



2004 Urban Air Toxics Monitoring Program (UATMP)

December 2005
Final Report

EPA-454/R-06-001
December 2005

2004 Urban Air Toxics Monitoring Program (UATMP)

Prepared By:
Eastern Research Group
Research Triangle Park, North Carolina

Prepared for:
Margaret Dougherty and Mike Jones
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

Contract No. 68-D-03-049
Delivery Orders 03 and 04

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emissions, Monitoring and Analysis Division
Research Triangle Park, NC 27711

2004 Urban Air Toxics Monitoring Program (UATMP)

**Final Report
EPA Contract No. 68-D-03-049
Delivery Order 03
Delivery Order 04**

Prepared for:

Margaret Dougherty and Mike Jones
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

Prepared by:

Eastern Research Group, Inc.
1600 Perimeter Park
Morrisville, NC 27560

December 2005

DISCLAIMER

Through its Office of Air Quality Planning and Standards, the U.S. Environmental Protection Agency funded and managed the research described in this report under EPA Contract No. 68-D-03-049 to Eastern Research Group, Inc. This report has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products in this report does not constitute endorsement or recommendation for their use.

TABLE OF CONTENTS

	<u>Page</u>
List of Figures	xiii
List of Tables	xix
List of Acronyms	xxvii
Abstract	xxxix
1.0 Introduction	1-1
2.0 The 2004 UATMP	2-1
2.1 Monitoring Locations	2-1
2.2 Compounds Selected for Monitoring	2-3
2.3 Sampling Schedules	2-3
2.4 Completeness	2-6
2.5 Sampling and Analytical Methods	2-7
2.5.1 VOC Sampling and Analytical Method	2-8
2.5.2 Carbonyl Sampling and Analytical Method	2-10
2.5.3 Semivolatile Sampling and Analytical Method	2-11
2.5.4 Metals Compounds Sampling and Analytical Data	2-11
3.0 Summary of the 2004 UATMP Data	3-1
3.1 Data Summary Parameters	3-2
3.1.1 Number of Sampling Detects	3-2
3.1.2 Concentration Range	3-3
3.1.3 Geometric Means	3-3
3.1.4 Prevalence	3-4
3.1.5 Pearson Correlations	3-7
3.2 UATMP Compound Groups	3-8
3.2.1 Hydrocarbons	3-8
3.2.2 Halogenated Hydrocarbons	3-9
3.2.3 Polar Compounds	3-10
3.2.4 Carbonyl Compounds	3-10
3.3 Correlations with Selected Meteorological Parameters	3-10
3.3.1 Maximum and Average Temperature	3-11
3.3.2 Moisture	3-11

TABLE OF CONTENTS (Continued)

	<u>Page</u>
3.3.3	Wind and Pressure Information 3-12
3.3.4	Back Trajectory Analysis 3-13
3.4	The Impact of Motor Vehicle Emissions on Spatial Variations 3-14
3.4.1	Motor Vehicle Ownership Data 3-15
3.4.2	BTEX Concentration Profiles 3-16
3.4.3	Estimated Traffic Data 3-17
3.4.4	Mobile Source Tracer Analysis 3-17
3.4.5	Reformulated Gasoline (RFG) Analysis 3-18
3.5	Variability Analysis 3-20
3.6	UATMP NATTS Sites 3-21
3.6.1	Federal Regulation Analysis 3-21
3.6.1.1	Regulations for Stationary Sources 3-21
3.6.1.2	Regulations for Mobile Sources 3-22
3.6.1.3	Future Regulation Analysis 3-23
3.6.2	Emission Tracer Analysis 3-24
3.7	Analysis of Additional Compound Types 3-25
3.8	Site Trends Analysis 3-25
3.8.1	Site Trends in Annual Averages 3-25
3.9	UATMP Historical MSA Trends Analysis 3-26
3.9.1	Pollutants of Interest 3-26
3.9.2	MSA Definitions 3-27
3.9.3	Time Period of Interest 3-28
3.9.4	Methodology 3-28
3.9.4.1	Historical Ambient Monitoring Data 3-29
3.9.4.2	Historical Emissions Data 3-29
3.9.4.3	2004 UATMP Ambient Monitoring Data 3-30
3.9.4.4	Results 3-30
3.10	Summary of Additional Analyses 3-31
4.0	Sites in Arizona 4-1
4.1	Prevalent Compounds at the Arizona Sites 4-2
4.2	Toxicity Analysis 4-2

TABLE OF CONTENTS (Continued)

	<u>Page</u>
4.4 Spatial Analysis	4-4
4.5 RFG Analysis	4-5
4.6 NATTS Site Analysis	4-6
4.6.1 Regulation Analysis	4-6
4.6.2 Emission Tracer Analysis	4-7
4.7 Trends Analysis	4-7
4.7.1 Site-Specific Trends Analyses	4-7
4.7.2 MSA-Specific Trends Analyses	4-8
5.0 Sites in Colorado	5-1
5.1 Prevalent Compounds at the Colorado Sites	5-1
5.2 Toxicity Analysis	5-2
5.3 Meteorological and Concentration Averages at the Colorado Sites	5-2
5.4 Spatial Analysis	5-3
5.5 NATTS Site Analysis	5-4
5.5.1 Regulation Analysis	5-4
5.5.2 Emission Tracer Analysis	5-4
5.6 Trends Analysis	5-5
5.6.1 Site-Specific Trends Analyses	5-5
5.6.2 MSA-Specific Trends Analyses	5-5
6.0 Site in Connecticut	6-1
6.1 Prevalent Compounds at the Connecticut Site	6-1
6.2 Toxicity Analysis	6-2
6.3 Meteorological and Concentration Averages at the Connecticut Site	6-2
6.4 Spatial Analysis	6-3
6.5 RFG Analysis	6-3

TABLE OF CONTENTS (Continued)

	<u>Page</u>
6.6 Trends Analysis	6-4
6.6.1 Site-Specific Trends Analyses	6-4
6.6.2 MSA-Specific Trends Analyses	6-4
7.0 Sites in Florida	7-1
7.1 Prevalent Compounds at the Florida Sites	7-2
7.2 Toxicity Analysis	7-2
7.3 Meteorological and Concentration Averages at the Florida Sites	7-2
7.4 Spatial Analysis	7-4
7.5 NATTS Site Analysis	7-4
7.5.1 Regulation Analysis	7-5
7.5.2 Emission Tracer Analysis	7-5
7.6 Trends Analysis	7-5
7.6.1 Site-Specific Trends Analysis	7-5
7.6.2 MSA-Specific Trends Analysis	7-6
8.0 Sites in Illinois	8-1
8.1 Prevalent Compounds at the Illinois Sites	8-2
8.2 Toxicity Analysis	8-2
8.3 Meteorological and Concentration Averages at the Illinois Sites	8-3
8.4 Spatial Analysis	8-4
8.5 RFG Analysis	8-5
8.6 NATTS Site Analysis	8-7
8.6.1 Regulation Analysis	8-7
8.6.2 Emission Tracer Analysis	8-7
8.7 Trends Analysis	8-7
8.7.1 Site-Specific Trends Analyses	8-8
8.7.2 MSA-Specific Trends Analyses	8-8

TABLE OF CONTENTS (Continued)

	<u>Page</u>
9.0 Site in Indiana	9-1
9.1 Prevalent Compounds at the Indiana Site	9-1
9.2 Toxicity Analysis	9-2
9.3 Meteorological and Concentration Averages at the Indiana Site	9-2
9.4 Spatial Analysis	9-3
9.5 RFG Analysis	9-3
9.6 Trends Analysis	9-4
9.6.1 Site-Specific Trends Analyses	9-4
9.6.2 MSA-Specific Trends Analyses	9-4
10.0 Sites in Massachusetts	10-1
10.1 Prevalent Compounds at the Massachusetts Site	10-1
10.2 Toxicity Analysis	10-2
10.3 Meteorological and Concentration Averages at the Massachusetts Site	10-3
10.4 Spatial Analysis	10-3
10.5 RFG Analysis	10-4
10.6 NATTS Site Analysis	10-4
10.6.1 Regulation Analysis	10-4
10.6.2 Emission Tracer Analysis	10-5
10.7 Trends Analysis	10-5
10.7.1 Site-Specific Trends Analyses	10-5
10.7.2 MSA-Specific Trends Analyses	10-5
11.0 Sites in Michigan	11-1
11.1 Prevalent Compounds at the Michigan Sites	11-2
11.2 Toxicity Analysis	11-3
11.3 Meteorological and Concentration Averages at the Michigan Sites	11-3

TABLE OF CONTENTS (Continued)

	<u>Page</u>
11.4 Spatial Analysis	11-5
11.5 NATTS Site Analysis	11-6
11.5.1 Regulation Analysis	11-6
11.5.2 Emission Tracer Analysis	11-6
11.6 Trends Analysis	11-7
11.6.1 Site-Specific Trends Analyses	11-7
11.6.2 MSA-Specific Trends Analyses	11-8
12.0 Sites in Mississippi	12-1
12.1 Prevalent Compounds at the Mississippi Sites	12-2
12.2 Toxicity Analysis	12-3
12.3 Meteorological and Concentration Averages at the Mississippi Sites	12-3
12.4 Spatial Analysis	12-5
12.5 Trends Analysis	12-6
12.5.1 Site-Specific Trends Analyses	12-7
12.5.2 MSA-Specific Trends Analyses	12-7
13.0 Site in Missouri	13-1
13.1 Prevalent Compounds at the Missouri Site	13-1
13.2 Toxicity Analysis	13-2
13.3 Meteorological and Concentration Averages at the Missouri Site	13-3
13.4 Spatial Analysis	13-4
13.5 RFG Analysis	13-5
13.6 NATTS Site Analysis	13-6
13.6.1 Regulation Analysis	13-7
13.6.2 Emission Tracer Analysis	13-7
13.7 Trends Analysis	13-8
13.7.1 Site-Specific Analyses	13-8
13.7.2 MSA-Specific Trends Analyses	13-8

TABLE OF CONTENTS (Continued)

	<u>Page</u>
14.0 Sites in New Jersey	14-1
14.1 Prevalent Compounds at the New Jersey Sites	14-2
14.2 Toxicity Analysis	14-2
14.3 Meteorological and Concentration Averages at the New Jersey Sites	14-3
14.4 Spatial Analysis	14-5
14.5 RFG Analysis	14-6
14.6 Trends Analysis	14-8
14.6.1 Site-Specific Trends Analysis	14-8
14.6.2 MSA-Specific Trends Analyses	14-9
15.0 Site in North Carolina	15-1
15.1 Prevalent Compounds at the North Carolina Sites	15-2
15.2 Toxicity Analysis	15-2
15.3 Meteorological and Concentration Averages at the North Carolina Site	15-2
15.4 Spatial Analysis	15-4
15.5 Trends Analysis	15-4
15.5.1 Site-Specific Trends Analysis	15-4
15.5.2 MSA-Specific Trends Analyses	15-4
16.0 Site in North Dakota	16-1
16.1 Prevalent Compounds at the North Dakota Site	16-1
16.2 Toxicity Analysis	16-2
16.3 Meteorological and Concentration Averages at the North Dakota Site	16-2
16.4 Spatial Analysis	16-3
16.5 Trends Analysis	16-4
16.5.1 Site-Specific Trends Analysis	16-4
16.5.2 MSA-Specific Trends Analyses	16-4

TABLE OF CONTENTS (Continued)

	<u>Page</u>
17.0 Site in South Dakota	17-1
17.1 Prevalent Compounds at the South Dakota Sites	17-1
17.2 Toxicity Analysis	17-2
17.3 Meteorological and Concentration Averages at the South Dakota Sites	17-3
17.4 Spatial Analysis	17-5
17.5 Trends Analysis	17-6
17.5.1 Site-Specific Trends Analyses	17-6
17.5.2 MSA-Specific Trends Analyses	17-6
18.0 Site in Tennessee	18-1
18.1 Prevalent Compounds at the Tennessee Sites	18-2
18.2 Toxicity Analysis	18-3
18.3 Meteorological and Concentration Averages at the Tennessee Sites	18-3
18.4 Spatial Analysis	18-6
18.5 Trends Analysis	18-6
18.5.1 Site-Specific Trends Analyses	18-7
18.5.2 MSA-Specific Trends Analyses	18-7
19.0 Site in Utah	19-1
19.1 Prevalent Compounds at the Utah Site	19-1
19.2 Toxicity Analysis	19-2
19.3 Meteorological and Concentration Averages at the Utah Site	19-3
19.4 Spatial Analysis	19-4
19.5 NATTS Site Analysis	19-5
19.5.1 Regulation Analysis	19-5
19.5.2 Emission Tracer Analysis	19-5
19.6 Trends Analysis	19-6

TABLE OF CONTENTS (Continued)

	<u>Page</u>
19.6.1 Site-Specific Trends Analyses	19-6
19.6.2 MSA-Specific Trends Analyses	19-6
20.0 Site in Wisconsin	20-1
20.1 Prevalent Compounds at the Wisconsin Site	20-1
20.2 Toxicity Analysis	20-2
20.3 Meteorological and Concentration Averages at the Wisconsin Site	20-2
20.4 Spatial Analysis	20-4
20.5 Trends Analysis	20-4
20.5.1 Site-Specific Trends Analyses	20-5
20.5.2 MSA-Specific Trends Analyses	20-5
21.0 Data Quality	21-1
21.1 Precision	21-2
21.1.1 Analytical Precision	21-2
21.1.2 Sampling and Analytical Precision	21-6
21.2 Accuracy	21-10
22.0 Conclusions and Recommendations	22-1
22.1 Conclusions	22-1
22.1.1 National-level Conclusions	22-1
22.1.2 State-level Conclusions	22-3
22.1.3 Data Quality	22-16
22.2 Recommendations	22-17
23.0 References	23-1

TABLE OF CONTENTS (Continued)

	<u>Page</u>
List of Appendices	
Appendix A	AIRS Site Descriptions for the 2003 UATMP Monitoring Stations A-1
Appendix B	2004 Summary of Invalidated UATMP Samples by Site B-1
Appendix C	2004 Summary Tables for VOC Monitoring C-1
Appendix D	2004 Summary Tables for SNMOC Monitoring D-1
Appendix E	2004 Summary Tables of Carbonyl Monitoring E-1
Appendix F	2004 Summary Tables for SVOC Monitoring F-1
Appendix G	2004 Summary Tables for Metals Monitoring G-1
Appendix H	2004 VOC Raw Monitoring Data H-1
Appendix I	2004 SNMOC Raw Monitoring Data I-1
Appendix J	2004 Carbonyl Raw Monitoring Data J-1
Appendix K	2004 SVOC Raw Monitoring Data K-1
Appendix L	2004 Metal Raw Monitoring Data L-1

LIST OF FIGURES

	<u>Page</u>
2-1 Monitoring Sites and Associated MSAs for the 2004 UATMP	2-12
3-1 Comparison of Average Hydrocarbon Concentration vs. Vehicle Registration	3-32
3-2 Comparison of Concentration Ratios for BTEX Compounds vs. Roadside Study	3-33
3-3 Comparison of Average Hydrocarbon Concentration vs. Daily Traffic Counts	3-37
3-4 Comparison of Average Acetylene Concentration vs. Daily Traffic Counts	3-38
3-5 Coefficient of Variance Analysis of 1,3-Butadiene Across 27 Sites	3-39
3-6 Coefficient of Variance Analysis of Acetaldehyde Across 34 Sites	3-40
3-7 Coefficient of Variance Analysis of Acetonitrile Across 28 Sites	3-41
3-8 Coefficient of Variance Analysis of Acrylonitrile Across 26 Sites	3-42
3-9 Coefficient of Variance Analysis of Benzene Across 33 Sites	3-43
3-10 Coefficient of Variance Analysis of Bromomethane Across 9 Sites	3-44
3-11 Coefficient of Variance Analysis of Carbon Tetrachloride Across 32 Sites	3-45
3-12 Coefficient of Variance Analysis of Formaldehyde Across 34 Sites	3-46
3-13 Coefficient of Variance Analysis of <i>p</i> -Dichlorobenzene Across 17 Sites	3-47
3-14 Coefficient of Variance Analysis of Tetrachloroethylene Across 25 Sites	3-48
3-15 Coefficient of Variance Analysis of Xylenes (Total) Across 32 Sites	3-49
3-16 Average Seasonal 1,3-Butadiene Concentration Comparison by Season	3-50
3-17 Average Seasonal Acetaldehyde Concentration Comparison by Season	3-51
3-18 Average Seasonal Acetonitrile Concentration Comparison by Season	3-52
3-19 Average Seasonal Acrylonitrile Concentration Comparison by Season	3-53
3-20 Average Seasonal Benzene Concentration Comparison by Season	3-54
3-21 Average Seasonal Bromomethane Concentration Comparison by Season	3-55
3-22 Average Seasonal Carbon Tetrachloride Concentration Comparison by Season	3-56
3-23 Average Seasonal Formaldehyde Concentration Comparison by Season	3-57
3-24 Average Seasonal <i>p</i> -Dichlorobenzene Concentration Comparison by Season	3-58
3-25 Average Seasonal Tetrachloroethylene Concentration Comparison by Season	3-59
3-26 Average Seasonal Xylenes (Total) Concentration Comparison by Season	3-60
3-27 Comparison by Yearly Averages for the APMI Monitoring Station	3-61
3-28 Comparison by Yearly Averages for the AZFL Monitoring Station	3-62
3-29 Comparison by Yearly Averages for the BTMO Monitoring Station	3-63
3-30 Comparison by Yearly Averages for the CANJ Monitoring Station	3-64
3-31 Comparison by Yearly Averages for the CHNJ Monitoring Station	3-65
3-32 Comparison by Yearly Averages for the CUSD Monitoring Station	3-66
3-33 Comparison by Yearly Averages for the DEMI Monitoring Station	3-67
3-34 Comparison by Yearly Averages for the EATN Monitoring Station	3-68
3-35 Comparison by Yearly Averages for the ELNJ Monitoring Station	3-69
3-36 Comparison by Yearly Averages for the GAFL Monitoring Station	3-70
3-37 Comparison by Yearly Averages for the GPMS Monitoring Station	3-71
3-38 Comparison by Yearly Averages for the HOMI Monitoring Station	3-72
3-39 Comparison by Yearly Averages for the JAMS Monitoring Station	3-73
3-40 Comparison by Yearly Averages for the LOTN Monitoring Station	3-74
3-41 Comparison by Yearly Averages for the NBNJ Monitoring Station	3-75

LIST OF FIGURES (Continued)

