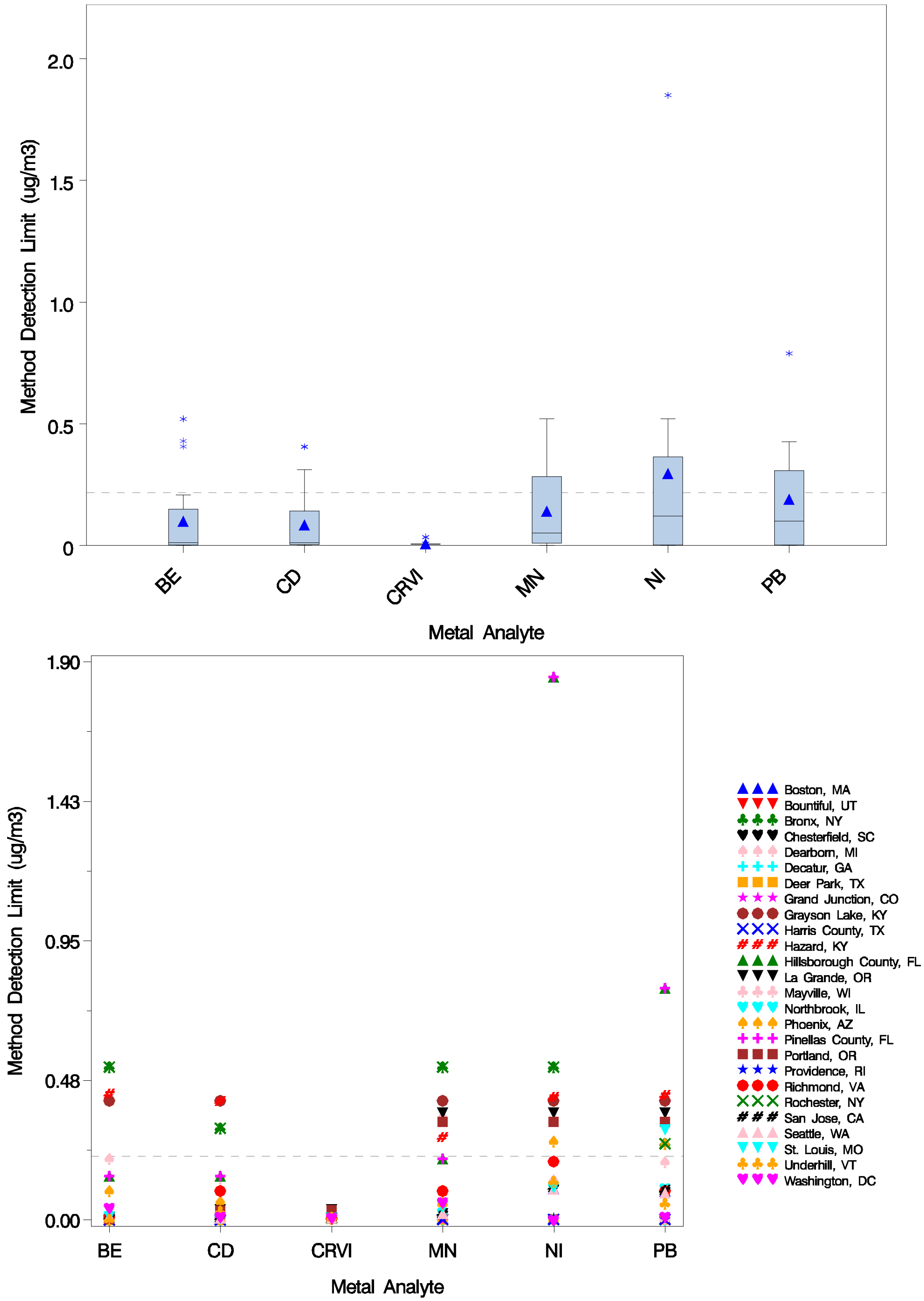

Figure 25. Distribution of Method Detection Limits for Metals for 2008 NATTS Data (dotted line indicates MQO target MDL for arsenic; > 1.5 × IQR are identified as blue stars in top display).

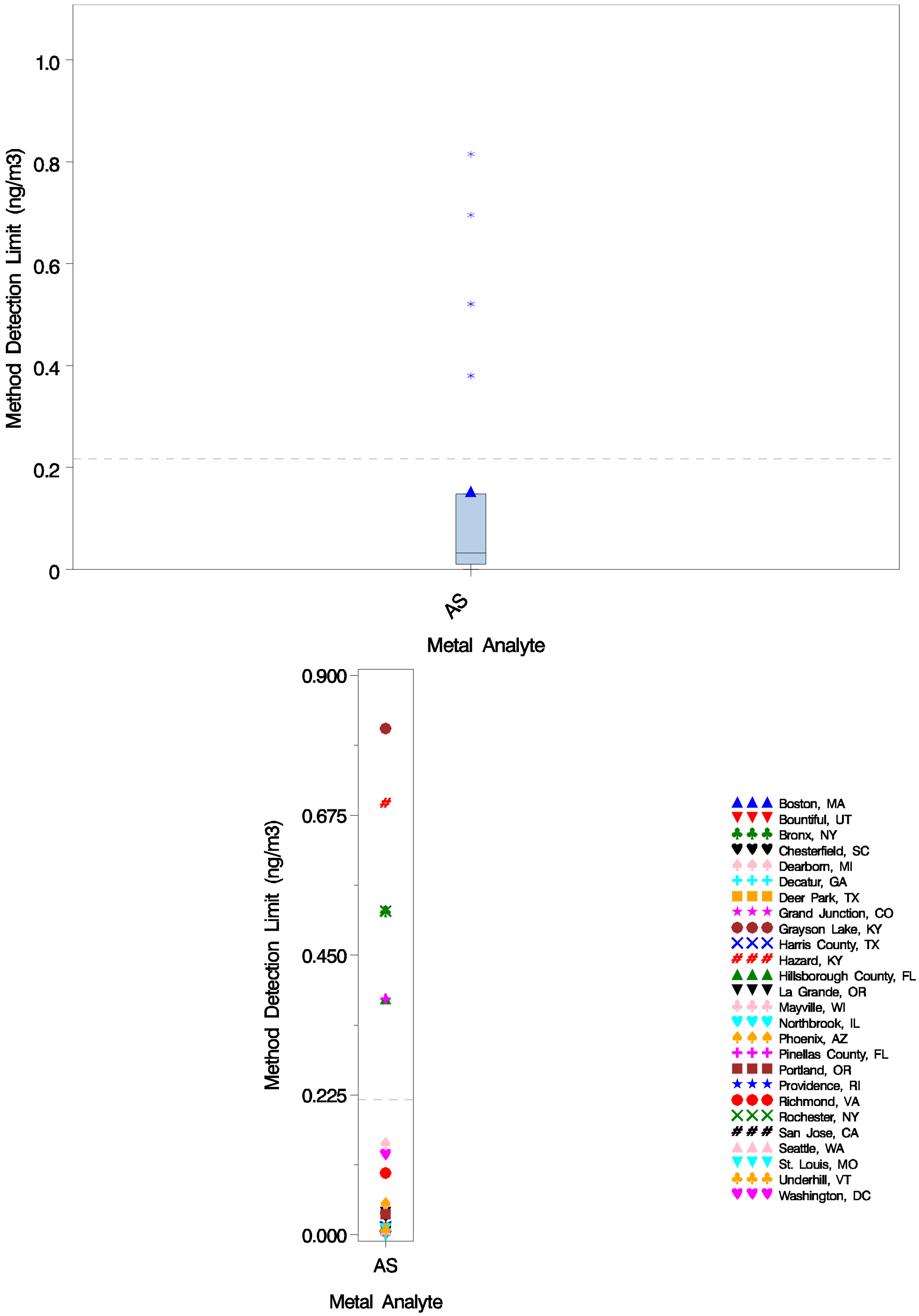

Figure 26. Distribution of Method Detection Limits for Arsenic for 2008 NATTS Data (dotted line indicates MQO target MDL for arsenic; > 1.5 × IQR are identified as blue stars in top display).