	<u>Page</u>
3-42 Comparison by Yearly Averages for the PGMS Monitoring Station	3-76
3-43 Comparison by Yearly Averages for the PSAZ Monitoring Station	3-77
3-44 Comparison by Yearly Averages for the QVAZ Monitoring Station	3-78
3-45 Comparison by Yearly Averages for the S4MO Monitoring Station	3-79
3-46 Comparison by Yearly Averages for the SFSD Monitoring Station	3-80
3-47 Comparison by Yearly Averages for the SLMO Monitoring Station	3-81
3-48 Comparison by Yearly Averages for the SPAZ Monitoring Station	3-82
3-49 Comparison by Yearly Averages for the TUMS Monitoring Station	3-83
3-50 Comparison by Yearly Averages for the YFMI Monitoring Station	3-84
4-1 Phoenix, Arizona Site 1 (MCAZ) Monitoring Site	4-9
4-2 Phoenix, Arizona Site 2 (PSAZ) Monitoring Site	4-10
4-3 Phoenix, Arizona Site 3 (QVAZ) Monitoring Site	4-11
4-4 Phoenix, Arizona Site 4 (SPAZ) Monitoring Site	4-12
4-5 Facilities Located Within 10 Miles of MCAZ, PSAZ, and SPAZ	4-13
4-6 Facilities Located Within 10 Miles of QVAZ	4-14
4-7 Composite Back Trajectory Map for MCAZ	4-15
4-8 Composite Back Trajectory Map for PSAZ	4-16
4-9 Composite Back Trajectory Map for QVAZ	4-17
4-10 Composite Back Trajectory Map for SPAZ	4-18
4-11 Composite Back Trajectory Map for MCAZ	4-19
4-12 Composite Back Trajectory Map for PSAZ	4-20
4-13 Composite Back Trajectory Map for QVAZ	4-21
4-14 2004 Total VOC Profile at SPAZ	4-22
4-15 Acrylonitrile Pollution Rose for PSAZ	4-23
4-16 Acrylonitrile Sources Along the February 27, 2004 Back Trajectory at PSAZ	4-24
5-1 Grand Junction, Colorado (GPCO) Monitoring Site	5-6
5-2 Facilities Located Within 10 Miles of GPCO	5-7
5-3 Composite Back Trajectory Map for GPCO	5-8
5-4 Acetaldehyde Pollutant Rose at GPCO	5-9
5-5 Formaldehyde Pollutant Rose at GPCO	5-11
5-6 Acetaldehyde Sources Along the September 6, 2004 Back Trajectory at GPCO	5-11
5-7 Formaldehyde Sources Along the September 6, 2004 Back Trajectory at GPCO	5-12
6-1 Hartford, Connecticut (HACT) Monitoring Station	6-5
6-2 Facilities Located Within 10 Miles of HACT	6-6
6-3 Composite Back Trajectory Map for HACT	6-7
7-1 St. Petersburg, Florida (AZFL) Monitoring Site	7-7
7-2 Tampa, Florida (GAFL) Monitoring Site	7-8
7-3 Winter Park, Florida (ORFL) Monitoring Site	7-9
7-4 Pinellas Park, Florida (SKFL) Monitoring Site	7-10

LIST OF FIGURES (Continued)

	<u>Page</u>
7-5 Plant City, Florida Site (SYFL) Monitoring Site	7-11
7-6 Facilities Located Within 10 Miles of AZFL, GAFL, SKFL and SYFL	7-12
7-7 Facilities Located Within 10 Miles of ORFL	7-13
7-8 Composite Back Trajectory Map for AZFL	7-14
7-9 Composite Back Trajectory Map for GAFL	7-15
7-10 Composite Back Trajectory Map for ORFL	7-16
7-11 Composite Back Trajectory Map for SKFL	7-17
7-12 Composite Back Trajectory Map for SYFL	7-18
8-1 Chicago, Illinois Site 1 (NBIL) Monitoring Site	8-9
8-2 Chicago, Illinois Site 2 (SPIL) Monitoring Site	8-10
8-3 Facilities Located Within 10 Miles of NBIL and SPIL	8-11
8-4 Composite Back Trajectory Map for NBIL	8-12
8-5 Composite Back Trajectory Map for SPIL	8-13
8-6 2004 Total VOC Profile at NBIL	8-14
8-7 2004 Total VOC Profile at SPIL	8-15
9-1 Gary, Indiana (INDEM) Monitoring Site	9-6
9-2 Facilities Located Within 10 Miles of INDEM	9-7
9-3 Composite Back Trajectory Map for INDEM	9-8
10-1 Boston Massachusetts (BOMA) Monitoring Site	10-6
10-2 Facilities Located Within 10 Miles of BOMA	10-7
10-3 Composite Back Trajectory Map for BOMA	10-8
11-1 Detroit, Michigan Site 1 (APMI) Monitoring Site	11-9
11-2 Detroit, Michigan Site 2 (DEMI) Monitoring Site	11-10
11-3 Houghton, Michigan (HOMI) Monitoring Site	11-11
11-4 Sault Ste. Marie, Michigan (ITCMI) Monitoring Site	11-12
11-5 Yellow Freight, Detroit, Michigan (YFMI) Monitoring Site	11-13
11-6 Facilities Located Within 10 Miles of APMI, DEMI, and YFMI	11-14
11-7 Facilities Located Within 10 Miles of HOMI	11-15
11-8 Facilities Located Within 10 Miles of ITCMI	11-16
11-9 Composite Back Trajectory Map for APMI	11-17
11-10 Composite Back Trajectory Map for DEMI	11-18
11-11 Composite Back Trajectory Map for HOMI	11-19
11-12 Composite Back Trajectory Map for ITCMI	11-20
11-13 Composite Back Trajectory Map for YFMI	11-21
11-14 Acetaldehyde Pollution Rose for DEMI	11-22
11-15 Formaldehyde Pollution Rose for DEMI	11-23
11-16 Acetaldehyde Sources Along the September 6, 2004 Back Trajectory at DEMI	11-24

LIST OF FIGURES (Continued)

	<u>Page</u>
11-17 Formaldehyde Sources Along the September 6, 2004 Back Trajectory at DEMI	11-25
11-18 Acrylonitrile Pollution Rose for DEMI	11-26
11-19 Acrylonitrile Sources Along the October 18, 2004 Back Trajectory at DEMI	11-27
12-1 Gulfport, Mississippi (GPMS) Monitoring Site	12-9
12-2 Grenada, Mississippi (GRMS) Monitoring Site	12-10
12-3 Jackson, Mississippi (JAMS) Monitoring Site	12-11
12-4 Pascagoula, Mississippi (PGMS) Monitoring Site	12-12
12-5 Tupelo, Mississippi (TUMS) Monitoring Site	12-13
12-6 Facilities Located Within 10 Miles of GPMS	12-14
12-7 Facilities Located Within 10 Miles of GRMS	12-15
12-8 Facilities Located Within 10 Miles of JAMS	12-16
12-9 Facilities Located Within 10 Miles of PGMS	12-17
12-10 Facilities Located Within 10 Miles of TUMS	12-18
12-11 Composite Back Trajectory Map for GPMS	12-19
12-12 Composite Back Trajectory Map for GRMS	12-20
12-13 Composite Back Trajectory Map for JAMS	12-21
12-14 Composite Back Trajectory Map for PGMS	12-22
12-15 Composite Back Trajectory Map for TUMS	12-23
13-1 Bonne Terre, Missouri (BTMO) Monitoring Site	13-10
13-2 St. Louis, Missouri Site 1 (S4MO) Monitoring Site	13-11
13-3 St. Louis, Missouri Site 2 (SLMO) Monitoring Site	13-12
13-4 Facilities Located Within 10 Miles of BTMO	13-13
13-5 Facilities Located Within 10 Miles of S4MO and SLMO	13-14
13-6 Composite Back Trajectory Map for BTMO	13-15
13-7 Composite Back Trajectory Map for S4MO	13-16
13-8 Composite Back Trajectory Map for SLMO	13-17
13-9 2004 Total VOC Profile at S4MO	13-18
13-10 Acetaldehyde Pollution Rose for S4MO	13-19
13-11 Formaldehyde Pollution Rose for S4MO	13-20
13-12 Acetaldehyde Sources Along the August 31, 2004 Back Trajectory at S4MO	13-21
13-13 Formaldehyde Sources Along the August 31, 2004 Back Trajectory at S4MO	13-22
13-14 Manganese Compound Pollution Rose for S4MO	13-23
13-15 Manganese Compound Sources Along the August 31, 2004 Back Trajectory at S4MO	13-24
14-1 Camden, New Jersey (CANJ) Monitoring Site	14-11
14-2 Chester, New Jersey (CHNJ) Monitoring Site	14-12
14-3 Elizabeth, New Jersey (ELNJ) Monitoring Site	14-13
14-4 New Brunswick, New Jersey (NBNJ) Monitoring Site	14-14
14-5 Facilities Located Within 10 Miles of CANJ	14-15

LIST OF FIGURES (Continued)

	<u>Page</u>
14-6 Facilities Located Within 10 Miles of CHNJ	14-16
14-7 Facilities Located Within 10 Miles of ELNJ and NBNJ	14-17
14-8 Composite Back Trajectory Map for CANJ	14-18
14-9 Composite Back Trajectory Map for CHNJ	14-19
14-10 Composite Back Trajectory Map for ELNJ	14-20
14-11 Composite Back Trajectory Map for NBNJ	14-21
14-12 2004 Total VOC Profile at CANJ	14-22
14-13 2004 Total VOC Profile at CHNJ	14-23
14-14 2004 Total VOC Profile at ELNJ	14-24
14-15 2004 Total VOC Profile at NBNJ	14-25
15-1 Candor, North Carolina (CANC) Monitoring Site	15-6
15-2 Research Triangle Park, North Carolina (RTPNC) Monitoring Site	15-7
15-3 Facilities Located Within 10 Miles of CANC	15-8
15-4 Facilities Located Within 10 Miles of RTPNC	15-9
15-5 Composite Back Trajectory Map for CANC	15-10
15-6 Composite Back Trajectory Map for RTPNC	15-11
16-1 Spirit Lake Nation, North Dakota (SLND) Monitoring Site	16-5
16-2 Facilities Located Within 10 Miles of SLND	16-6
16-3 Composite Back Trajectory Map for SLND	16-7
17-1 Custer, South Dakota (CUSD) Monitoring Site	17-7
17-2 Sioux Falls, South Dakota (SFSD) Monitoring Site	17-8
17-3 Facilities Located Within 10 Miles of CUSD	17-9
17-4 Facilities Located Within 10 Miles of SFSD	17-10
17-5 Composite Back Trajectory Map for CUSD	17-11
17-6 Composite Back Trajectory Map for SFSD	17-12
18-1 Dickson, Tennessee (DITN) Monitoring Site	18-9
18-2 Nashville Site 1, Tennessee (EATN) Monitoring Site	18-10
18-3 Kingsport, Oregon (KITN) Monitoring Site	18-11
18-4 Loudon, Tennessee (LDTN) Monitoring Site	18-12
18-5 Nashville Site 2 (LOTN) Monitoring Site	18-13
18-6 Facilities Located Within 10 Miles of DITN	18-14
18-7 Facilities Located Within 10 Miles of EATN and LOTN	18-15
18-8 Facilities Located Within 10 Miles of KITN	18-16
18-9 Facilities Located Within 10 Miles of LDTN	18-17
18-10 Composite Back Trajectory Map for DITN	18-18
18-11 Composite Back Trajectory Map for EATN	18-19
18-12 Composite Back Trajectory Map for KITN	18-20
18-13 Composite Back Trajectory Map for LDTN	18-21
18-14 Composite Back Trajectory Map for LOTN	18-22

LIST OF FIGURES (Continued)

	<u>Page</u>
19-1 Bountiful, Utah (BTUT) Monitoring Site	19-8
19-2 Facilities Located Within 10 Miles of BTUT	19-9
19-3 Composite Back Trajectory Map for BTUT	19-10
19-4 Acetaldehyde Pollution Rose for BTUT	19-11
19-5 Formaldehyde Pollution Rose for BTUT	19-12
19-6 Acetaldehyde Sources Along the August 31, 2004 Back Trajectory at BTUT	19-13
19-7 Formaldehyde Sources Along the August 31, 2004 Back Trajectory at BTUT	19-14
19-8 Arsenic Compound Pollution Rose for BTUT	19-15
19-9 Arsenic Compound Sources Along the December 5, 2004 Back Trajectory at BTUT	19-16
20-1 Madison, Wisconsin (MAWI) Monitoring Site	20-6
20-2 Facilities Located Within 10 Miles of MAWI	20-7
20-3 Composite Back Trajectory Map for MAWI	20-8
21-1 Concentration Distribution of Toluene	21-11
21-2 Concentration Distribution of Dichloromethane	21-12
21-3 Concentration Distribution of Acetonitrile	21-13
21-4 Concentration Distribution of Methyl Ethyl Ketone	21-14

LIST OF TABLES

	<u>Page</u>
1-1 Organization of the 2004 UATMP Report	1-3
2-1 Text Descriptions of the 2004 UATMP Monitoring Sites	2-13
2-2 Site Descriptions for the 2004 UATMP Monitoring Sites	2-25
2-3 Current Monitoring Sites for the UATMP with Past Participation	2-29
2-4 VOC Average Method Detection Limits	2-32
2-5 SNMOC Average Method Detection Limits	2-34
2-6 Carbonyl Average Method Detection Limits	2-36
2-7 Semivolatile Organic Compound Average Method Detection Limits	2-37
2-8 Metal Compounds Average Method Detection Limits	2-38
2-9 Sampling Schedules and Completeness for Carbonyl, VOC, Metals, SNMOC, and SVOC	2-39
3-1 Target Compound Detection Summaries of the VOC Concentrations	3-85
3-2 Target Compound Detection Summaries of the Carbonyl Concentrations	3-89
3-3 Range of Detectable Concentrations by Site	3-90
3-4 Geometric Means by Site	3-92
3-5a Nationwide Cancer Compound Toxicity Ranking (Prevalent Compounds Shaded) ..	3-94
3-5b Nationwide Noncancer Compound Toxicity Ranking (Prevalent Compounds Shaded)	3-96
3-6 Summary of Pearson Correlation Coefficients for Selected Meteorological Parameters and Prevalent Compounds	3-99
3-7 Summary of Mobile Information by Site	3-100
3-8 UATMP Sites in MSAs Using Reformulated Gasoline (RFG)	3-102
3-9 Regulations Implemented After 2002	3-104
3-10 Future Regulation Analysis of Emissions for NATTS Sites	3-107
3-11 Summary of Additional Analyses	3-114
3-12 Population and 1,000 Vehicle Miles Traveled (1000VMT) Profiles for Each MSA	3-115
3-13a Total Acetaldehyde Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-116
3-13b Total Benzene Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-117
3-13c Total Cadmium Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-118
3-13d Total Ethylbenzene Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-119
3-13e Total Formaldehyde Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-120
3-13f Total Lead Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-121
3-13g Total Mercury Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-122
3-13h Total Toluene Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-123
3-13i Total Xylene Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison	3-124
3-14 Summary of Additional Analyses by Site	3-125
4-1 Average Concentration and Meteorological Parameters for Sites in Arizona	4-25
4-2 Summary of the Toxic Cancer Compounds at Monitoring Sites 1, 2, 3 and 4 in Phoenix, Arizona	4-26

LIST OF TABLES (CONTINUED)

4-3	Summary of the Toxic Noncancer Compounds at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona	4-28
4-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona	4-32
4-5	Motor Vehicle Information vs. Daily Concentration for Arizona Monitoring Sites . .	4-34
5-1	Average Concentration and Meteorological Parameters for Sites in Colorado	5-13
5-2	Summary of the Toxic Cancer Compounds at the Colorado Monitoring Site 1 - GPCO	5-14
5-3	Summary of the Toxic Noncancer Compounds at the Colorado Monitoring Site 1 - GPCO	5-15
5-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Site #1 in Grand Junction, Colorado (GPCO)	5-16
5-5	Motor Vehicle Information vs. Daily Concentration for Colorado Monitoring Site . .	5-17
6-1	Average Concentration and Meteorological Parameters for the HACT Site in Connecticut	6-8
6-2	Summary of the Toxic Cancer Compounds at the Hartford, Connecticut Monitoring Site - HACT	6-9
6-3	Summary of the Toxic Noncancer Compounds at the Hartford, Connecticut Monitoring Site - HACT	6-10
6-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Hartford, Connecticut Site (HACT)	6-11
6-5	Motor Vehicle Information vs. Daily Concentration for the Connecticut Monitoring Site	6-12
7-1	Average Concentration and Meteorological Parameters for Sites in Florida	7-19
7-2	Summary of the Toxic Cancer Compounds at the St. Petersburg, Tampa, Winter Park, Pinellas Park, and Plant City, Florida Monitoring Sites	7-20
7-3	Summary of the Toxic Noncancer Compounds at the St. Petersburg, Tampa, Winter Park, Pinellas Park, and Plant City, Florida Monitoring Sites	7-21
7-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the St. Petersburg, Tampa, Winter Park, Pinellas Park, and Plant City, Florida Sites	7-22
7-5	Motor Vehicle Information vs. Daily Concentration for Florida Monitoring Sites . . .	7-23
8-1	Average Concentration and Meteorological Parameters for Sites in Illinois	8-16
8-2	Summary of the Toxic Cancer Compounds at the Northbrook and Schiller Park, Illinois Monitoring Sites	8-17
8-3	Summary of the Toxic Noncancer Compounds at the Northbrook and Schiller Park, Illinois Monitoring Sites	8-18
8-4	TNMOC Measured by the Chicago, Illinois (NBIL) Monitoring Station	8-20
8-5	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters in Northbrook and Schiller Park, Illinois Sites	8-21

LIST OF TABLES (CONTINUED)

8-6	Motor Vehicle Information vs. Daily Concentration for Illinois Monitoring Sites . . .	8-22
9-1	Average Concentration and Meteorological Parameters for the Site in Indiana	9-9
9-2	Summary of the Toxic Cancer Compounds at the Gary, Indiana Monitoring Site - INDEM	9-10
9-3	Summary of the Toxic Noncancer Compounds at the Gary, Indiana Monitoring Site - INDEM	9-11
9-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Gary, Indiana Site (INDEM)	9-12
9-5	Motor Vehicle Information vs. Daily Concentration for Indiana Monitoring Site	9-13
10-1	Average Concentration and Meteorological Parameters for the BOMA Site in Massachusetts	10-9
10-2	Summary of the Toxic Cancer Compounds at the Boston, Massachusetts Monitoring Site - BOMA	10-10
10-3	Summary of the Toxic Noncancer Compounds at the Boston, Massachusetts Monitoring Site - BOMA	10-11
10-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Boston, Massachusetts Site (BOMA)	10-12
10-5	Motor Vehicle Information vs. Daily Concentration for Massachusetts Monitoring Site	10-13
11-1	Average Concentration and Meteorological Parameters for Sites in Michigan	11-28
11-2	Summary of the Toxic Cancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites	11-29
11-3	Summary of the Toxic Noncancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites	11-32
11-4	SVOC Concentrations for Michigan Monitoring Sites	11-36
11-5	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Allen Park, Dearborn, Sault Ste. Marie, and Yellow Freight Sites in Detroit, Michigan	11-37
11-6	Motor Vehicle Information vs. Daily Concentration for Michigan Monitoring Sites	11-39
12-1	Average Concentration and Meteorological Parameters for Sites in Mississippi	12-24
12-2	Summary of the Toxic Cancer Compounds at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo, Mississippi Monitoring Sites	12-25
12-3	Summary of the Toxic Noncancer Compounds at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo, Mississippi Monitoring Sites	12-27
12-4	TNMOC Measured by the Pascagoula, Mississippi (PGMS) Monitoring Station . . .	12-31

LIST OF TABLES (CONTINUED)