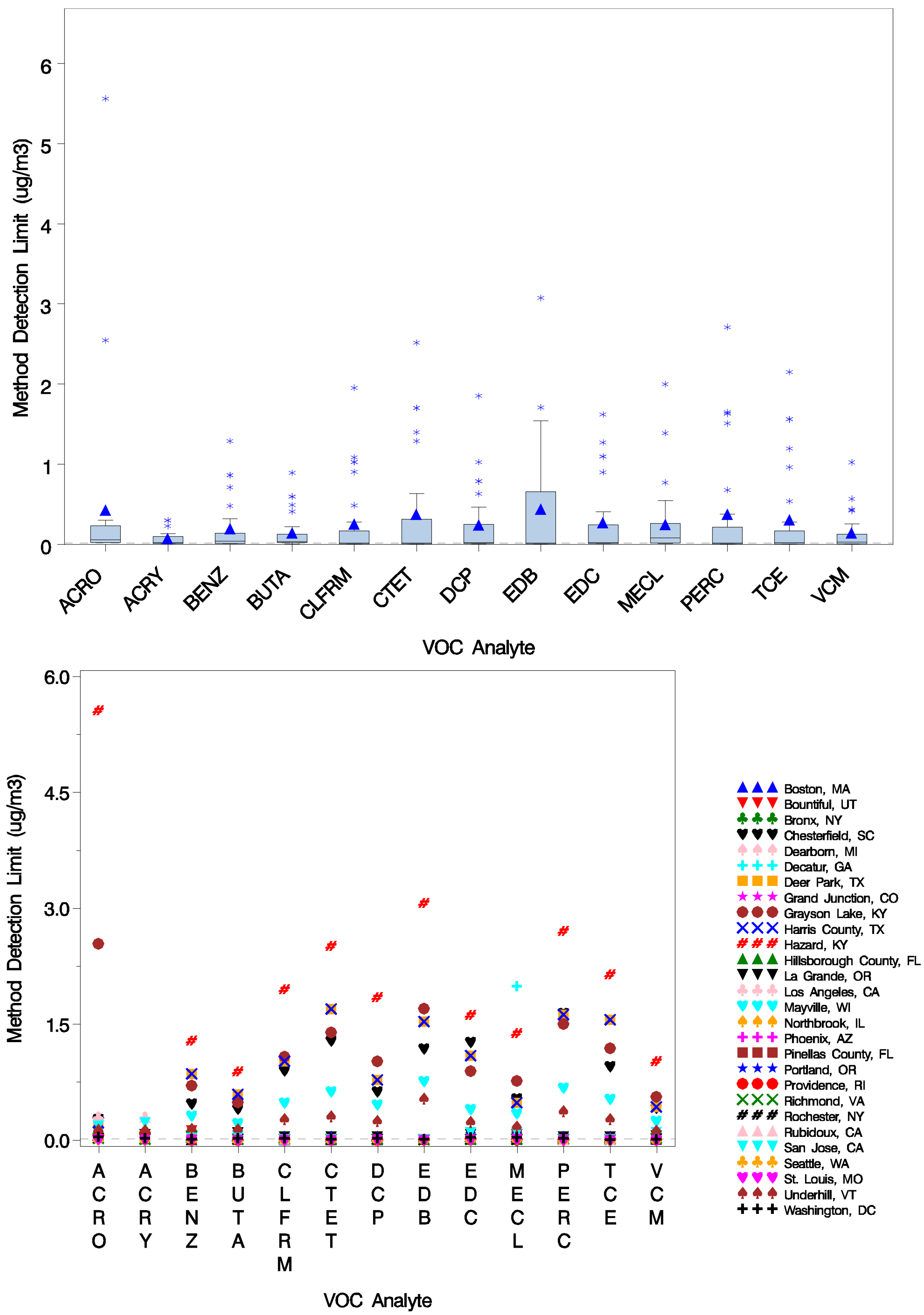

Figure 27. Distribution of Method Detection Limits for VOCs for 2008 NATTS Data (dotted line indicates MQO target MDL for benzene; > 1.5 × IQR are identified as blue stars in top display).

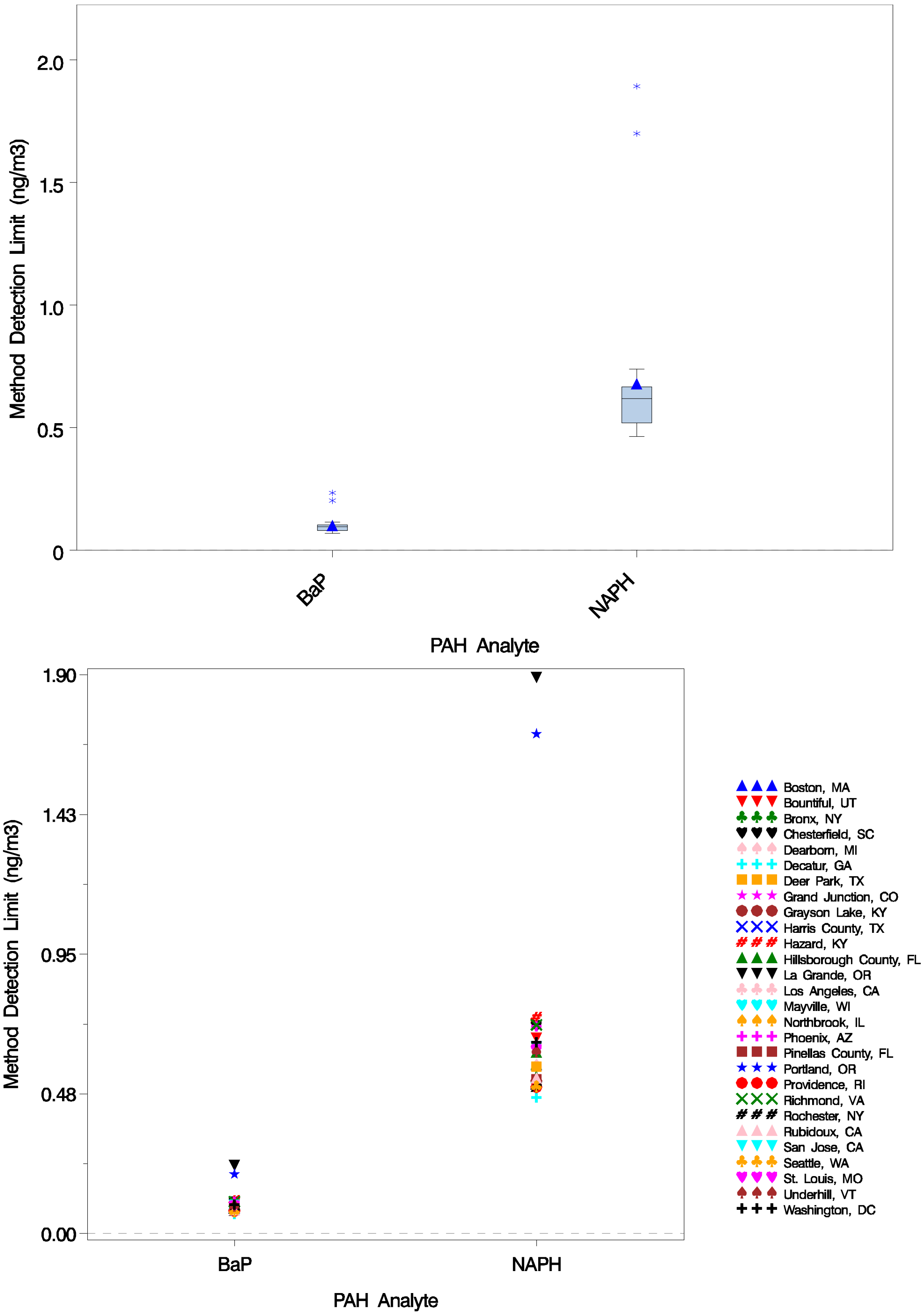

Figure 28. Distribution of Method Detection Limits for PAHs for 2008 NATTS Data (> 1.5 × IQR are identified as blue stars in top display).