12-5	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo Mississippi Sites	12-32
12-6	Motor Vehicle Information vs. Daily Concentration for Mississippi Monitoring Sites	12-34
13-1	Average Concentration and Meteorological Parameters for the Site in Missouri ...	13-25
13-2	Summary of the Toxic Cancer Compounds at the Bonne Terre, St. Louis Site 4, and St. Louis 1, Missouri Monitoring Sites	13-26
13-3	Summary of the Toxic Noncancer Compounds at the Bonne Terre, St. Louis Site 4, and St. Louis 1, Missouri Monitoring Sites	13-27
13-4	Metals and Compounds, and SNMOC Measured by the Missouri Monitoring Sites	13-29
13-5	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Bonne Terre, St. Louis Site 4, and St. Louis Site 1, Missouri Sites	13-30
13-6	Motor Vehicle Information vs. Daily Concentration for the Missouri Monitoring Sites	13-31
14-1	Average Concentration and Meteorological Parameters for Sites in New Jersey ...	14-26
14-2	Summary of the Toxic Cancer Compounds at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Monitoring Sites	14-27
14-3	Summary of the Toxic Noncancer Compounds at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Monitoring Sites	14-29
14-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Camden, Chester, Elizabeth, New Brunswick, and New Jersey Sites	14-33
14-5	Motor Vehicle Information vs. Daily Concentration for New Jersey Monitoring Sites	14-35
15-1	Average Concentration and Meteorological Parameters for the Sites in North Carolina	15-12
15-2	Summary of the Toxic Cancer Compounds at the Candor and Research Triangle Park, North Carolina Monitoring Sites	15-13
15-3	Summary of the Toxic Noncancer Compounds at the Candor and Research Triangle Park, North Carolina Monitoring Sites	15-14
15-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Candor and Research Triangle Park, North Carolina Sites	15-15
15-5	Motor Vehicle Information vs. Daily Concentration for the North Carolina Monitoring Sites	15-16
16-1	Average Concentration and Meteorological Parameters for the Site in North Dakota .	16-8
16-2	Summary of the Toxic Cancer Compounds at the Spirit Lake Nation, North Dakota Monitoring Site - SLND	16-9

LIST OF TABLES (CONTINUED)

16-3	Summary of the Toxic Noncancer Compounds at the Spirit Lake Nation, North Dakota Monitoring Site - SLND	16-10
16-4	SVOC Concentration for the North Dakota Monitoring Site	16-11
16-5	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Spirit Lake Nation, North Dakota Site (SLND)	16-12
16-6	Motor Vehicle Information vs. Daily Concentration for the North Dakota Monitoring Site	16-13
17-1	Average Concentration and Meteorological Parameters for the Site in South Dakota	17-13
17-2	Summary of the Toxic Cancer Compounds at the Custer and Sioux Falls, South Dakota Monitoring Sites	17-14
17-3	Summary of the Toxic Noncancer Compounds at the Custer and Sioux Falls, South Dakota Monitoring Sites	17-15
17-4	TNMOC Measured by the Custer and Sioux Falls, South Dakota (CUSD and SFSD) Monitoring Sites	17-17
17-5	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Custer and Sioux Falls, South Dakota Sites	17-18
17-6	Motor Vehicle Information vs. Daily Concentration for the South Dakota Monitoring Sites	17-19
18-1	Average Concentration and Meteorological Parameters for the Sites in Tennessee .	18-23
18-2	Summary of the Toxic Cancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites	18-24
18-3	Summary of the Toxic Noncancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites	18-27
18-4	Average Metal Concentration Measured by the Nashville Monitoring Sites	18-32
18-5	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Sites	18-33
18-6	Motor Vehicle Information vs. Daily Concentration for the Tennessee Monitoring Sites	18-35
19-1	Average Concentration and Meteorological Parameters for Site in Utah	19-17
19-2	Summary of the Toxic Cancer Compounds at the Bountiful, Utah Monitoring Site - BTUT	19-18
19-3	Summary of the Toxic Noncancer Compounds at the Bountiful, Utah Monitoring Site - BTUT	19-19
19-4	TNMOC and Metal Compounds Measured by the Bountiful, Utah (BTUT) Monitoring Site	19-21
19-5	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Bountiful, Utah Site (BTUT)	19-22
19-6	Motor Vehicle Information vs. Daily Concentration for Utah Monitoring Site	19-23

LIST OF TABLES (CONTINUED)

20-1	Average Concentration and Meteorological Parameters for the Site in Wisconsin . . .	20-9
20-2	Summary of the Toxic Cancer Compounds at the Madison, Wisconsin Monitoring Site - MAWI	20-10
20-3	Summary of the Toxic Noncancer Compounds at the Madison, Wisconsin Monitoring Site - MAWI	20-11
20-4	Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Madison, Wisconsin Site (MAWI)	20-12
20-5	Motor Vehicle Information vs. Daily Concentration for the South Dakota Monitoring Sites	20-13
21-1	VOC Analytical Precision: 480 Replicate Analyses for all Duplicate and Collocated Samples	21-15
21-2	VOC Analytical Precision: 190 Replicate Analyses for all Collocated Samples	21-17
21-3	VOC Analytical Precision: 290 Replicate Analyses for all Duplicate Samples	21-19
21-4	VOC Analytical Precision: 110 Replicate Analyses for Collocated Samples in Detroit, MI (DEMI)	21-21
21-5	VOC Analytical Precision: 18 Replicate Analyses for all Duplicate Samples in Grand Junction, CO (GPCO)	21-23
21-6	VOC Analytical Precision: Eight Replicate Analyses for Collocated Samples in North Brook, IL (NBIL)	21-25
21-7	VOC Analytical Precision: Four Replicate Analyses for Collocated Samples in Phoenix, AZ (PSAZ)	21-27
21-8	VOC Analytical Precision: 24 Replicate Analyses for all Duplicate Samples in Bountiful, UT (BTUT)	21-29
21-9	VOC Analytical Precision: Four Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO)	21-31
21-10	VOC Analytical Precision: Coefficient of Variation for all Replicate Analyses, All Sites	21-33
21-11	VOC Analytical Precision: 100 Replicate Analyses for all Duplicate Samples	21-42
21-12	VOC Analytical Precision: 12 Replicate Analyses for Collocated Samples in North Brook, IL (NBIL)	21-45
21-13	VOC Analytical Precision: 24 Replicate Analyses for Duplicate Samples in Bountiful, UT (BTUT)	21-48
21-14	VOC Analytical Precision: Four Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO)	21-51
21-15	SNMOC Analytical Precision: Coefficient of Variation for all Replicate Analyses, All Sites	21-54
21-16	Carbonyl Analytical Precision: 498 Replicate Analyses for all Duplicate and Collocated Samples	21-57
21-17	Carbonyl Analytical Precision: 158 Replicate Analyses for all Collocated Samples	21-58
21-18	Carbonyl Analytical Precision: 340 Replicate Analyses for all Duplicate Samples	21-59
21-19	Carbonyl Analytical Precision: 16 Replicate Analyses for Duplicate Samples in Tampa, FL (SYFL)	21-60

LIST OF TABLES (CONTINUED)

21-20 Carbonyl Analytical Precision: 100 Replicate Analyses for Collocated Samples in Detroit, MI (DEMI)	21-61
21-21 Carbonyl Analytical Precision: 20 Replicate Analyses for Duplicate Samples in Grand Junction, CO (GPCO)	21-62
21-22 Carbonyl Analytical Precision: 24 Replicate Analyses for all Duplicate Samples in Bountiful, UT (BTUT)	21-63
21-23 Carbonyl Analytical Precision: Six Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO)	21-64
21-24 Carbonyl Analytical Precision: Coefficient of Variation for all Duplicate Analyses, All Sites	21-65
21-25 VOC Sampling and Analytical Precision: 218 Duplicate and Collocated Samples ..	21-68
21-26 VOC Sampling and Analytical Precision: 70 Collocated Samples	21-70
21-27 VOC Sampling and Analytical Precision: 148 Collocated Samples	21-72
21-28 VOC Sampling and Analytical Precision: 30 Collocated Samples in Detroit, MI (DEMI)	21-74
21-29 VOC Sampling and Analytical Precision: 10 Duplicate Samples in Grand Junction, CO (GPCO)	21-76
21-30 VOC Sampling and Analytical Precision: Four Collocate Samples in North Brook, IL (NBIL)	21-78
21-31 VOC Sampling and Analytical Precision: Four Collocate Samples in Phoenix, AZ (PSAZ)	21-80
21-32 VOC Sampling and Analytical Precision: 12 Duplicate Samples in Bountiful, UT (BTUT)	21-82
21-33 VOC Sampling and Analytical Precision: Two Duplicate Samples in St. Louis, MO (S4MO)	21-84
21-34 VOC Sampling and Analytical Precision: Coefficient of Variation for all Duplicate Samples, All Sites	21-86
21-35 SNMOC Sampling and Analytical Precision: 52 Duplicate Samples	21-95
21-36 SNMOC Sampling and Analytical Precision: Six Duplicate Samples in North Brook, IL (NBIL)	21-98
21-37 SNMOC Sampling and Analytical Precision: 12 Duplicate Samples in Bountiful, UT (BTUT)	21-101
21-38 SNMOC Sampling and Analytical Precision: Two Duplicate Samples in St. Louis, MO (S4MO)	21-101
21-39 SNMOC Sampling and Analytical Precision: Coefficient of Variation for all Duplicate Analyses, All Sites	21-107
21-40 Carbonyl Sampling and Analytical Precision: 224 Duplicate and Collocated Samples	21-110
21-41 Carbonyl Sampling and Analytical Precision: 54 Collocated Samples	21-111
21-42 Carbonyl Sampling and Analytical Precision: 170 Duplicate Samples	21-112
21-43 Carbonyl Sampling and Analytical Precision: Eight Duplicate Samples in Tampa, FL (SYFL)	21-113
21-44 Carbonyl Sampling and Analytical Precision: 26 Collocated Samples in Detroit, MI (DEMI)	21-114

LIST OF TABLES (CONTINUED)

21-45 Carbonyl Sampling and Analytical Precision: 10 Duplicate Samples in
Grand Junction, CO (GPCO) 21-115

21-46 Carbonyl Sampling and Analytical Precision: 12 Duplicate Samples in
Bountiful, UT (BTUT) 21-116

21-47 Carbonyl Sampling and Analytical Precision: Two Duplicate Samples in
St. Louis, MO (S4MO) 21-117

21-48 Carbonyl Sampling and Analytical Precision: Coefficient of Variation for all
Duplicate Analyses, All Sites 21-118

21-49 Metal Sampling and Analytical Precision: 106 Collocated Samples 21-121

21-50 Metal Sampling and Analytical Precision: 52 Collocated Samples in
Boston, MA (BOMA) 21-122

LIST OF ACRONYMS

AIRS	Aerometric Information and Retrieval System
AQS	Air Quality Subsystem (of the Aerometric Information and Retrieval System)
BTEX	benzene, toluene, ethylbenzene, and xylenes (<i>o</i> -, <i>m</i> -, and <i>p</i> -xylene)
CAA	Clean Air Act
CFR	Code of Federal Regulations
CV	coefficient of variation
DNPH	2,4-dinitrophenylhydrazine
EPA	U.S. Environmental Protection Agency
FID	flame ionization detection
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
HAP	hazardous air pollutant
HPLC	high-performance liquid chromatography
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
MACT	maximum achievable control technology
MEK	methyl ethyl ketone
MDL	method detection limit
MTBE	methyl <i>tert</i> -butyl ether
NAAQS	National Ambient Air Quality Standards
NATA	National Air Toxics Assessment
NATTS	National Air Toxics Trends System
NA	not applicable
ND	nondetect
NEI	National Emissions Inventory
NESHAP	National Emissions Standards for Hazardous Air Pollution
NLEV	National Low Emissions Vehicles
NMOC	Nonmethane Organic Compounds
NOAA	National Oceanic and Atmospheric Administration
NO _x	oxides of nitrogen
NSPS	New Source Standards of Performance
NTI	National Toxics Inventory
OTC	Ozone Transport Commission
ppbC	parts per billion carbon
ppbv	parts per billion (by volume)
PM	particulate matter
RfC	Reference Concentration

LIST OF ACRONYMS (Continued)

RFG	Reformulated Gasoline
RPD	relative percent difference
SIC	Standard Industrial Classification
SNMOC	Speciated Nonmethane Organic Compound
SVOC	Semivolatile Organic Compounds
UATMP	Urban Air Toxics Monitoring Program
VOC	Volatile Organic Compound(s)
TNMOC	Total Nonmethane Organic Compound(s)
tpy	tons per year
URE	Unit Risk Estimate
VMT	vehicle miles traveled
WBAN	Weather Bureau/Army/Navy ID

LIST OF ACRONYMS (Continued)

Monitoring Stations

APMI	Allen Park in Detroit, Michigan
AZFL	Azalea Park in St. Petersburg, Florida
BOMA	Boston, Massachusetts
BTMO	Bonne Terre, Missouri
BTUT	Bountiful, Utah
CANC	Candor, North Carolina
CANJ	Camden, New Jersey
CHNJ	Chester, New Jersey
CUSD	Custer, South Dakota
DEMI	Dearborn in Detroit, Michigan
DITN	Dickson, Tennessee
EATN	Nashville, Tennessee (Site #1)
ELNJ	Elizabeth, New Jersey
GAFL	Gandy in Tampa, Florida
GPCO	Grand Junction, Colorado
GPMS	Gulfport, Mississippi
GRMS	Grenada, Mississippi
HACT	Hartford, Connecticut
HOMI	Houghton Lake, Michigan
INDEM	Gary, Indiana
ITCMI	Sault Sainte Marie, Michigan
JAMS	Jackson, Mississippi
KITN	Kingsport, Tennessee
LDTN	Loudon, Tennessee
LOTN	Nashville, Tennessee (Site #2)
MAWI	Madison, Wisconsin
MCAZ	Phoenix, Arizona
NBIL	Northbrook in Chicago, Illinois
NBNJ	New Brunswick, New Jersey
ORFL	Orlando, Florida
PGMS	Pascagoula, Mississippi
PSAZ	Supersite in Phoenix, Arizona
QVAZ	Queen Valley in Phoenix, Arizona
RTPNC	Research Triangle Park, North Carolina
S4MO	St. Louis, Missouri (Site #4)

LIST OF ACRONYMS (Continued)

SFSD	Sioux Falls, South Dakota
SKFL	Pinellas Park, Florida
SLMO	St. Louis, Missouri (Site #1)
SLND	Spirit Lake Nation in Fort Totten, North Dakota
SPAZ	South Phoenix, Arizona
SPIL	Schiller Park in Chicago, Illinois
SYFL	Plant City, Florida
TUMS	Tupelo, Mississippi
YFMI	Yellow Freight in Detroit, Michigan

Abstract

This report presents the results and conclusions from the ambient air monitoring conducted as part of the 2004 Urban Air Toxics Monitoring Program (UATMP)—a program designed to characterize the magnitude and composition of potentially toxic air pollution in, or near, urban locations. The 2004 UATMP included 44 monitoring stations that collected 24-hour air samples, typically on a 6- or 12-day schedule. Forty-three sites analyzed ambient air samples for concentrations of 58 volatile organic compounds (VOC) and/or 12 carbonyl compounds. Eight sites also analyzed for 78 speciated nonmethane organic compounds (SNMOC). Three sites analyzed for 19 semivolatile compounds (SVOC) while five sites analyzed 11 metal compounds. Overall, nearly 140,000 ambient air concentrations were measured during the 2004 UATMP. The summary presented in this report uses various graphical, numerical, and statistical analyses to put the vast amount of ambient air monitoring data collected into perspective.

Not surprisingly, the ambient air concentrations measured during the program varied significantly from city to city and from season to season. This report describes and interprets these spatial and temporal variations separately for halogenated hydrocarbons, hydrocarbons, polar compounds, and carbonyls.

The ambient air monitoring data collected during the 2004 UATMP serve a wide range of purposes. Not only do these data characterize the nature and extent of urban air pollution close to the 44 monitoring stations participating in this study, but they also indicate some trends and patterns that may be common to all urban environments. Therefore, this report presents some results that are specific to particular monitoring locations and presents other results that are apparently common to urban environments. These results should ultimately provide additional insight into the complex nature of urban air pollution. The final data are also included in the appendices to this report.

1.0 Introduction

Air pollution in urban locations incorporates many components that originate from a wide range of industrial, motor vehicle, and natural emissions sources. Because some of these components include toxic compounds known or suspected to be carcinogenic, the U.S. Environmental Protection Agency (EPA) continues to encourage state and local agencies to understand and appreciate the nature and extent of potentially toxic air pollution in urban locations. To achieve this goal, EPA sponsors the Urban Air Toxics Monitoring Program (UATMP) to characterize the composition and magnitude of urban air pollution through extensive ambient air monitoring. Since the inception of UATMP in 1987, many environmental and health agencies have participated in the UATMP to assess the causes and effects of air pollution within their jurisdictions. This report summarizes and interprets the 2004 UATMP monitoring effort, which included 12 months of 6- and 12-day measurements of ambient air quality at 44 monitoring sites in or near 29 urban/rural locations including 21 metropolitan statistical areas (MSAs). Much of the analysis and data interpretation in this report focuses on compound-specific data trends.

Since 1987, the UATMP annual sampling cycle typically began in September and ended in August of the following calendar year. However, for the 2001 “program year,” ERG began sampling in January 2001 and ended all sampling at the end of December 2001. The 2002-2004 “program years” follow the same convention as 2001.

The contents of this report provide both a qualitative overview of air pollution at selected urban locations and a quantitative analysis of the factors that appear to affect urban air quality most significantly. This report also focuses on data trends at each of the 44 different air sampling locations, a site-specific approach that allows for much more detailed analyses of the factors (e.g., motor vehicle emission sources, industrial sources, natural sources) that affect air quality differently from one urban center to the next.

The contents of this report offer participating agencies useful insights into important air quality issues. For example, participating agencies can use trends and patterns in the UATMP monitoring data to determine whether levels of air pollution present public health concerns, to identify which emissions sources contribute most to air pollution, or to forecast whether proposed pollution control initiatives might significantly improve air quality. Since 2001, EPA has been actively conducting the National Air Toxics Assessment (NATA), which uses air toxics emissions to model ambient monitoring concentrations across the nation. UATMP monitoring data may be used to compare modeling results, similarly to NATA. The data analyses in this report present a comprehensive account of urban air pollution at every participating UATMP monitoring station. However, state and local environmental agencies are encouraged to perform additional analyses of the monitoring data so that the many factors that affect their specific ambient air quality can be understood fully.

To facilitate examination of the 2004 UATMP monitoring data, the complete set of measured concentrations is presented in appendices of this report. In addition, these data are publicly available in electronic format from the Air Quality Subsystem (AQS) of EPA's Aerometric Information Retrieval System (AIRS) at <http://www.epa.gov/ttn/airs/airsaqs/>.

The remainder of this report is organized into 23 text sections and 12 appendices. Table 1-1 highlights the contents of each section. As with previous UATMP annual reports, all figures and tables in this report appear at the end of their respective sections (figures first, followed by tables).