Review of the graphically displayed MDL results reveals a number of interesting features. MDLs for carbonyls (Figure 24) are reasonably consistent across laboratories but almost universally greater than the MQO. Metals results in Figures 25 and 26 show a majority of MDL values falling within the MQO, with relatively few values outside the inter-quartile range. The consistency and magnitude of MDLs reported for chromium (VI) is astounding and may occur largely because only three laboratories are performing this analysis for all NATTS sites. Likely because of the high complexity of both the collection and analysis procedures, VOCs show much greater variability in MDLs across laboratories, with a high percentage of values occurring above the MQO.

As reported by the metals analysis laboratories for 2008, 19 NATTS sites (San Jose, CA; Washington, DC; Boston-Roxbury, MA; Decatur, GA; Hillsborough County, FL; Pinellas County, FL; Dearborn, MI; Mayville, WI; Northbrook, IL; Harrison County, TX; St. Louis, MO; La Grande, OR; Portland, OR; Seattle, WA; Providence, RI; Chesterfield, SC; Deer Park, TX; Underhill, VT; Richmond, VA) collected high-volume PM_{10} metals on 8 in. x 10 in. quartz fiber filters. Seven sites reported using low-volume PM_{10} metals sampling on 47 mm Teflon filters (Bronx, NY; Rochester, NY; Bountiful, UT; Grand Junction, CO; Phoenix, AZ; Hazard, KY; Grayson Lake, KY). The remaining sites either did not collect PM_{10} samples for metals analysis or did not report the type of sampling implemented.

Comparison of MDLs for the two sampling approaches is meaningful only when the analysis laboratory is the same for the two sites; otherwise the variability in MDLs is an aggregate effect of sample collection and sample analysis. The metals results provided by the ERG laboratory offer a unique opportunity to examine MDLs between high- and low-volume sampling without the influence of cross-laboratory instrumental detection limit variability. Table 17 shows the MDLs for each of the PM_{10} metal analytes. After discussion of these results with the ERG program manager, the lower background associated with the Teflon filters used with low-volume samplers may be largely influential in the MDLs for the low-volume sampling being 80 to ~300 times lower than those for the high-volume sampling for the same analyte. This effect notwithstanding, the overall variability in MDLs among laboratories is very large, and all metals data were combined for the summary analyses presented in this report (Table 16 and Figures 24 through 26).

Table 17. Comparison of Method Detection Limits for Metals between High- and Low-Volume Samplers in Calendar Year 2008.

Analyte	Method Detection Limits (ng/m^3) Median (Std. Dev.)		MDL Ratio (High/Low)
	2000 m^3 Samples[a]	20 m^3 Samples[b]	
Arsenic	0.010 (<0.001)	0.0001 (0.0315)	125
Beryllium	0.012 (0.004)	<0.001 (0.064)	80
Cadmium	0.008 (0.008)	<0.001 (0.036)	88.9
Lead	0.107 (0.187)	<0.001 (0.156)	274
Manganese	0.021 (0.033)	<0.001 (0.050)	162
Nickel	0.110 (0.010)	<0.001 (0.149)	297

[a] Based on six sites conducting high-volume PM_{10} sampling.
[b] Based on two sites conducting low-volume PM_{10} sampling.

The geometric mean MDLs (Table 18) for the select analytes—benzene, 1,3-butadiene, and formaldehyde—do not meet the target MQO MDL. Conversely, the MDL for arsenic falls within the target MQO.

Table 18. Summary Statistics for MDLs across All Reporting NATTS Laboratories for 2008.

MDL	Selected Analyte			
	Benzene, ($\mu g/m^3$)	1,3-butadiene, ($\mu g/m^3$)	Formaldehyde, ($\mu g/m^3$)	Arsenic, (ng/m^3)
Geometric Mean	0.053	0.047	0.044	0.031
Arithmetic Mean	0.195	0.147	0.113	0.153
Standard Deviation	0.334	0.231	0.225	0.239
Minimum	0.008	0.003	0.005	<0.001
Median	0.041	0.035	0.054	0.032
Maximum	1.52	1.05	1.25	0.856
MQO	0.016	0.013	0.0074	0.217
Ratio of Geo. Mean to MQO	3.3	3.6	5.9	0.14

3.0 SUMMARY

Based on four HAPs representative of the various chemical classes—benzene, 1,3-butadiene, formaldehyde, and arsenic, the following summary comments are appropriate for the 2008 NATTS data.