Table 1-1. Organization of the 2004 UATMP Report

Report Section	Section Title	Overview of Contents
2	The 2004 UATMP	<p>This section provides background information on the scope of the 2004 UATMP and includes information about the:</p> <ul style="list-style-type: none"> • Monitoring locations • Compounds selected for monitoring • Sampling and analytical methods • Sampling schedules • Completeness of the air monitoring program.
3	Summary of the 2004 UATMP	<p>These sections, which present and discuss significant trends and relationships in the UATMP data, characterize how ambient air concentrations varied with monitoring location and with time, then present an interpretation of the significance of the observed spatial and temporal variations.</p>
4	Sites in Arizona	Monitoring results for Phoenix-Mesa-Scottsdale, AZ (MCAZ, PSAZ, QVAZ, and SPAZ) MSA
5	Site in Colorado	Monitoring results for Grand Junction, CO (GPCO) MSA
6	Site in Connecticut	Monitoring results for Hartford-East Hartford, CT (HACT) MSA
7	Sites in Florida	Monitoring results for Orlando, FL (ORFL) MSA, and Tampa-St. Petersburg-Clearwater, FL (AZFL, GAFL, SKFL, and SYFL) MSA
8	Sites in Illinois	Monitoring results for Chicago-Naperville-Joliet, IL-IN-WI (NBIL and SPIL) MSA
9	Site in Indiana	Monitoring results for Chicago-Naperville-Joliet, IL-IN-WI (INDEM) MSA
10	Site in Massachusetts	Monitoring results for Boston-Cambridge-Quincy, MA-NH (BOMA) MSA
11	Sites in Michigan	Monitoring results for Detroit-Warren-Livonia, MI (APMI, DEMI, and YFMI) MSA, Houghton Lake, MI (HOMI) and Sault Sainte Marie, MI (ITCMI)
12	Sites in Mississippi	Monitoring results for Grenada, MS (GRMS), Gulfport-Biloxi, MS (GPMS) MSA, Jackson, MS (JAMS) MSA, Pascagoula, MS (PGMS) MSA, and Tupelo, MS (TUMS)
13	Sites in Missouri	Monitoring results for St. Louis, MO-IL (S4MO and SLMO) MSA, and Bonne Terre, MO (BTMO)
14	Sites in New Jersey	Monitoring results for New York-Newark-Edison, NY-NJ-PA (CHNJ, ELNJ, and NBNJ) MSA and Philadelphia-Camden-Wilmington, PA-NJ-DE-ND (CANJ) MSA
15	Sites in North Carolina	Monitoring results for Durham-Chapel Hill (RTPNC) MSA and Candor, NC (CANC)

Table 1-1. Organization of the 2004 UATMP Report (Continued)

Report Section	Section Title	Overview of Contents
16	Site in North Dakota	Monitoring results for Spirit Lake Nation, ND (SLND)
17	Sites in South Dakota	Monitoring results for Custer, SD (CUSD) and Sioux Falls, SD (SFSD) MSA
18	Sites in Tennessee	Monitoring results for Kingsport-Bristol, TN-VA (KITN) MSA, Knoxville, TN (LDTN) MSA and Nashville-Davidson-Murfreesboro, TN (DITN, EATN, and LOTN) MSA
19	Site in Utah	Monitoring results for Ogden-Clearfield, UT (BTUT) MSA
20	Site in Wisconsin	Monitoring results for Madison, WI (MAWI) MSA
21	Data Quality	This section defines and discusses the concepts of precision and accuracy. Based on quantitative and qualitative analyses, this section comments on the precision and accuracy of the 2004 UATMP ambient air monitoring data.
22	Conclusions and Recommendations	This section summarizes the most significant findings of the report and makes several recommendations for future projects that will involve ambient air monitoring in urban locations.
23	References	This section lists the references cited throughout the report.

2.0 The 2004 UATMP

The 2004 UATMP included 44 monitoring stations that collected 24-hour integrated ambient air samples for up to 12 months, at six or twelve day sampling intervals. All UATMP samples were analyzed in a central laboratory for concentrations of selected hydrocarbons, halogenated hydrocarbons, and polar compounds from the canister samples, carbonyl compounds from the cartridge samples, semivolatiles from the XAD-2[®] thimbles, and metal compounds from filters. The following discussion reviews the monitoring locations, compounds selected for monitoring, sampling schedules, completeness of the 2004 UATMP dataset, and sampling and analytical methods.

2.1 Monitoring Locations

Although EPA sponsors the UATMP, EPA does not dictate the location of the UATMP monitoring stations. Rather, representatives from the state and local agencies that voluntarily participate in the program and contribute to the overall monitoring costs select the monitoring locations based on specific siting criteria. Some monitors were placed near the centers of heavily populated cities (e.g., Chicago, IL and Phoenix, AZ), while others were placed in moderately populated areas (e.g., Candor, NC and Custer, SD).

Figure 2-1 shows the 29 urban and rural areas participating in the 2004 program. The site descriptions in Tables 2-1 and 2-2 and in Appendix A provide detailed information on the surroundings at the 2004 UATMP monitoring locations. Monitors that are designated as EPA National Air Toxic Trend System (NATTS) sites are indicated by bold type in Table 2-1. The monitoring sites participating in previous UATMP programs are listed in Table 2-3, and are discussed further in Section 3.8 Trends analysis. Sections 4 through 20 are state-specific breakdowns of the data analysis, and each contains topographic maps for each of the sites. Industrial facilities within 10 miles of the monitoring sites are provided in these sections as well. The location and category descriptions of these industrial emissions sources were retrieved from the 2002 National Emission Inventory (NEI) (US EPA, 2005a).

As Figure 2-1 shows, the 2004 UATMP monitoring sites are distributed across the country. The monitoring data from these stations may indicate certain air quality trends that are common to all urban environments, but may also show distinct geographic trends. The analyses in this report differentiate those trends that appear to be site-specific from those that appear to be common to most urban environments.

Chemical concentrations measured during the 2004 UATMP varied significantly from monitoring location to monitoring location. As discussed throughout this report, the proximity of the monitoring locations to different emissions sources, especially industrial facilities and heavily traveled roadways, often explains the observed spatial variations in ambient air quality. To provide a first approximation of the contributions of stationary source emissions on ambient air quality at each site, Table 2-2 lists the number of people living within 10 miles of each monitoring location, as well as the stationary source emissions in the monitor's residing county, according to the 2002 NEI.

At every UATMP monitoring location, the air sampling equipment was installed in a temperature-controlled enclosure (usually a trailer or a shed) with the sampling inlet probe exposed to the ambient air. With this common setup, every UATMP monitor sampled ambient air at heights approximately 5 to 20 feet above local ground level.

For record keeping and reporting purposes, each of these locations was assigned:

- A unique UATMP site code – used to track samples from the monitoring locations to the laboratory; and
- A unique nine-digit AQS site code – used to index monitoring results in the AQS database.

This report often cites these codes when presenting selected monitoring results.

2.2 Compounds Selected for Monitoring

Urban air pollution typically contains hundreds of components, including, but not limited to, volatile organic compounds (VOCs), carbonyl compounds, metals, inorganic acids, and particulate matter. Because the sampling and analysis required to monitor for every component of air pollution has been prohibitively expensive, the UATMP instead focuses on measuring ambient levels of 58 VOCs (12 hydrocarbons, 37 halogenated hydrocarbons, and nine polar compounds), 12 carbonyl compounds, 78 Speciated Nonmethane Organic Compounds (SNMOC), 19 Semivolatile Organic Compounds (SVOC), and 11 metal compounds. Tables 2-4, 2-5, 2-6, 2-7, and 2-8 identify the specific compounds of interest and their corresponding experimentally determined average method detection limits (MDL).

2.3 Sampling Schedules

Table 2-9 presents the dates on which sampling began and ended for each monitoring location. The UATMP monitoring locations started sampling in January 2004 and stopped sampling in December 2004, with the following exceptions, five sites began sampling after January 2004:

- Allen Park in Detroit, MI (APMI) site started in October 2004;
- Research Triangle Park, NC (RTPNC) site started in August 2004;
- Madison, WI (MAWI) site started in October 2004;
- Skyview Elementary School site in Pinellas Park, FL (SKFL) started in July 2004;
- Yellow Freight site in Detroit, MI (YFMI) started in October 2004;

Twelve sites ended sampling before December 2004:

- Bonne Terre, MO site (BTMO) ended in January 2004;
- Gulfport, MS site (GPMS) ended in October 2004;

- Hartford, CT site (HACT) ended in May 2004;
- Houghton Lake, MI site (HOMI) ended in February 2004;
- Jackson, MS site (JAMS) ended in October 2004;
- Kingsport TN site (KITN) ended in August 2004;
- Phoenix sites (MCAZ, PSAZ, QVAZ and SPAZ) ended in March 2004;
- Research Triangle Park, NC site (RTPNC) ended in November 2004; and
- St. Louis, MO site #1 (SLMO) ended in February 2004.

According to the UATMP schedule, 24-hour integrated samples were to be collected at every monitoring location approximately once every 6 or 12 days and each sample collection began and ended at midnight, local standard time. At each site, VOC and carbonyl samples were collected concurrently, except for the following sites:

- All Florida sites (AZFL, GAFL, ORFL, SKFL, and SYFL) - carbonyls only;
- Bonne Terre, MO (BTMO) and St. Louis, MO site 1 (SLMO) - carbonyls only;
- Candor, NC (CANC) - carbonyls only;
- Chicago, IL sites (NBIL and SPIL) - VOCs only;
- All Phoenix, AZ, sites (MCAZ, PSAZ, QVAZ, and SPAZ) - VOCs only;
- Hartford, CT (HART) - carbonyls only;
- Gary, IN (INDEM) - carbonyls only;
- Intertribal Council site in Sault Sainte Marie, MI (ITCMI) - carbonyls only;
- Research Triangle Park, NC (RTPNC) - carbonyls only;
- Spirit Lake site in Fort Totten, ND (SLND) - VOC only; and
- Yellow Freight site in Detroit, MI (YFMI) - VOC only.

Of the 44 sites, only one did not sample for VOCs and/or carbonyls - BOMA in Boston, MA. Only ITCMI, SLND, and YFMI collected SVOC samples. The following eight sites also collected SNMOC samples:

- Bountiful, UT (BTUT);
- Northbrook site in Chicago, IL (NBIL);
- Custer, SD (CUSD);
- Sioux Falls, SD (SFSD);
- Pascagoula, MS (PGMS); and
- St. Louis (Bonne Terre, site 1, and site 4), MO (BTMO, SLMO, and S4MO).

Five sites collected metals samples:

- Boston, MA (BOMA);
- Bountiful, UT (BTUT);
- Nashville, TN (EATN and LOTN); and
- St. Louis, MO site 4 (S4MO).

As part of the sampling schedule, site operators were instructed to collect duplicate samples on roughly 10% of the sampling days. Sampling calendars were distributed to help site operators schedule the collection of samples, duplicates, and field blanks. In cases where monitors failed to collect valid samples on a scheduled sampling day, site operators sometimes rescheduled samples for other days. This practice explains why some monitoring locations periodically strayed from the 6- or 12-day sampling schedule. The State of Michigan prepared a schedule that allowed Michigan's Department of Environmental Quality's laboratory to share samples with ERG's laboratory.

The 6- or 12-day sampling schedule permits cost-effective data collection for characterization (annual-average concentrations) of toxic compounds in ambient air and ensures that sampling days are evenly distributed among the seven days of the week to allow comparison of air quality on weekdays to air quality on weekends.

2.4 Completeness

Completeness refers to the number of valid samples collected compared to the number of samples expected from a 6- or 12-day sampling cycle. Monitoring programs that consistently generate valid results have higher completeness than programs that consistently invalidate samples. The completeness of an air monitoring program, therefore, is a qualitative measure of the reliability of air sampling equipment and laboratory analytical equipment and a measure of the efficiency with which the program was managed.

Appendix B identifies samples that were invalidated and lists the specific reasons why the samples were invalidated. Table 2-9 summarizes the completeness of the monitoring data sets collected during the 2004 UATMP:

- For VOC sampling, the completeness ranged from 59 to 100%, with an overall completeness of 94%;
- For carbonyl sampling, the completeness ranged from 55 to 100% with an overall completeness of 91%;
- For SNMOC sampling, the completeness ranged from 94 to 100% with an overall completeness of 97% for all sites;
- For SVOC sampling, the completeness was 75 to 88% with an overall completeness of 86% for all sites; and
- For metals sampling, the completeness ranged from 97 to 100% with an overall completeness of 99%.

The UATMP data quality objectives are based on the 2004 EPA-approved Quality Assurance Project Plan (QAPP), 85-100% of samples collected at a given monitoring station must be analyzed successfully to generate a sufficiently complete data set for estimating annual average air concentrations. The data in Table 2-9 shows that 14 data sets (from a total of 83 data sets) for the 2004 UATMP monitoring stations did not meet this data quality objective. These data sets were lower than the 85% criteria because some sites ended before they made up their required make-up samples (BTMO, EATN, HOMI, LOTN, PGMS, and QVAZ) or were having sampling site issues that would not allow make-up samples to be performed (CHNJ, DITN, and YFMI). Five sites which measured carbonyls (out of 34 sites), 10 VOC sites (out of 33), five SNMOC sites (out of eight), and three Metals sites (out of five) achieved 100 percent completeness.

2.5 Sampling and Analytical Methods

During the 2004 UATMP, four EPA-approved methods were used to characterize urban air pollution:

- *Compendium Method TO-15* was used to measure ambient air concentrations of 58 VOC and 78 SNMOC;
- *Compendium Method TO-11A* was used to measure ambient air concentrations of 12 carbonyl compounds;
- *Compendium Method TO-13A* was used to collect ambient air concentrations of 19 SVOC. Analysis was performed following Compendium Method TO-13A protocols;
- *Compendium Method IO-3.5* was used to collect ambient concentration of 11 metals. Analysis was performed following Compendium Method IO-3.5 protocols.

The following discussion presents an overview of these sampling and analytical methods. For detailed descriptions of the methods, readers should refer to EPA's original documentation of the Compendium Methods (US EPA, 1999a; US EPA, 1999b).

2.5.1 VOC Sampling and Analytical Method

As specified in the EPA method, ambient air samples for VOC analysis were collected in passivated stainless steel canisters. The central laboratory distributed the prepared canisters (i.e., cleaned and evacuated) to the UATMP monitoring stations before each scheduled sampling event, and site operators connected the canisters to air sampling equipment prior to each sampling day. Before their use in the field, the passivated canisters had internal pressures much lower than atmospheric. Because of this pressure differential, ambient air naturally flowed into the canisters once they were opened, and pumps were not needed to collect ambient air for VOC analysis. A flow controller on the sampling device ensured that ambient air entered the canister at a constant rate across the collection period. At the end of the 24-hour sampling period, a solenoid valve automatically stopped ambient air from flowing into the canister, and site operators returned the canisters to the central laboratory for analysis.

By analyzing each sample with gas chromatography incorporating mass selective detection and flame ionization detection (GC/MS-FID), laboratory staff determined ambient air concentrations of 58 VOC (12 hydrocarbons, 37 halogenated hydrocarbons, and nine polar compounds) and 78 SNMOC within the sample. Because isobutene and 1-butene as well as *m*-xylene and *p*-xylene elute from the GC column at the same time, the VOC analytical method reports only the sum of the concentrations for these compounds, and not the separate concentrations for each compound.

Table 2-4 lists the MDLs for the laboratory analysis of the VOC samples and Table 2-5 lists the MDLs for the SNMOC samples. Although the sensitivity of the analytical method varies from compound to compound, the average detection limit for VOC reported for every compound is lower than 0.19 parts per billion by volume (ppbv). Speciated Nonmethane Organic Compound (SNMOC) detection limits are expressed in parts per billion carbon (ppbC). All of the detection limits were less than 0.83 ppbC.

Appreciating Detection Limits

All detection limits of the analytical methods must be considered carefully when interpreting the corresponding ambient air monitoring data. By definition, detection limits represent the lowest concentrations at which laboratory equipment have been experimentally determined to reliably quantify concentrations of selected compounds to a specific confidence level. If a chemical concentration in ambient air does not exceed the method sensitivity (as gauged by the detection limit), the analytical method might not differentiate the compound from other compounds in the sample or from the random “noise” inherent in laboratory analyses. Therefore, when samples contain concentrations at levels below their respective detection limits, multiple analyses of the same sample may lead to a wide range of results, including highly variable concentrations or “nondetect” observations. Data analysts must exercise caution when interpreting monitoring data with many reported concentrations at levels near or below the corresponding detection limits.

MDLs are determined at the ERG analytical laboratory using 40 CFR, Part 136 procedures. This procedure involves analyzing at least seven replicate standards prepared on/in the appropriate sampling media (per analytical method). Instrument detection limits are not determined (replicates of standards only) because sample preparation procedures are not considered.

Because nondetect results significantly limit the range of data interpretations for ambient air monitoring programs, participating agencies should note that the approach for treating nondetects may slightly affect the magnitude of the calculated central tendency concentrations, especially for compounds with a low prevalence. Nondetects will not be replaced with one-half of the compound’s corresponding MDL. The nondetect is treated as a valid data point that can be used, in conjunction with back trajectories, for validation of nearby emission sources.

Similar to 2003, the reportable SNMOC analysis option was combined with the standard VOC sampling. These data are presented in Appendix D.

2.5.2 Carbonyl Sampling and Analytical Method

Following the specifications of EPA Compendium Method TO-11A, ambient air samples for carbonyl analysis were collected by passing ambient air over silica gel cartridges coated with 2,4-dinitrophenylhydrazine (DNPH), a compound known to react selectively and reversibly with many aldehydes and ketones. Carbonyl compounds in ambient air remain within the sampling cartridge, while other compounds pass through the cartridge without reacting with the DNPH-coated matrix. As with the VOC sampling, the central laboratory distributed the silica gel cartridges to the monitoring locations, and site operators connected the cartridges to the air sampling equipment. After each 24-hour sampling period, site operators returned the cartridges to the central laboratory for chemical analysis.

To quantify concentrations of carbonyls in the sampled ambient air, laboratory analysts eluted the exposed silica gel cartridges with acetonitrile. This solvent elution liberated a solution of DNPH derivatives of the aldehydes and ketones collected from the ambient air. High-performance liquid chromatography (HPLC) analysis and ultraviolet detection of these solutions determined the relative amounts of individual carbonyls present in the original air sample. Because butyraldehyde and isobutyraldehyde elute from the HPLC column at the same time, the carbonyl analytical method can report only the sum of the concentrations for these compounds, and not the separate concentrations for each compound. For the same reason, the analytical method reports only the sum of the concentrations for the three tolualdehyde isomers, as opposed to reporting separate concentrations for the three individual compounds.

Table 2-6 lists the MDLs reported by the analytical laboratory for measuring concentrations of 12 carbonyl compounds. Although the sensitivity of the analytical method varies from compound to compound and from site to site, the average detection limit reported by the analytical laboratory for every compound is less than or equal to 0.025 ppbv with a 1000L sample volume.

2.5.3 Semivolatile Sampling and Analytical Method

Semivolatile sampling was performed completely by the sites in accordance with EPA Compendium Method TO-13A. ERG supplies prepared sampling media and receives the samples from the sites for analysis only. Semivolatile sampling modules containing polyurethane foam (PUF) and petri dishes containing filters, together with Chain of Custody forms and all associated documentation, were shipped to the ERG laboratory from the field. Upon receipt at the laboratory, sample preparation and analysis procedures are based on Compendium Method TO-13A.

Table 2-7 lists the MDLs for the laboratory analysis of the SVOC samples. MDLs for semivolatile organic compounds ranged from 0.02 to 0.58 pg/m³, with most falling below 0.10 pg/m³ in an average sample volume of 200 m³.

2.5.4 Metal Compounds Sampling and Analytical Data

Inorganic sampling was performed completely by the sites in accordance with EPA Compendium Method IO-3.5 for inorganic compounds (metals). Metals filters, together with Chain of Custody forms and all associated documentation, were shipped to the ERG laboratory from the field. Upon receipt at the laboratory, filters were subcontracted for part of the year for analyses based on Compendium Method IO-3.5. For the remainder of the year, the ERG laboratory analyzed samples in house.

Table 2-8 lists the MDLs for the laboratory analysis of the metal samples. Because the sample volumes for the collection of metals ranged from approximately 0 to 1,839 m³, the MDLs are presented only in total ng/filter. The average MDLs ranged from 26 to 1,850 total ng/filter.

Figure 2-1. Monitoring Sites and Associated MSAs for the 2004 UATMP



Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
APMI	Allen Park, Detroit, MI	Commercial	Suburban	60,000	Unknown	The Allen Park site is an intermediate site located in a residential neighborhood 300 feet away from Interstate 75. Historically, this site has been used to detect impacts from mobile sources. There are no major industrial sources within a half-mile of the site. Of all the population-oriented sites in the Detroit MSA, Allen Park has the highest PM ₁₀ levels. Therefore, Allen Park has been selected as the PM _{2.5} trend speciation site and the collocated site for the federal reference method (FRM) monitors. Other criteria pollutant measurements that are collected at Allen Park include CO, O ₃ , SO ₂ , and PM ₁₀ .
AZFL	Azalea Park, St. Petersburg, FL	Residential	Suburban	51,000	Unknown	A neighborhood spatial scale of representativeness characterizes this monitoring site selected for the Tampa Bay pilot project. This monitor is sited in an area of high population density with uniform mixed land use, consisting of residential, commercial, and industrial properties. Major point sources are located approximately 2 to 10 miles from the monitoring site. In addition, this site is at least 150 meters from major roadways. However, given the proximity of motor vehicle traffic it is expected that mobile sources will contribute appreciably to the measured samples.
BOMA	Boston, MA	Commercial	Urban	27,287	2000	The Boston site is located in a residential neighborhood on Harrison Avenue in Dudley Square. Its purpose is to measure population exposure for a city bus terminal which is located across the street from the monitor and other urban sources.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
BTMO	Bonne Terre, MO	Agricultural	Rural	4,360	1995	The Bonne Terre site is located on a farm approximately one hundred miles due south of downtown St. Louis and is used for our St. Louis area upwind site. Its purpose is to measure transport of various pollutants into the St. Louis area; BTMO houses ozone, PM _{2.5} Speciation, and Air Toxics monitors. There are no sources within 5 miles of the site, except VOCs/Formaldehyde from nearby forests.
BTUT	Bountiful, UT	Residential	Suburban	33,310	2002	The Bountiful Viewmont site is located in a suburban area of the Ogden-Clearfield MSA, at 171 West 1370 North in Bountiful, Utah. This site is a relocation of the BOUT site, which was about 1.1 miles south of the new site. The site is located on the grounds of Viewmont High School, adjacent to a parking lot, tennis courts, and a football field. The surrounding neighborhood is made up of residential properties. BTUT is a SLAMS neighborhood-scale site for monitoring population exposure to SO ₂ , CO, NO ₂ , and PM _{2.5} ; and a NAMS neighborhood-scale site for monitoring maximum ozone concentrations. Speciated PM _{2.5} sampling, meteorological monitoring, and NATTS air toxics sampling are also done at the Bountiful Viewmont station. Several petroleum refineries are located two to five miles away from the site, as are several sand and gravel mining operations.
CANC	Candor, NC	Forest	Rural	100	1999	The Candor, NC, site is in rural Montgomery Co., at the end of a private dead end road named Perry Dr. which is off McCallum Rd. The site sits approximately 1.5 miles off a main road (McCallum Rd.). There is not a pollution source within 5 miles of the site. EPA also monitors next to this site.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
CANJ	Camden, NJ	Residential	Suburban	62,000	1986	Although this monitoring site in Camden, NJ, is in a residential area, numerous industrial facilities and busy roadways are located within a 10 mile radius. The monitors are situated in a parking lot of a business complex.
CHNJ	Chester, NJ	Agricultural	Rural	12,623	1995	The Chester, NJ, site is located in a rural-agricultural, residential section and is topographically rolling. The site is located near Lucent Laboratory Building #1. There is potential population exposure to, ozone, NO ₂ , and SO ₂ .
CUSD	Custer, SD	Residential	Suburban	1,940	2002	The site is located on the edge of an urban area, in a pasture across the road from the last housing development on the east side of the City of Custer. The city has a population of 1,860 and is the largest city in the county. The city is located in a river valley in the Black Hills with pine covered hills on the north and south sides of the valley. The site is located in the center of the valley on the east side of the city. Major sources near the site include vehicles (highest traffic counts from May through September), forest fires (mainly during July through September), wood burning for heat, and wild land heath fires (during the winter months). The main industries in the area include tourism, logging, and mining of feldspar/quartz.
DEMI	Dearborn in Detroit, MI	Industrial	Suburban	12,791	1990	Dearborn, MI, an addition to the State network, is located in a residential neighborhood with industrial impacts. An auto and steel manufacturing plant is located in close proximity to the monitoring site. Previous violations of the PM ₁₀ standard have also occurred at this site. The site lies between Interstate 75 and Interstate 94. This site is expected to show some of the highest levels of air toxics in the Detroit Pilot program area. The SO ₂ and PM ₁₀ measurements are also made there.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
DITN	Dickson, TN	Commercial	Urban	4,420	2003	The Dickson, TN site was set up due to public concern about air emissions from several sources in an industrial park. Among these sources is one that cast aluminum engine blocks, another one that reclaims scrap metal, and a large printing company.
EATN	Nashville, TN (Site #1)	Residential	Urban	38,450	1993	This site is located in Nashville, TN and is located on the roof of East Nashville Health Center. The site is north (predominately downwind) of downtown Nashville and is a population oriented site predominantly influenced by primarily commercial and mobile sources.
ELNJ	Elizabeth, NJ	Industrial	Suburban	170,000	Unknown	Elizabeth is located in Union County, NJ, at an urban-industrial site where the topography is relatively smooth. The monitoring site is located 75 yards away from the Toll Plaza and about one mile from Bayway Refinery. The neighborhood scale is at maximum concentration. The location has a PM ₁₀ filter analyzer for sulfates and nitrates as well as the UATMP site.
GAFI	Gandy in Tampa, FL	Commercial	Suburban	81,460	Unknown	A neighborhood spatial scale of representativeness characterizes this monitoring site selected for the Tampa Bay Region Air Toxics Study Monitoring Stations (TBRATS) pilot project. This monitor is sited in an area of high population density with uniform mixed land use, consisting of residential, commercial, and industrial properties. Major point sources are located greater than one mile from the monitoring site. Since the emission points from these sources are elevated and not proximate to the monitor, concentrations measured during this study should not be dominated by a single source. In addition, this site is at least 150 meters from major roadways. However, given the proximity of motor vehicle traffic, mobile sources are expected to contribute appreciably to the measured samples.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
GPCO	Grand Junction, CO	Commercial	Urban and City Center	19,572	2000/2001/2002	This site is located at 645 1/4 Pitkin Avenue. This site is a small 1-story shelter that houses the VOC/carbonyl sampler. The inlet for this sampler is 13' above the ground and 35' south of Pitkin Avenue. This site also has meteorological sensors (WS, WD, T, RH) on a 10 meter tower, a carbon monoxide sampler and a continuous PM ₁₀ sampler. Monitoring is being conducted on the southeast side of the downtown area. The area is very mixed usage, with commercial business to the west, northwest and north, residential to the northeast and east, and industrial to the southeast, south and southwest. The location is next to one of the major east-west roads in Grand Junction.
GPMS	Gulfport, MS	Commercial	Rural	17,000	1995	The Gulfport site is in a light commercial and residential area. This site was selected because this area is believed to have high ambient air toxic concentrations based upon information from the NATA study and Mississippi's major source emission inventories.
GRMS	Grenada, MS	Agricultural	Rural	1,100	2000	The Grenada County monitoring site was established because it was identified by Region IV's Air Toxics Monitoring Network planning effort as a county where toxic emissions concentrations were expected to be higher and pose a higher than normal risk to residents. There are several major industries in the area which are primarily included in the surface coating industry. The area is moderately populated but the area itself would be considered rural.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
HACT	Hartford, CT	Commercial	Urban	10,000	Unknown	This CT site is located on Morgan St. in Hartford, a downtown urban location. The traffic flows in one direction (east). The site lies under the I-84 east fly-over to I-91 north which is about 50 feet above the ground. There is a 6 level parking garage diagonally across the street. This site was chosen because it showed a potential for high concentrations based on a grid study.
HOMI	Houghton Lake, MI	Forest/ Agricultural	Rural	7,000	2002	The Houghton Lake station is located in Mississaukee County in the north central portion of Michigan's lower peninsula. Primary industries in the area include year-round tourism (boating, fishing, hunting and snow mobiling) as well as Christmas tree farming. The county is sparsely populated, but attracts many tourists as it is a prime recreational area containing many lakes, rivers and streams. The station is located at a deer research facility just west of US Route 27. Though not located close to the site, oil and natural gas production occurs in counties to the south and north, as Michigan is the nation's 4th largest oil and gas producer.
INDEM	Gary, IN	Industrial	Urban	42,950	1990	This site is located in Gary is located on property now owned by the Dunes National Lakeshore. It is approximately one-half to three-quarter mile south west of the USX coking battery for their mill. The site is part of the Chicago PAMS network. It is considered a Type 2 or source site. Monitoring for ozone, NO/NO _x , ozone precursors, and carbonyls began in 1995 as the network was deployed in Wisconsin, Illinois, Indiana, and Michigan. Other parameters monitored at this location are SO ₂ , PM ₁₀ , PM _{2.5} , speciated PM _{2.5} , and several meteorological parameters.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
ITCMI	Sault Sainte Marie, MI	Residential	Rural	100,000	1990	Tribal members had issued complaints arising from the smell and the clouds being produced from a steel plant and paper mill located on the other side of the Saint Mary's River. The site is located on Lake Superior State University campus, which is a residential area. This site includes two sequential PM _{2.5} filter based FRM monitors (primary and a collocated), a PM _{2.5} speciation monitor, a PM _{2.5} TEOM monitor, an AVOCS monitor, a PAH monitor, a meteorological station, and a large particulate matter collector (dustfall monitor).
JAMS	Jackson, MS	Commercial	Suburban	12,500	Unknown	The Jackson site is located in a light commercial and residential area, selected because this area is believed to have high ambient air toxic concentrations based upon information from the NATA study and Mississippi's major source emission inventories.
KITN	Kingsport, TN	Residential	Suburban	300	1998	The site in Kingsport, TN, was set up to determine the impact of a very, very large organic chemical manufacturing company, Eastman Chemical. There are other sources in this area but Eastman is the primary one of concern.
LDTN	Loudon, TN	Residential	Suburban	13,360	2003	The site at Loudon, TN, was set up due to public concern about air emissions from several sources in an industrial park. Among these sources is a very large facility that processes corn to make corn syrup, A.E. Staley, a sausage casing manufacturer, boat manufacturer, paper products manufacturer, waste metal reclamation, waste paper reclamation, and others.
LOTN	Nashville, TN (Site #2)	Industrial	Urban	3,000	Unknown	This core site is located on the roof of Lockland School, which is located in the heart of downtown Nashville. This is also a population oriented site influenced primarily by commercial and mobile sources.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
MAWI	Madison, WI	Residential	Urban	23,750	1993	The Madison monitoring site is located on the East High School's Killiher Athletic field, near the corner of Hoard and Fifth Street. The monitoring site was originally established in 1992 as an ozone monitoring site. Air toxics monitoring was added in 2002 as part of the Region 5 State and Local Regional Air Toxics Monitoring Strategy. The station was selected to provide new monitoring data for a midsize city experiencing urban growth.
MCAZ	Phoenix, AZ (Site #1)	Industrial	Urban	3,000	Unknown	This site is located on West 43rd Avenue (Maricopa County Environmental Services Department) and 3940 W. Broadway, Phoenix. MCAZ is a middle scale site and the objective is maximum concentration for PM ₁₀ . MCAZ is downwind of major industrial sources, including sand and gravel, and metal recycling. Monitors include PM ₁₀ hi-vol, wind speed/direction, delta temp, temp and pressure, VOC canisters (ADEQ).
NBIL	Northbrook in Chicago, IL	Residential	Suburban	29,600	2001	The village of Northbrook is located in northeast Cook County. This monitoring site is located at the Northbrook Water Filtration Station at 750 Dundee Road. A forest preserve is located immediately south with residential areas farther south (southeast to southwest). Residential areas are also immediately to the west. Commercial areas are located along Dundee Road and to the east. A major expressway (I-94) is located 1 km to the east and north. O'Hare Airport is located 18 km to the southwest and the Chicago Loop is located 32 km to the southeast.
NBNJ	New Brunswick, NJ	Agricultural	Rural	63,000	Unknown	The New Brunswick site is located in a suburban-agricultural, residential area and is topographically smooth. The actual site location is in Rutgers University's Horticultural Farm.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
ORFL	Orlando, FL	Commercial	Urban	59,000	Unknown	The site is an Urban/Neighborhood spatial scale site to determine the concentrations of the EPA Criteria pollutants (and now Air Toxics) to which the area population may be exposed. The primary emission source is motor vehicles with some commercial businesses also in the area.
PGMS	Pascagoula, MS	Commercial	Urban	8,600	2000	The Pascagoula site is mostly in a commercial area in proximity to perhaps the largest industrial area in Mississippi. The industries near the Pascagoula site include chemical processes, petroleum refining, and ship building.
PSAZ	Supersite in Phoenix, AZ (Site #2)	Residential	Urban	250	1993	The Supersite is intended to represent the central core of the Phoenix metropolitan area in a high emissions area, and is a PAMS Type 2 site. The site houses a variety of air monitoring equipment including criteria pollutant samplers and analyzers, PAMS and air toxics, total NMHC, meteorology, visibility/urban haze, and has been selected for several state and national air monitoring studies. The area surrounding the site is primarily residential neighborhoods. There is an interstate highway approximately one mile west of the site, as well as commercial and industrial areas within five miles of the site.
QVAZ	Queen Valley in Phoenix, AZ	Desert	Rural	200	2001	The state of Arizona established the Queen Valley Water Tank site in 2001, near the Superstition Wilderness Class I area, as a state Class I visibility monitoring site and a PAMS Type 3 monitoring site. The Queen Valley site consists of an IMPROVE aerosol sampler, a nephelometer and meteorological monitoring equipment. The state also operates O ₃ , trace level NO _{x/y} , PAMS and air toxics monitors. The area surrounding the site is primarily undeveloped desert. The town of Queen Valley is located approximately 0.5 miles north of the site.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
RTPNC	Research Triangle Park, NC	Commercial	Suburban	12,000	2003	The RTP site is located on the north side of the EPA campus. It is approximately 600 meters south of intersection I-40. There are trees to the east of the site, but it slopes down from the site to the trees. The height of the tallest tree (relative to the sampling port) to the east is less than 2 times the distance to the trees. The site has at least 270° clearance around the site.
S4MO	St. Louis, MO (Site #4)	Residential	Urban	22,840	1995	Blair Street has some industry around it and a fair amount of industry to the east. The site is also only about 250 meters from I-70 (at its closest point).
SFSD	Sioux Falls, SD	Residential	Urban	4,320	1999	The SFSD monitoring site is located in Sioux Falls, SD, the largest city in the state, near two grade schools north of the site and residential areas on the west, east, and south. The area within 1 mile of the site is mostly residential with a few retail businesses. The main industrial area of the city is about 3 miles northwest and 2 miles to the west of the site. The site was selected because it represents population exposure to chemical and particulate emissions from the industrial parts of the city. The predominant wind direction is northwest for most of the year with southeast winds during the summer months.
SKFL	Skyview in Tampa, FL	Residential	Suburban	50,500	2003	This air monitoring site is located in south central Pinellas County at Skyview Elementary School, 8601 60th St. N., Pinellas Park Florida. This site is a NATTS and samples for all pollutants/parameters required by NATTS, including VOCs, carbonyls, metals, PM-2.5 speciation, and black carbon. In addition, measurements are made for wind speed, wind direction, ambient pressure, and ambient temperature. Site spatial scale is neighborhood. This is a population-oriented site. The predominate land use around the site is residential.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
SLMO	St. Louis, MO (Site #1)	Residential	Urban	15,016	2,000	The SLMO site at Grant School in St. Louis is a residential site. Commercial influences are approximately 200 yards east. Volatile organic compounds, carbonyls, hydrocarbons, meteorological parameters, metals, and PM _{2.5} speciation were conducted at this site in 2004.
SLND	Spirit Lake Nation, ND	Residential	Rural	925	Estimated from multiple years	Sampling was undertaken primarily to monitor Sioux Mfg. Corp. Approximately 960 people live in the Fort Totten Community, where the facility is located. The terrain is mostly flat, with some pasture land and several hundred acres of farmland within the facility's range of impact. Many of the public services, administration buildings, the local community college, public schools, and other resources of the reservation are within a few blocks of the facility. The PUF and AT-2 samplers are located in a trailer near the Sioux Mfg property line. Sioux Mfg. is to the west of the trailer and residential neighborhoods are located to the east. Open fields are located south of the trailer. The area is bounded by Hwy 57 to the north and Bia Road 7 to the south.
SPAZ	South Phoenix, AZ (Site # 3)	Residential	Urban	50,000	1995	Maricopa County established the South Phoenix site at its current location in 1999 and operates CO, O ₃ and PM ₁₀ monitors. The state of Arizona also operates PAMS and air toxics monitors. The site is at the edge of a residential area, but also borders on a mixture of commercial properties (retail stores, restaurants and offices). Industrial areas are located approximately one mile north of the site.

Table 2-1. Text Descriptions of the 2004 UATMP Monitoring Sites (Continued)

UATMP Code	Monitoring Sites	Land Use	Location Setting	Estimated Traffic (# vehicles)	Traffic Year Estimate	Description of the Immediate Surroundings
SPIL	Schiller Park in Chicago, IL	Mobile	Suburban	214,900	2001	This monitoring site is located on a trailer at 4743 Mannheim Road just south of Lawrence Ave. and between Mannheim Road and I-294. The closest runway at O'Hare Airport is 0.5 km to the northwest. The immediate vicinity is mostly commercial. Residential areas are located east across I-294.
SYFL	Sydney in Plant City, FL	Residential	Rural	5,142	2002	The site in Sydney is a NATTS neighborhood/rural site. Monitoring has been occurring at Sydney for 5 years as a background site. Current development in the area warranted it becoming a NATTS site. The Sydney site is also being used for an intercomparison of the port of Tampa as compared to a neighbor/rural site.
TUMS	Tupelo, MS	Commercial	Suburban	4,900	1997/1995	The Tupelo site is in a light commercial and residential area. This site was selected because this area is believed to have high ambient air toxic concentrations based upon information from the NATA study and Mississippi's major source emission inventories.
YFMI	Yellow Freight in Detroit, MI	Industrial	Urban	500	Unknown	The Yellow Freight site currently collects SO ₂ measurements and is located in the center of a highly industrialized area. The primary influence is from a nearby car battery plant. The site is about 2.25 miles away from the Dearborn site. Its inclusion in the study provides information about the degree of heterogeneity of toxic air contaminants across a small scale.