1. Excluding NATTS sites intentionally not collecting data for a particular analyte class (e.g., PM_{10} metals), the mean percent completeness of data reported into AQS across

all NATTS sites were 99, 99, 100, 65, 102, 94, and 97% for benzene, 1,3-butadiene, acrolein, naphthalene, formaldehyde, chromium (VI), and arsenic, respectively. With the exception of naphthalene and chromium (VI), which many sites are collecting for the first time in 2008, data from specific sites were found to fall within the MQO. Overall, the MQO was achieved for six of the seven analytes. The seventh analyte, naphthalene, achieved the MQO for approximately half of the sites.

2. With a few exceptions as noted in the text of this report, analytical precision among sites for which replicate analyses were available was found to be below the 15% MQO threshold for benzene, 1,3-butadiene, formaldehyde, and arsenic. The notable exceptions to this achievement for specific sites might reflect extreme disagreements between measurements for selected samples and are not necessarily indicative of a general lack of analytical precision. Analytical precision for chromium and acrolein was considerably more variable, with laboratory performance above and below the MQO across sites. As expected, the frequency of cases where the MQO threshold was exceeded was distinctly greater for overall precision (i.e., including sampling and analysis) among all analytes and particularly for chromium (VI) and acrolein. Estimates of overall precision included both duplicate and collocated samples.
3. Laboratory performance, as assessed by the percentage difference between the laboratory measurement and the certified sample concentration of the proficiency testing samples, was within the ±25% MQO for all analytes (i.e., benzene, 1,3-butadiene, formaldehyde, and arsenic) for available data from 2008. The poorest performance across all laboratories and analytes was observed for vinyl chloride, with an overall bias of -12.2. The proportion of laboratories participating in the 2008 performance testing program was 80% for carbonyls and VOCs, and 87% for metals; a significant decline over participation in 2007. Laboratories not performing analyses of a particular analyte were excluded from these statistics.
4. With a single exception, sampler flows measured during instrument performance audits conducted at NATTS field sites showed less than ±5% difference from their site-recorded values.
5. Among all measures of data quality, MDLs were substantially greater than the corresponding MQOs and showed substantial variability for any given analyte across sites (i.e., laboratories). Only arsenic showed detectability within the MQO threshold. The ratios of the geometric means to the corresponding MQOs were 3.3, 3.6, 5.9, and 0.14 for benzene, 1,3-butadiene, formaldehyde, and arsenic, respectively.

4.0 RECOMMENDATIONS

The acquisition of information, both analytical results and site characteristics, for the NATTS network samples present in the AQS database was accomplished successfully, based on a thorough understanding of the database structure. However, two very important pieces of information were quite difficult to obtain and required significant effort as well as EPA support to realize. These included (1) the assignment of the POCs for the primary, duplicate, and collocated samples and (2) the MDL data for laboratories not posting MDLs to AQS directly.

The POCs are present in the AQS database, but the associated sampler information is not. Since POCs are arbitrarily assigned by either the agency monitoring a particular NATTS site or the laboratory uploading the data to AQS, and are largely nonstandardized across NATTS sites [4] (see Table 6), the inclusion of a field in the AQS database to specify whether a particular POC is “primary,” “duplicate,” or “collocated” would be of enormous benefit to the utility of the AQS data.

Summary statistics created for this report reflect the overall condition of the data but may, in some cases, be unduly influenced by selected extreme values. Instances where the summary statistics fall outside of the MQOs warrant further investigation of the individual data points and, possibly, direct discussions with the laboratory performing the analyses.

The acquisition and assembly of MDL information was improved dramatically over the procedure employed for the 2007 data through the extraction of the ALT_MDL field for RD records in the AQS database. Only instances where this optional field was not populated by the contributing laboratory (~15%) required direct contacts with individual laboratory supervisors. Changing the character of this field to “required” would eliminate this follow-up step entirely.

5.0 REFERENCES

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