BOLD = EPA-designated National Air Toxics Trend System (NATTS) site.

Table 2-2. Site Descriptions for the 2004 UATMP Monitoring Sites

2004 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Site ^a	County-level Stationary Source HAP Emissions in the 2002 NEI ^b (tpy)	Closest National Weather Service Station
APMI	26-163-0001	Allen Park in Detroit, MI	964,194	7,924	Detroit/Metropolitan Airport
AZFL	12-103-0018	Azalea Park in St. Petersburg, FL	572,722	996	St. Petersburg/Whitted Airport
BOMA	25-025-0042	Boston, MA	1,589,367	803	General Logan Int'l. Airport
BTMO	29-187-0005	Bonne Terre, MO	34,969	206	Farmington Regional Airport
BTUT	49-011-0004	Bountiful, UT	243,462	1,197	Salt Lake City International
CANC	37-123-0001	Candor, NC	11,014	197	Moore County Airport
CANJ	34-007-0003	Camden, NJ	2,030,976	1,151	Philadelphia International Airport
CHNJ	34-027-3001	Chester, NJ	234,148	1,061	Somerville, NJ/Somerset Airport
CUSD	46-033-0003	Custer, SD	4,449	429	Custer County Airport
DEMI	26-163-0033	Dearborn in Detroit, MI	1,201,847	7,924	Detroit Metropolitan Airport
DITN	47-043-0010	Dickson, TN	29,214	1,222	Outlaw Field Airport
EATN	47-037-0011	Nashville, TN (Site #1)	516,083	3,904	Nashville/Metro Airport

Table 2-2. Site Descriptions for the 2004 UATMP Monitoring Sites (Continued)

2004 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Site ^a	County-level Stationary Source HAP Emissions in the 2002 NEI ^b (tpy)	Closest National Weather Service Station
ELNJ	34-039-0004	Elizabeth, NJ	2,179,781	1,719	Newark International
GAFL	12-057-1065	Gandy in Tampa, FL	462,119	7,018	Tampa, FL International
GPCO	08-077-0018	Grand Junction, CO	106,900	403	Walker Field Airport
GPMS	28-047-0008	Gulfport, MS	172,653	3,144	Gulf Port/Biloxi Regional Airport
GRMS	28-043-0001	Grenada, MS	21,446	410	Greenwood-Leflore Airport
HACT	09-003-0017	Hartford, CT	583,236	1,378	Hartford-Brainard Airport
HOMI	26-113-0001	Houghton Lake, MI	10,187	123	Houghton Lake/Roscommon County Airport
INDEM	18-089-0022	Gary, IN	404,545	3,053	Lancing Municipal Airport
ITCMI	26-033-0901	Sault Sainte Marie, MI	22,188	237	Sault Ste. Marie Municipal Airport
JAMS	28-049-0010	Jackson, MS	266,182	1,020	Hawkins Field Airport
KITN	47-163-1007	Kingsport, TN	130,473	1,786	Tri City Airport
LDTN	47-105-0108	Loudon, TN	46,750	1,556	McGhee Tyson Airport
LOTN	47-037-0023	Nashville, TN (Site #2)	464,804	3,904	Nashville Metro Airport

Table 2-2. Site Descriptions for the 2004 UATMP Monitoring Sites (Continued)

2004 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Site ^a	County-level Stationary Source HAP Emissions in the 2002 NEI ^b (tpy)	Closest National Weather Service Station
MAWI	55-025-0041	Madison, WI	356,676	1,912	Dane County Regional-Traux Field Airport
MCAZ	04-013-4009	Phoenix, AZ (Site#1)	851,962	9,165	Phoenix Sky Harbor International Airport
NBIL	17-031-4201	Northbrook in Chicago, IL	883,969	19,377	Palwaukee Municipal Airport
NBNJ	34-023-0006	New Brunswick, NJ	787,380	2,501	Somerville, NJ/Somerset Airport
ORFL	12-095-2002	Winter Park, FL	962,938	2,970	Orlando Executive Airport
PGMS	28-059-0006	Pascagoula, MS	56,235	2,596	Pascagoula, MS/Lott International Airport
PSAZ	04-013-9997	Supersite in Phoenix, AZ (Site #2)	1,409,602	9,165	Phoenix Sky Harbor International Airport
QVAZ	04-021-8001	Queen Valley in Phoenix, AZ	61,848	1,636	Phoenix Sky Harbor International Airport
RTPNC	37-063-0014	Research Triangle Park, NC	380,541	598	Raleigh-Durham International Airport
S4MO	29-510-0085	St. Louis, MO (Site #4)	822,941	1,396	St. Louis Downtown Airport
SFSD	46-099-0007	Sioux Falls, SD	154,472	546	Joe Foss Field Airport

Table 2-2. Site Descriptions for the 2004 UATMP Monitoring Sites (Continued)

2004 UATMP Code	AQS Site Code	Location	Population Residing Within 10 Miles of the Monitoring Site ^a	County-level Stationary Source HAP Emissions in the 2002 NEI ^b (tpy)	Closest National Weather Service Station
SKFL	12-103-0026	Skyview in Tampa, FL	698,981	996	St. Pete-Clearwater International Airport
SLMO	29-510-0089	St. Louis, MO (Site #1)	755,374	1,396	St. Louis Downtown Airport
SLND	38-005-7001	Spirit Lake Nation, ND	0	77	Devils Lake Municipal Airport
SPAZ	04-013-4003	South Phoenix, AZ (Site #3)	851,962	9,165	Phoenix Sky Harbor International Airport
SPIL	17-031-3103	Schiller Park in Chicago, IL	2,087,514	19,377	O'Hare International Airport
SYFL	12-057-3002	Sydney in Plant City, FL	259,538	7,018	Winter Haven's Gilbert Airport
TUMS	28-081-0005	Tupelo, MS	70,215	487	Tupelo Municipal Airport
YFMI	26-163-0027	Yellow Freight in Detroit, MI	1,154,934	7,924	Detroit City Airport

^a Reference: <http://zipnet.htm>

^b Reference: EPA, 2005a.

Table 2-3. Current UATMP Monitoring Sites with Past Participation

Monitoring Site	Program Years During Which Station Past Participated in the UATMP ^a								
	1994	1995	1996	1997	1998	1999/ 2000 ^b	2001	2002	2003
Azalea Park, St. Petersburg, FL (AZFL)							✓	✓	✓
Bonne Terre, MO (BTMO)								✓	✓
Boston, MA (BOMA)									✓
Bountiful, UT (BTUT)									✓
Camden, NJ (CANJ)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Candor, NC (CANC)									✓
Chester, NJ (CHNJ)							✓	✓	✓
Northbrook, Chicago, IL (NBIL)									✓
Schiller Park, Chicago, IL (SPIL)									✓
Custer, SD (CUSD)								✓	✓
Allen Park, Detroit, MI (APMI)							✓	✓	✓
Dearborn, Detroit, MI (DEMI)							✓	✓	✓
Yellow Freight, Detroit, MI (YFMI)							✓	✓	
Dickson, TN (DITN)									✓
Elizabeth, NJ (ELNJ)						✓	✓	✓	✓
Gandy, Tampa, FL (GAFL)							✓	✓	✓

Table 2-3. Current UATMP Monitoring Sites with Past Participation (Continued)

Monitoring Site	Program Years During Which Station Past Participated in the UATMP ^a								
	1994	1995	1996	1997	1998	1999/ 2000 ^b	2001	2002	2003
Grenada, MS (GRMS)									✓
Gulfport, MS (GPMS)							✓	✓	✓
Hartford, CT (HACT)									✓
Houghton Lake, MI (HOMI)								✓	✓
Inter-Tribal Council, Sault Ste. Marie, MI (ITCMI)									✓
Jackson, MS (JAMS)							✓	✓	✓
Kingsport, TN (KITN)									✓
Knoxville, TN (LDTN)									✓
Nashville, TN Site #1 (EATN)								✓	✓
Nashville, TN Site #2 (LOTN)								✓	✓
New Brunswick, NJ (NBNJ)							✓	✓	✓
Pascagoula, MS (PGMS)							✓	✓	✓
Queen Valley, Phoenix, AZ (QVAZ)							✓	✓	✓
Sioux Falls, SD (SFSD)						✓	✓	✓	✓
Maricopa, Phoenix, AZ (MCAZ)									✓
Supersite, Phoenix, AZ (PSAZ)							✓	✓	✓

Table 2-3. Current UATMP Monitoring Sites with Past Participation (Continued)

Monitoring Site	Program Years During Which Station Past Participated in the UATMP ^a								
	1994	1995	1996	1997	1998	1999/ 2000 ^b	2001	2002	2003
South Phoenix, AZ (SPAZ)							✓	✓	✓
St. Louis, MO Site # 1 (SLMO)							✓	✓	✓
St. Louis, MO Site # 4 (S4MO)								✓	✓
Tupelo, MS (TUMS)							✓	✓	✓
Winter Park, FL (ORFL)									✓

^a Some of the stations shown in the table participated in UATMP prior to the 1994 program. However, this report considers only ambient air monitoring data collected during the current and previous two EPA contracts (i.e., UATMP program years 1994 through 2004).

^b The time period for the 1999/2000 UATMP covers October 1999 to December 2000.

Table 2-4. VOC Average Method Detection Limits

Compound	Method Detection Limit (ppbv)
Hydrocarbons	
Acetylene	0.05
Benzene	0.05
1,3-Butadiene	0.06
Ethylbenzene	0.04
<i>n</i> -Octane	0.06
Propylene	0.07
Styrene	0.04
Toluene	0.05
1,2,4-Trimethylbenzene	0.06
1,3,5-Trimethylbenzene	0.04
<i>m</i> -, <i>p</i> -Xylene	0.05
<i>o</i> -Xylene	0.04
Halogenated Hydrocarbons	
Bromochloromethane	0.09
Bromodichloromethane	0.04
Bromoform	0.06
Bromomethane	0.05
Carbon Tetrachloride	0.06
Chlorobenzene	0.04
Chloroethane	0.10
Chloroform	0.04
Chloromethane	0.05
Chloromethylbenzene	0.05
Chloroprene	0.05
Dibromochloromethane	0.07
1,2-Dibromoethane	0.05
<i>m</i> -Dichlorobenzene	0.07
<i>o</i> -Dichlorobenzene	0.04
<i>p</i> -Dichlorobenzene	0.06
1,1-Dichloroethane	0.05
1,2-Dichloroethane	0.06
1,1-Dichloroethene	0.05
<i>cis</i> -1,2-Dichloroethylene	0.06
<i>trans</i> -1,2-Dichloroethylene	0.05
1,2-Dichloropropane	0.07
<i>cis</i> -1,3-Dichloropropene	0.05

Table 2-4. VOC Average Method Detection Limits (Continued)

Compound	Method Detection Limit (ppbv)
Halogenated Hydrocarbons (Continued)	
<i>trans</i> -1,3-Dichloropropene	0.05
Dichlorodifluoromethane	0.03
Dichlorotetrafluoroethane	0.03
Hexachloro-1,3-butadiene	0.16
Dichloromethane	0.08
1,1,2,2-Tetrachloroethane	0.05
Tetrachloroethylene	0.05
1,2,4-Trichlorobenzene	0.18
1,1,1-Trichloroethane	0.05
1,1,2-Trichloroethane	0.08
Trichloroethylene	0.05
Trichlorofluoromethane	0.04
Trichlorotrifluoroethane	0.04
Vinyl Chloride	0.04
Polar Compounds	
Acetonitrile	0.13
Acrylonitrile	0.08
Ethyl Acrylate	0.06
Ethyl <i>tert</i> -Butyl Ether	0.05
Methyl Ethyl Ketone (MEK)	0.15
Methyl Isobutyl Ketone	0.08
Methyl Methacrylate	0.11
Methyl <i>tert</i> -Butyl Ether (MTBE)	0.07
<i>tert</i> -Amyl Methyl Ether	0.07

Because *m*-xylene and *p*-xylene elute from the GC column at the same time, the VOC analytical method can report only the sum of *m*-xylene and *p*-xylene concentrations and not concentrations of the individual compounds.

Table 2-5. SNMOC Average Method Detection Limits

Compound	Method Detection Limit	Compound	Method Detection Limit
	ppbC		ppbC
Acetylene	0.06	3-Methyl-1-butene	0.32
Benzene	0.26	Methylcyclohexane	0.13
1,3-Butadiene	0.52	Methylcyclopentane	0.12
<i>n</i> -Butane	0.52	2-Methylheptane	0.39
<i>cis</i> -2-Butene	0.13	3-Methylheptane	0.28
<i>trans</i> -2-Butene	0.08	2-Methylhexane	0.18
Cyclohexane	0.29	3-Methylhexane	0.23
Cyclopentane	0.12	2-Methylpentane	0.28
Cyclopentene	0.32	3-Methylpentane	0.23
<i>n</i> -Decane	0.20	2-Methyl-1-pentene	0.29
1-Decene	0.26	4-Methyl-1-pentene	0.29
<i>m</i> -Diethylbenzene	0.26	<i>n</i> -Nonane	0.15
<i>p</i> -Diethylbenzene	0.16	1-Nonene	0.36
2,2-Dimethylbutane	0.29	<i>n</i> -Octane	0.25
2,3-Dimethylbutane	0.27	1-Octene	0.82
2,3-Dimethylpentane	0.43	<i>n</i> -Pentane	0.09
2,4-Dimethylpentane	0.28	1-Pentene	0.21
<i>n</i> -Dodecane	0.78	<i>cis</i> -2-Pentene	0.12
1-Dodecene	0.78	<i>trans</i> -2-Pentene	0.21
Ethane	0.20	α -Pinene	0.26
2-Ethyl-1-butene	0.29	β -Pinene	0.26
Ethylbenzene	0.19	Propane	0.18
Ethylene	0.07	<i>n</i> -Propylbenzene	0.17

Table 2-5. SNMOC Average Method Detection Limits (Continued)

Compound	Method Detection Limit	Compound	Method Detection Limit
	ppbC		ppbC
<i>m</i> -Ethyltoluene	0.14	Propylene	0.12
<i>o</i> -Ethyltoluene	0.15	Propyne	0.18
<i>p</i> -Ethyltoluene	0.21	Styrene	0.82
<i>n</i> -Heptane	0.26	Toluene	0.35
1-Heptene	0.43	<i>n</i> -Tridecane	0.78
<i>n</i> -Hexane	0.09	1-Tridecene	0.78
1-Hexene	0.26	1,2,3-Trimethylbenzene	0.13
<i>cis</i> -2-Hexene	0.29	1,2,4-Trimethylbenzene	0.21
<i>trans</i> -2-Hexene	0.29	1,3,5-Trimethylbenzene	0.15
Isobutane	0.07	2,2,3-Trimethylpentane	0.82
Isobutene/1-Butene	0.30	2,2,4-Trimethylpentane	0.43
Isopentane	0.32	2,3,4-Trimethylpentane	0.36
Isoprene	0.17	<i>n</i> -Undecane	0.59
Isopropylbenzene	0.36	1-Undecene	0.59
2-Methyl-1-Butene	0.32	<i>m</i> -, <i>p</i> -Xylene	0.22
2-Methyl-2-Butene	0.32	<i>o</i> -Xylene	0.19

Concentration in ppbC = concentration in ppbv x number of carbon atoms in compound.

Because isobutene and 1-butene elute from the GC column at the same time, the SNMOC analytical method can report only the sum of concentrations for these two compounds and not concentrations of the individual compounds. For the same reason, the *m*-xylene and *p*-xylene concentrations are reported as a sum.

Table 2-6. Carbonyl Average Method Detection Limits

Compound	Method Detection Limit (ppbv)
Acetaldehyde	0.020
Acetone	0.012
Benzaldehyde	0.005
Butyr/Isobutyraldehyde	0.007
Crotonaldehyde	0.006
2,5-Dimethylbenzaldehyde	0.004
Formaldehyde	0.025
Hexaldehyde	0.003
Isovaleraldehyde	0.005
Propionaldehyde	0.007
Tolualdehydes	0.006
Valeraldehyde	0.005

Because butyraldehyde and isobutyraldehyde elute from the HPLC column at the same time, the carbonyl analytical method can report only the sum of concentrations for these two compounds and not concentrations of the individual compounds. For the same reason, the analytical method also reports only the sum of concentrations for the three tolualdehyde isomers, as opposed to reporting separate concentrations for the three individual compounds.

Table 2-7. Semivolatile Organic Compound Average Method Detection Limits

Compound	Method Detection Limit Total pg/m ³
Acenaphthene	0.09
Acenaphthylene	0.58
Anthracene	0.35
Benzo(a)anthracene	0.19
Benzo(a)pyrene	0.35
Benzo(b)fluoranthene	0.17
Benzo(e) pyrene	0.17
Benzo(g,h,i)perylene	0.14
Benzo(k)fluoranthene	0.14
Chrysene	0.10
Coronene	0.17
Dibenz(a,h)anthracene	0.15
Fluoranthene	0.16
Fluorene	0.14
Indeno(1,2,3-cd)pyrene	0.17
Naphthalene	0.10
Perylene	0.22
Phenanthrene	0.11
Pyrene	0.16

Table 2-8. Metal Compounds Average Method Detection Limits

Compound	Method Detection Limit (ng/filter)
Antimony	43
Arsenic	26
Beryllium	35
Cadmium	27
Chromium (total Chromium)	258
Cobalt	38
Lead	1,853
Manganese	244
Mercury	224
Nickel	266
Selenium	26

Table 2-9. Sampling Schedules and Completeness for Carbonyls, VOC, Metals, SNMOC, and SVOC

Site	Monitoring Sites	Sampling Period ^a		Carbonyl			VOC			Metals			SNMOC			SVOC			
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
APMI	Allen Park in Detroit, MI	10/6/04	12/29/04	14	15	93	14	14	100	—	—	—	—	—	—	—	—	—	—
AZFL	Azalea Park in St. Petersburg, FL	1/4/04	12/29/04	60	62	97	—	—	—	—	—	—	—	—	—	—	—	—	—
BOMA	Boston, MA	1/4/04	12/23/04	—	—	—	—	—	—	45	46	98	—	—	—	—	—	—	—
BTMO	Bonne Terre, MO	1/4/04	1/28/04	4	5	80	0	1	0	—	—	—	4	4	100	—	—	—	—
BTUT	Bountiful, UT	1/4/04	12/29/04	59	63	94	60	63	95	63	63	100	60	63	95	—	—	—	—
CANC	Candor, NC	1/10/04	12/23/04	24	26	92	—	—	—	—	—	—	—	—	—	—	—	—	—
CANJ	Camden, NJ	1/10/04	12/29/04	53	65	82	60	65	92	—	—	—	—	—	—	—	—	—	—
CHNJ	Chester, NJ	1/1/04	12/29/04	54	66	82	57	67	85	—	—	—	—	—	—	—	—	—	—
CUSD	Custer Park, SD	1/4/04	12/29/04	58	62	94	62	62	100	—	—	—	62	62	100	—	—	—	—
DEMI	Dearborn in Detroit, MI	1/10/04	12/29/04	47	51	92	50	52	96	—	—	—	—	—	—	—	—	—	—
DITN	Dickson, TN	1/4/04	12/29/04	18	22	82	17	21	81	—	—	—	—	—	—	—	—	—	—
EATN	Nashville, TN	1/10/04	12/23/04	12	22	55	13	22	59	28	28	100	—	—	—	—	—	—	—
ELNJ	Elizabeth, NJ	1/4/04	12/29/04	59	61	97	60	60	100	—	—	—	—	—	—	—	—	—	—

Table 2-9. Sampling Schedules and Completeness for Carbonyls, VOC, Metals, SNMOC, and SVOC (Continued)

Site	Monitoring Sites	Sampling Period ^a		Carbonyl			VOC			Metals			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
GAFL	Gandy in Tampa, FL	1/4/04	12/29/04	57	62	92	—	—	—	—	—	—	—	—	—	—	—	—
GPCO	Grand Junction, CO	1/22/04	12/29/04	57	60	95	55	60	92	—	—	—	—	—	—	—	—	—
GPMS	Gulfport, MS	1/10/04	10/12/04	23	25	92	25	25	100	—	—	—	—	—	—	—	—	—
GRMS	Grenada, MS	1/4/04	12/23/04	29	32	91	31	32	97	—	—	—	—	—	—	—	—	—
HACT	Hartford, CT	1/4/04	5/27/04	25	25	100	—	—	—	—	—	—	—	—	—	—	—	—
HOMI	Houghton Lake, MI	1/10/04	2/3/04	3	3	100	2	3	67	—	—	—	—	—	—	—	—	—
INDEM	Gary, IN	1/4/04	12/29/04	53	58	91	—	—	—	—	—	—	—	—	—	—	—	—
ITCMI	Sault Sainte Marie, MI	1/4/04	12/29/04	—	—	—	60	61	98	—	—	—	—	—	—	52	60	87
JAMS	Jackson, MS	1/10/04	10/2/04	23	25	92	25	25	100	—	—	—	—	—	—	—	—	—
KITN	Kingsport, TN	1/4/04	8/19/04	19	20	95	19	20	95	—	—	—	—	—	—	—	—	—
LDTN	Loudon, TN	1/4/04	12/29/04	31	33	94	31	33	94	—	—	—	—	—	—	—	—	—
LOTN	Nashville, TN	1/1/04	12/23/04	23	31	74	25	31	81	28	29	97	—	—	—	—	—	—
MAWI	Madison, WI	10/6/04	12/29/04	14	15	93	15	15	100	—	—	—	—	—	—	—	—	—
MCAZ	Phoenix, AZ	1/4/04	3/16/04	—	—	—	3	13	100	—	—	—	—	—	—	—	—	—

Table 2-9. Sampling Schedules and Completeness for Carbonyls, VOC, Metals, SNMOC, and SVOC (Continued)

Site	Monitoring Sites	Sampling Period ^a		Carbonyl			VOC			Metals			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
NBIL	Northbrook in Chicago, IL	1/4/04	12/29/04	—	—	—	58	61	95	—	—	—	42	43	98	—	—	—
NBNJ	New Brunswick, NJ	1/4/04	12/29/04	59	65	91	60	65	92	—	—	—	—	—	—	—	—	—
ORFL	Orlando, FL	1/4/04	12/30/04	52	53	95	—	—	—	—	—	—	—	—	—	—	—	—
PGMS	Pascagoula, MS	1/10/04	12/23/04	21	26	81	27	27	100	—	—	—	15	15	100	—	—	—
PSAZ	Supersite in Phoenix, AZ	1/4/04	3/16/04	—	—	—	12	13	92	—	—	—	—	—	—	—	—	—
QVAZ	Queen Valley in Phoenix, AZ	1/10/04	3/10/04	—	—	—	5	6	83	—	—	—	—	—	—	—	—	—
RTPNC	Research Triangle Park, NC	8/1/04	11/17/04	9	9	100	—	—	—	—	—	—	—	—	—	—	—	—
S4MO	St. Louis, MO Site #4	1/4/04	12/29/04	63	68	93	65	66	98	61	61	100	9	9	100	—	—	—
SFSD	Sioux Falls, SD	1/4/04	12/29/04	62	71	87	67	71	94	—	—	—	67	71	94	—	—	—
SKFL	Skyview in Tampa, FL	7/20/04	12/29/04	28	28	100	—	—	—	—	—	—	—	—	—	—	—	—

Table 2-9. Sampling Schedules and Completeness for Carbonyls, VOC, Metals, SNMOC, and SVOC (Continued)

Site	Monitoring Sites	Sampling Period ^a		Carbonyl			VOC			Metals			SNMOC			SVOC		
		Starting Date	Ending Date	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
SLMO	St. Louis, MO (Site #1)	1/4/04	2/3/04	5	5	100	—	—	—	—	—	—	5	5	100	—	—	—
SLND	Spirit Lake Nation, ND	1/22/04	12/29/04	—	—	—	25	29	86	—	—	—	—	—	—	23	26	88
SPAZ	South Phoenix, AZ	1/4/04	3/16/04	—	—	—	13	13	100	—	—	—	—	—	—	—	—	—
SFIL	Schiller Park in Chicago, IL	1/4/04	12/29/04	—	—	—	57	60	95	—	—	—	—	—	—	—	—	—
SYFL	Sydney in Plant City, FL	1/5/04	12/29/04	60	63	95	—	—	—	—	—	—	—	—	—	—	—	—
TUMS	Tupelo, MS	1/10/04	12/23/04	25	27	93	26	27	96	—	—	—	—	—	—	—	—	—
YFMI	Detroit, MI	10/6/04	12/29/04	—	—	—	14	14	100	—	—	—	—	—	—	9	12	75
---	Overall	---	—	1203	1326	91	1123	1197	94	225	227	99	264	272	97	84	98	86

^a Begins with 1st valid sample and includes all five types.

A = Valid Samples

B = Total Number of Samples

C = Completeness (%)

3.0 Summary of the 2004 UATMP Data

This section summarizes the data gathered during the 2004 UATMP reporting year. A total of 70 VOC and carbonyl compounds were sampled during this program reporting year. (Unlike previous years, acrolein was not reported.) Within the VOCs, three distinct groups of compounds were identified: hydrocarbons, halogenated hydrocarbons, and polar compounds. These VOC compound groups and carbonyls are discussed in greater detail in Sections 3.2 through 3.5.

A complete presentation of the data is found in Appendices C through L. Specifically:

- Appendix C: 2004 Summary Tables for VOC Monitoring;
- Appendix D: 2004 Summary Tables for SNMOC Monitoring;
- Appendix E: 2004 Summary Tables for Carbonyl Monitoring;
- Appendix F: 2004 Summary Tables for SVOC Monitoring;
- Appendix G: 2004 Summary Tables for Metals Monitoring;
- Appendix H: 2004 VOC Raw Monitoring Data;
- Appendix I: 2004 SNMOC Raw Monitoring Data;
- Appendix J: 2004 Carbonyl Raw Monitoring Data;
- Appendix K: 2004 SVOC Raw Monitoring Data; and
- Appendix L: 2004 Metal Raw Monitoring Data.

Nearly 106,045 urban air toxics VOC and carbonyl data concentrations (including duplicate and replicate samples) were collected at the 43 sites for the 2004 UATMP reporting year. Additionally, eight sites chose to sample for speciated nonmethane organic compounds (SNMOC) accounting for another 27,540 data concentrations. Semivolatile data were collected at three sites totaling 1,597 data concentrations. Metals data were collected at five sites totaling

nearly 2,926 data concentrations. These data were analyzed on a site-specific basis and results are presented in Sections 4.0 through 20.0. Although 44 stations are listed in Section 2 of this document, the Boston, MA (BOMA) site did not sample for either VOCs or carbonyls.

3.1 Data Summary Parameters

The summary tables in Appendices C through G were uploaded into a database for air quality statistical analysis. This section examines five different data summary parameters for VOCs and/or carbonyl compounds only: 1) number of sampling detects, 2) concentration range, 3) geometric means, 4) prevalence, and 5) correlation. The following paragraphs review the basic findings determined from the statistical analysis.

To better understand, the following sections, it is important to know how the concentration data were treated. First, all duplicate and replicate samples were averaged in order to calculate one concentration for each compound for each sample day at each site. Second, *m,p*-xylene and *o*-xylene concentrations were summed together and are henceforth referred to as “total xylenes” or “xylenes (total)” throughout the remainder of this report, with the exception of Table 3-1, where results are broken down into *m,p*-xylene and *o*-xylene.

3.1.1 Number of Sampling Detects

Tables 3-1 and 3-2 summarize sampling detects of the 70 VOC and carbonyl concentrations. Less than 39 percent of the pollutants sampled were above the MDL. Of those that were detected:

- 30.3 percent were hydrocarbons;
- 22.4 percent were halogenated hydrocarbons;
- 7.0 percent were polar compounds; and
- 40.4 percent were carbonyl compounds.

The percentages determined for 2004 are consistent with those determined for the 2001-2003 UATMP data. Acetaldehyde, acetone, butyr/isobutyraldehyde, and formaldehyde had the greatest number of detectable values reported in samples ($\geq 1,200$), while seven compounds had zero detects (see Tables 3-1 and 3-2).

3.1.2 Concentration Range

Nearly 85 percent of the detects had concentration values less than 1 ppbv, consistent with the trends found in the 2001-2003 data. Less than 2 percent had concentrations greater than 5 ppbv. Carbonyl compounds were observed in the highest number of samples with concentrations greater than 5 ppbv (247); halogenated hydrocarbons were observed the least (8). At least one compound sampled had a concentration greater than 5 ppbv on 72 of 107 total sampling days. Twenty-five of the 70 compounds monitored never exceeded 1 ppbv.

The range of detectable values for each site is listed in Table 3-3. The CUSD, DEMI, GPCO, GPMS, GRMS, INDEM, NBIL, NBNJ, and SLND sites had maximum concentration values over 100 ppbv, which is unusually high when compared to the other sites. S4MO had the greatest number of detects (1,776), as it did in 2003, while INDEM had the greatest number of samples with concentrations greater than 5 ppbv (53).

3.1.3 Geometric Means

The geometric mean is the central tendency of lognormally distributed data, and can be calculated by taking the “nth” root of the product of the “n” concentrations. The geometric mean is a useful parameter for calculating a central tendency of a concentration data set, whose arithmetic mean may be skewed by an unusually high or low concentration value. Geometric means for each site for the four different pollutant groups are presented in Table 3-4. The HOMI site had the highest geometric mean for total polar compounds (50.37 ppbv), while the SPAZ site had the highest geometric mean for total hydrocarbons (13.84 ppbv). The highest total halogenated hydrocarbon geometric mean was at APMI (5.79 ppbv). These three sites had the

highest geometric means for each respective VOC compound type in 2003 as well. The INDEM site has the highest total carbonyl geometric mean (27.38 ppbv).

3.1.4 Prevalence

In previous UATMPs, *prevalence* referred to the frequency with which an air pollutant was found at levels detectable by the corresponding sampling and analytical method. Beginning with the 2003 UATMP, prevalence refers only to compounds that are identified by EPA as cancer or noncancer compounds. Cancer compounds, when inhaled for chronic periods of time, contribute to the formation of cancer; noncancer compounds contribute to other illnesses, such as asthma. It is possible for a compound to be both a cancer and noncancer compound.

UATMP concentrations are normalized based on the toxicity factor of the compound. Accordingly, multiple compounds can be compared based on their toxicity factors on a common level. Unit Risk Exposure (URE) factors are used for the cancer normalization. Reference concentrations (RfC) are used for noncancer normalizations. However, less than half of all the measured UATMP compounds have either a URE or RfC factor. Because of this, some compounds that have high measured concentrations (e.g., acetylene) are not considered prevalent. Of the 261 total UATMP compounds, less than 100 compounds have either a URE for cancer or RfC for noncancer (Tables 3-5a and 3-5b). Only the VOC and carbonyl compounds (which are measured at 43 of the 44 total sites) will be used to determine nationwide prevalence.

Each UATMP site is ranked for the level of toxicity of compounds measured. Inter- and intra-site comparisons of the toxic compounds can now be performed because of the normalization, and provide useful insight in and among the urban and rural areas. Site-specific prevalence (presented in each state section) includes each compound type (VOC, metals, etc.) sampled by each site, not just VOC and carbonyl compounds as used for nationwide prevalence. For sites that measured both VOC and SNMOC, only VOC factors into site-specific prevalence.

Because the UATMP does not characterize every component of air pollution, many compounds known to be prevalent in urban air (e.g., ozone and nitrous oxides) are not considered in this report. Readers should be careful to distinguish between the most prevalent compounds program-wide identified by the 2004 UATMP with the most prevalent compounds in urban air pollution.

For the 2004 UATMP, a compound is considered prevalent if its average cancer and/or noncancer toxicity across the network of sites contributed to the top 95 percent of the total toxicity weighting for the network. Of the 18 VOC and carbonyl compounds with URE factors, the top 12 contributed to 95 percent of the total cancer toxicity weight. Of the 33 VOC and carbonyl compounds with RfC factors, the top 11 pollutants contributed to 95 percent of the total noncancer toxicity weight. Tables 3-5a-b summarize the toxicity analysis. Cancer risk per million people is also described in Table 3-5a, while the number of adverse health effect concentrations that were higher than its noncancer RfC is listed in Table 3-5b. Specific discussion of the cancer and noncancer risks are in the individual state sections.

For the 2004 UATMP, the program-wide prevalent compounds, organized by compound group (as discussed further in Section 3.2) are as follows:

- **HYDROCARBONS**
 - 1,3-Butadiene
 - Benzene
 - Xylenes (total)

- **HALOGENATED HYDROCARBONS**
 - 1,2-Dichloroethane
 - 1,2-Dichloropropane
 - Bromomethane
 - Carbon Tetrachloride
 - Chloroprene
 - *cis*-1,3 - Dichloropropene
 - *p*-Dichlorobenzene

- Tetrachloroethylene
- Vinyl Chloride

- **POLAR COMPOUNDS**

- Acrylonitrile
- Acetonitrile
- Ethyl Acrylate

- **CARBONYL COMPOUNDS**

- Acetaldehyde
- Formaldehyde

Of the prevalent compounds, six have both cancer and noncancer weightings:

- 1,2-dichloropropene;
- 1,3-butadiene;
- Acetaldehyde;
- Acrylonitrile;
- Benzene;
- *cis*-1,3-dichloropropene; and
- Tetrachloroethylene.

The other cancer compounds are:

- 1,2-dichloroethane;
- Ethyl acrylate;
- Carbon tetrachloride;
- *p*-dichlorobenzene; and
- Vinyl chloride.

The remaining noncancer compounds are:

- Acetonitrile;

- Formaldehyde;
- Bromomethane;
- Chloroprene; and
- Xylenes (total).

Readers interested in closer examination of data trends for the less program-wide prevalent compounds should refer to the summary tables in Appendices C through G, and the raw monitoring data in Appendices H through L. However, readers should note the limitations posed by data sets with many nondetect observations.

3.1.5 Pearson Correlations

This report uses Pearson correlation coefficients to measure the degree of correlation between two variables. By definition, Pearson correlation coefficients always lie between -1 and +1. Three qualification statements may be made:

- A correlation coefficient of -1 indicates a perfectly “negative” relationship, indicating that increases in the magnitude of one variable are associated with proportionate decreases in the magnitude of the other variable, and vice versa;
- A correlation coefficient of +1 indicates a perfectly “positive” relationship, indicating that the magnitudes of two variables both increase and both decrease proportionately.
- Data that are completely uncorrelated have Pearson correlation coefficients of 0.

Therefore, the sign (positive or negative) and magnitude of the Pearson correlation coefficient indicate the direction and strength, respectively, of data correlations. Generally, correlations greater than 0.75 or less than -0.75 are classified as very strong; correlation between 0.50 and 0.75 and -0.50 and -0.75 are classified as strong; and correlations between 0.25 and 0.50 and -0.25 and -0.50 are classified as moderately strong. Correlations between -0.25 and 0.25 are classified as weak.

When calculating correlations among the UATMP data, several measures were taken to identify spurious correlations and to avoid introducing bias to the correlations:

- The statistical significance of the Pearson correlation coefficients was evaluated using a standard t-test—a test commonly used for this purpose (Harnett, 1982). In this report, Pearson correlation coefficients were tested for statistical significance using the 5 percent level of significance. Whenever possible, a 95 percent confidence interval was calculated around the estimated correlation coefficient. If zero did not fall within the interval, the coefficient was considered statistically significantly different from 0.
- Data correlations were calculated only for the most program-wide prevalent compounds listed in this report. Because the UATMP monitoring data are least precise for compounds having many nondetect observations (see Section 21), eliminating the less program-wide prevalent compounds improves the correlation analysis.
- Correlations were calculated from the processed UATMP monitoring database in which each compound has just one numerical concentration for each successful sampling date.

Pearson correlation computations can be found in Section 3.3.

3.2 UATMP Compound Groups

The 70 UATMP compounds listed in Section 2 are grouped into four compound groups: hydrocarbons; halogenated hydrocarbons; polar compounds; and carbonyls. Each member of the compound groups shares similar chemical makeup, as well as exhibits similar tendencies.

3.2.1 Hydrocarbons

Hydrocarbons are organic compounds that contain only carbon and hydrogen. Hydrocarbons are derived mostly from crude petroleum sources and are classified according to the arrangement of the atoms, as alicyclic, aliphatic, and aromatic. Hydrocarbons are of prime economic importance because they encompass the constituents of the major fossil fuels, petroleum and natural gas, as well as plastics, waxes, and oils. In urban air pollution, these

components—along with oxides of nitrogen (NO_x) and sunlight—contribute to the formation of tropospheric ozone.

As stated above, hydrocarbons in the atmosphere originate from natural sources and from various anthropogenic sources, such as combustion of fuel and biomass, petroleum refining, petrochemical manufacturing, solvent use, and gas and oil production and use. Studies have shown that emissions from different anthropogenic sources vary significantly from location to location. For example, on a nationwide basis, EPA estimates that 50 percent of anthropogenic nonmethane volatile organic compound releases in 1996 came from industrial processes, 42 percent from transportation, 6 percent from fuel combustion, and the rest from other sources (USEPA, 1997). In urban areas, however, the estimated contributions of different source categories differ from these national averages. For instance, a 1987 study in the Los Angeles area estimated that 49 percent of nonmethane hydrocarbon emissions come from vehicle exhaust, 11 percent from liquid gasoline, 10 percent from gasoline vapor, and 30 percent from sources other than motor vehicles (Fujita et al., 1994). These figures suggest that motor vehicles may play a greater role in hydrocarbon emissions in urban areas than national statistics indicate.

3.2.2 Halogenated Hydrocarbons

Halogenated hydrocarbons are organic compounds that contain carbon, hydrogen, and halogens—the chemical group that includes chlorine, bromine, and fluorine. Most halogenated hydrocarbons are used for industrial purposes and as solvents, though some are produced naturally (Godish, 1997). Once emitted to the air, many volatile halogenated hydrocarbons resist photochemical breakdown and therefore persist in the atmosphere for relatively long periods of time (Godish, 1997; Ramamoorthy and Ramamoorthy, 1997). These compounds can cause chronic health effects as well as contribute to the formation of tropospheric ozone. Similar to hydrocarbons, only the halogenated hydrocarbons with lower molecular weights are volatile, and the sampling and analytical methods used in the 2004 UATMP measure a subset of 37 of these volatile compounds.

3.2.3 Polar Compounds

Polar compounds (i.e., oxygenated compounds such as methyl *tert*-butyl ether, methyl ethyl ketone, etc.) were added to the UATMP analyte list that already included the volatile halogenated hydrocarbons and selected hydrocarbons because of the nationwide use of these types of compounds as gasoline additives and their toxicity. Because of the presence of compounds characteristic of motor vehicle emissions, any compounds used as gasoline additives would be expected to be correspondingly prevalent. Other polar compounds such as acetonitrile were added to the analyte list because the compounds were observed at high concentrations at one or more monitoring sites.

3.2.4 Carbonyl Compounds

Carbonyl compounds are organic compounds characterized by their composition of carbon, hydrogen, and oxygen, and by the presence of at least one carbon-oxygen double bond. Several different factors are known to affect ambient air concentrations of carbonyl compounds, most notably:

- Combustion sources, motor vehicles, and various industrial processes that emit carbonyl compounds directly to the atmosphere;
- Photochemical reactions that *form* carbonyl compounds in the air, typically from airborne hydrocarbons; and
- Photochemical reactions that *consume* carbonyl compounds from the air, generally by photolysis or by reaction with hydroxyl radicals (Seinfeld, 1986).

3.3 Correlations with Selected Meteorological Parameters

Ambient air concentration tendencies often correlate favorably with ambient meteorological observations. The following three sections summarize how each of the prevalent compound concentrations correlated with eight meteorological parameters: maximum daily temperature; average daily temperature; average daily dew point temperature; average daily wet bulb temperature; average daily relative humidity; average daily sea level pressure; and average

wind information. Additionally, composite back trajectory maps were prepared to identify where air flow originated 24 hours prior to being sampled.

3.3.1 Maximum and Average Temperature

Temperature is often a component of high ambient air concentrations for some compounds, such as ozone. Temperature helps speed up the kinetics as compounds react with each other. According to Table 3-6, the program-wide prevalent compounds had mostly weak correlations with maximum temperature and average temperature. Acrylonitrile had the strongest correlation with maximum temperature (-0.16), while acrylonitrile, 1,3-butadiene and bromomethane shared the strongest correlation with average temperature (-0.13, -0.13, and 0.13, respectively). It should be noted that, although the correlations shown in Table 3-6 are low, they are mostly positive, which indicates that an increase in temperature is associated with a proportionate increase in concentrations.

The poor correlation across the majority of the sites is not surprising due to the complex and diverse local meteorology associated with the monitoring sites. For this report, 44 sites are spread across 17 states. As discussed in Sections 4 through 20, the temperature parameters correlate much better at certain individual sites.

3.3.2 Moisture

Three moisture parameters were used in this study for correlation with the prevalent compounds. The *dew point temperature* is the temperature to which moist air must be cooled to reach saturation with respect to water. The *wet-bulb temperature* is the temperature to which moist air must be cooled by evaporating water into it at constant pressure until saturation is reached. The *relative humidity* is the ratio of the mixing ratio to its saturation value at the same temperature and pressure (Rogers and Yau, 1989). All three of these parameters provide an indication of how much moisture is presently in the air. Higher dew point and wet bulb temperatures indicate increasing amounts of moisture in the air, while relative humidity is expressed as a percentage with 100 percent indicating saturation.

As illustrated in Table 3-6, the three moisture parameters had mostly weak correlations with the prevalent compounds. The strongest correlation was between the relative humidity and the p-dichlorobenzene concentration (-0.30). The sites used for sampling in the 2004 program year were located in different climatic zones ranging from a desert climate (Arizona) to a very moist climate (Florida). Bromomethane concentrations had the strongest correlations with wet bulb and dew point temperatures (0.22 with wet bulb temperature and 0.24 with dew point temperature, respectively). As discussed in Sections 4 through 20, the moisture parameters correlate much better at certain individual sites.

3.3.3 Wind and Pressure Information

Surface wind observations include two primary components: wind speed and wind direction. *Wind speed*, by itself, is a scalar value and is usually measured in nautical miles or knots. *Wind direction* describes where the wind is coming from, and is measured in degrees where 0° is from the north, 90° is from the east, 180° is from the south, and 270° is from the west. Together, the wind speed and wind direction are described as a vector, and the hourly values can now be averaged.

The *u*-component of the wind is the vector value traveling toward the x-axis in a Cartesian grid coordinate system. The *u*-component is calculated as follows:

$$u\text{-component} = -1 * (\text{wind speed}) * \sin(\text{wind direction, degrees})$$

Similarly, the *v*-component of the wind is the vector value traveling toward the y-axis in a Cartesian grid coordinate system. The *v*-component is calculated as follows:

$$v\text{-component} = -1 * (\text{wind speed}) * \cos(\text{wind direction, degrees})$$

Using the *u*- and *v*-components of the wind allows averaging and correlation analyses with the measured concentrations.

As shown in Table 3-6, the u - and v -components of the wind have very weak correlations with the prevalent compounds across all sites, which is consistent with the temperature and moisture parameter observations. Geographical features such as mountains or valleys influence wind speed and wind direction. The sites used for sampling in the 2004 program year are located in different geographic zones ranging from a mountainous region (Colorado) to a plains region (South Dakota). Additionally, sites located downwind may correlate better with the measured concentrations than sites upwind. Acrylonitrile concentrations had the strongest correlation with the u -component of the wind speed (-0.19), while bromomethane had the strongest correlation with the v -component of the wind speed (-0.14). As discussed in Sections 4.0 through 20.0, the u - and v -components correlate much better at certain individual sites.

Wind is created through changes in pressure. The magnitude of the pressure difference (or pressure gradient) over an area is directly proportional to the magnitude of the wind speed. The direction of the wind flow is governed by the direction of the pressure gradient. Sea level pressure is the local station pressure corrected for elevation, in effect bringing all geographic locations down to sea-level, thus making different topographical areas comparable.

Overall, sea level pressure correlated weakly with ambient concentration. The strongest positive correlation occurred with 1,3-butadiene (0.19), while the strongest negative correlation occurred with *p*-dichlorobenzene (-0.12).

3.3.4 Back Trajectory Analysis

A back trajectory analysis traces the origin of an air parcel in relation to the location where it is currently being measured. The method of constructing a back trajectory uses the Lagrangian frame of reference. In simplest terms, an air parcel can be traced back one hour to a new point of reference based on the current measured wind speed and direction. At this new point of reference that is now one hour prior to the current observation, the wind speed and direction are used again to determine where the air was one hour before. Each time segment is referred to as a “time step.” Typical back trajectories go 24 to 48 hours prior using surface and

upper air meteorological observations, which was used for this report. Back trajectory calculations are also governed by other meteorological parameters, such as pressure and temperature.

Gridded meteorological data and the model used for back trajectory analyses were prepared and developed by the National Oceanic and Atmospheric Administration (NOAA). The model used is the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT). More information on the model can be found at <http://www.arl.noaa.gov/ready/hysplit4.html>. The meteorological data represented the 2004 sampling year. Back trajectories were computed 24 hours prior to the sampling day, and composite back trajectory maps were constructed for sampling days using GIS software. The value of the composite back trajectory maps is the determination of an airshed domain for air originating 24 hours prior to a sampling day. Agencies can use the airshed domain to evaluate regions where long-range transport may affect their monitoring site. The individual state sections discuss these results in full detail.

3.4 The Impact of Motor Vehicle Emissions on Spatial Variations

Motor vehicles contribute significantly to air pollution in urban environments. Pollutants found in motor vehicle exhaust generally result from incomplete combustion of vehicle fuels. Although modern vehicles and, more recently, vehicle fuels have been engineered to minimize air emissions, all motor vehicles with internal combustion engines emit a wide range of chemical pollutants. The magnitude of these emissions in urban areas primarily depends on the volume of traffic, while the chemical profile of these emissions depends more on vehicle design and fuel content. This report uses five parameters to evaluate the impact of motor vehicle emissions on ambient air quality:

- Estimated motor vehicle ownership data;
- BTEX concentration profiles;
- Estimated daily traffic estimates;

- Mobile source tracer analysis; and
- Reformulated gasoline (RFG) analysis.

3.4.1 Motor Vehicle Ownership Data

As an indicator of motor vehicle emissions near the UATMP monitoring sites, Table 3-7 presents estimates of the number of cars owned by residents in the county in which the monitor is located. Car registration data are available at the state-level (EIA, 2004). Where possible, actual county-level registration was obtained from the state or local agency. If data were not available, then the county proportion of the state population was applied to the state registration count. For each UATMP county, a car registration to population ratio was developed. Each ratio was then applied to the 10-mile populations surrounding the monitors (from Table 2-3). These estimated values are discussed in the individual state sections.

For purposes of comparison, both motor vehicle ownership data and the arithmetic mean of total program-wide prevalent hydrocarbons are presented in Table 3-7 and Figure 3-1. The data in the table and figure indicate a positive linear correlation between motor vehicle ownership and ambient air concentrations of hydrocarbons. A Pearson correlation calculation from this data yields a very strong positive correlation (0.82), where greater than 0.75 is considered very strong. However, readers should keep in mind other factors that might impact the reliability of motor vehicle ownership data as an indicator of ambient air monitoring data results:

- Estimates of higher car ownership surrounding a monitoring site do not necessarily imply increased motor vehicle use in the immediate vicinity of a monitoring site. Conversely, sparsely populated regions often contain heavily traveled roadways.
- Emissions sources in the area other than motor vehicles may significantly affect levels of hydrocarbons in the ambient air.

3.4.2 BTEX Concentration Profiles

The *magnitude* of emissions from motor vehicles generally depends on the volume of traffic in urban areas, but the *composition* of these emissions depends more on vehicle design. Because the distribution of vehicle designs (i.e., the relative number of motor vehicles of different styles) is probably quite similar from one urban area to the next, the composition of air pollution resulting from motor vehicle emissions is not expected to exhibit significant spatial variations. In support of this hypothesis, previous air monitoring studies have observed relatively constant composition of ambient air samples collected along heavily traveled urban roadways (Conner et al., 1995). Roadside studies have found particularly consistent proportions of four hydrocarbons (benzene, toluene, ethylbenzene, and the xylene isomers - the “BTEX” compounds) both in motor vehicle exhaust and in ambient air near roadways.

To examine the impact of motor vehicle emissions on air quality at the 2004 UATMP monitoring sites, Figure 3-2 compares concentration ratios for the BTEX compounds measured during the 2004 UATMP to the ratios reported in a roadside study (Conner et al., 1995). This comparison provides a qualitative depiction of how greatly motor vehicle emissions affect air quality at the UATMP monitoring sites: the more similar the concentration ratios at a particular monitoring site are to those of the roadside study, the more likely that motor vehicle emissions impact ambient levels of hydrocarbons at that location.

As Figure 3-2 shows, the concentration ratios for BTEX compounds measured at nearly every UATMP monitoring site bear some resemblance to the ratios reported in the roadside study. The BTEX ratios at the ELNJ monitoring site appear to be the most similar to the roadside study profile. For all monitoring sites, the toluene:ethylbenzene ratio is clearly the largest value of the four ratios, with the exceptions of ITCMI, NBIL, and YFMI. The benzene:ethylbenzene ratio is clearly the smallest value of the ratios, with the exceptions of CUSD, DITN, ITCMI, LDTN, MAWI, NBIL, QVAZ, SFSD, and YFMI. These observations suggest, though certainly do not prove, that emissions from motor vehicles significantly affect levels of hydrocarbons in urban ambient air.

3.4.3 Estimated Traffic Data

When a site is being characterized, a parameter often recorded is the number of vehicles that pass the monitoring site on a daily basis. Traffic data were obtained from the site information provided on EPA's Air Quality Subsystem (AQS) database, or by contacting state and local agencies. Table 3-7 contains the estimated daily traffic values, as well as county-level on-road and non-road HAP (hazardous air pollutant) emissions.

The highest traffic volume occurred at the SPIL and ELNJ sites, with over 214,900 and 170,000 vehicles passing by this monitoring site, respectively. SPIL is located near Interstate 294 near the Chicago-O'Hare International Airport, and ELNJ is located near exit 13 on Interstate 95. The average hydrocarbon (total) value at ELNJ was 8.18 ppbv, which is ranked 6th among sites that measured hydrocarbons. SPAZ, NBIL, PSAZ, MCAZ, and YFMI each had average hydrocarbon concentrations greater than ELNJ, yet their traffic counts are ranked 10th, 15th, 42th, 27th, and 40th, respectively. At SPIL, the average hydrocarbon (total) value was only 4.96 ppbv, which ranked 15th. Specific characterizations for these sites appear in the separate state sections. Estimated on-road county emissions were highest in Maricopa County, AZ, which is the location of three UATMP sites (MCAZ, PSAZ, and SPAZ). The hydrocarbon averages in Maricopa County, AZ were similar to one another (14.71 ppbv at SPAZ; 11.46 ppbv at PSAZ; and 10.15 ppbv at MCAZ) and were or near the highest of the hydrocarbon concentrations. Estimated non-road county emissions were also highest in Maricopa County, AZ. Non-road emission sources include, but are not limited to, activities from airplanes, construction vehicles, and lawn and garden equipment. As shown in Figure 3-3, there does not appear to be a direct correlation between traffic counts and average hydrocarbon concentrations. Please refer to Table 3-4 and Figure 3-3 for a more detailed look at mobile emissions and average hydrocarbon concentrations. The calculated Pearson correlation was only 0.15, indicating a weak relationship.

3.4.4 Mobile Source Tracer Analysis

Research has shown that acetylene can be used as a signature compound for automotive emissions (Warneck, 1988; NRC, 1991), as this VOC is not typically emitted from biogenic or

stationary sources. As summarized in Table 3-7, many UATMP sites are located in high traffic areas (e.g., ELNJ and SPIL). Average site acetylene concentrations are also summarized in Table 3-7. As shown in Figure 3-4, there does not appear to be a direct correlation with daily traffic and acetylene concentrations. The calculated Pearson correlation was only 0.07 indicating a weak relationship.

Nearly all of ethylene emissions are due to automotive sources, with the exception of activities related to natural gas production and transmission. Ethylene is not detected as a VOC by the TO-15 sampling method, but is detected using the SNMOC method. For sites that chose the SNMOC option, ethylene to acetylene concentration ratios were computed and compared to a ratio developed in numerous tunnel studies. An ethylene to acetylene ratio of 1.7 to 1 is indicative of mobile sources (TNRCC, 2002). Of the sites that sampled SNMOC, NBIL's ethylene to acetylene ratio was the closest to the expected 1.7 to 1 ratio (1.51 to 1). These results are discussed further in the individual state sections.

3.4.5 Reformulated Gasoline (RFG) Analysis

For some areas of the country that exceed the national air quality standard for ozone, the Clean Air Act (CAA) requires use of gasoline that has been "reformulated" to achieve reductions in ozone-forming compounds and toxic air pollutants be made commercially available. For gasoline to be considered reformulated, it must have an oxygen content of at least 2.0 percent by weight, a benzene content no greater than 1.0 percent by volume, and no heavy metals (US EPA, 1994). Typical additives are methyl *tert*-butyl ether (MTBE), ethanol, *tert*-amyl methyl ether (TAME), and ethyl *tert*-butyl ether (ETBE). MTBE, TAME, and ETBE are compounds sampled for the UATMP. The use of reformulated gasoline (RFG) has been implemented in two phases. Phase I began in January 1, 1995, and Phase II began in 2000. Emissions of VOC and air toxics from vehicles using Phase I RFG are projected to be 15 percent less than those that would occur from the use of conventional gasoline. For vehicles using Phase II RFG, VOC and air toxics are reduced by an additional 20 to 25 percent (US EPA, 1999c).

Table 3-8 summarizes RFG programs pertaining to the UATMP sites. In reviewing the VOC data for these sites, the purpose of this analysis was to determine: 1) if VOC concentrations decreased during the RFG season; 2) if the BTEX compound concentrations decreased during the RFG season; and 3) if there is a trend in the RFG additive concentrations.

The VOCs sampled for this study were broken into four groups: 1) mobile source BTEX compounds; 2) mobile source non-BTEX HAP compounds; 3) stationary source HAP compounds; and 4) non-HAP VOCs. The sum of these four groups equals the total VOC concentration. According to the national emissions inventory (NEI) for mobile sources (US EPA 2003a), the following VOC HAPs may be emitted from mobile source (onroad and nonroad):

- 1,3-Butadiene;
- 2,2,4-Trimethylpentane;
- *tert*-Amyl Methyl Ether;
- Benzene;
- Ethylbenzene;
- Methyl *tert*-Butyl Ether;
- Styrene;
- Toluene; and
- Xylenes (total)

If a VOC sample contained any of the above HAPs, then it was divided into the BTEX group or non-BTEX group. The VOC HAPs not listed above, such as vinyl chloride, were grouped as stationary source HAPs. Finally, any VOC not a HAP (e.g., acetylene) was grouped together. It is important to note that a mobile source HAP may also be emitted from a stationary source.

If a site was in an MSA that participated in an RFG program, and if VOCs were sampled, then the results are discussed in the individual state sections. HACT, BOMA, and SLMO were all in RFG areas, but did not measure VOCs.

3.5 Variability Analysis

Two types of variability are analyzed for this report. The first type examines the coefficient of variation analysis for each of the nationwide prevalent compounds across the UATMP sites. Figures 3-5 to 3-15 are graphical displays of site standard deviation versus average concentration. This analysis is best suited for comparing variability across data distributions for different sites and compounds. Most of the prevalent compounds are either in a cluster (such as acrylonitrile), exhibit a positive linear correlation (such as 1,3-butadiene), or are spread randomly (such as *p*-dichlorobenzene). The coefficient of variation provides a relative measure of variability by expressing variations to the magnitude of the arithmetic mean.

Seasonal variability is the second type of variability analyzed in this report. The UATMP concentration data were divided into the four seasons:

- Spring (March, April, May);
- Summer (June, July, August);
- Autumn (September, October, November); and
- Winter (December, January, and February).

Figures 3-16 to 3-26 provide a graphic display of the average concentrations by season for the prevalent compounds.

Higher concentrations of the prevalent compounds tended to be sampled in autumn and winter, although high concentrations were also sampled in other seasons. Spring is when the lowest concentrations were measured. Other compound-specific trends were also noted, such as

high concentration of: 1) benzene were sampled in winter; 2) formaldehyde in summer; and 3) carbon tetrachloride in autumn. However, a quick review of the profiles reveals most compounds experienced noticeable concentration evaluations or “spikes” across the sites.

3.6 UATMP NATTS Sites

Additional analyses were conducted on the EPA-designated National Air Toxics Trends System (NATTS) sites (NATTS sites are designated in bold in Table 2-2). These monitoring sites can be used to evaluate air quality, similar to the National Ambient Air Quality Standards (NAAQS) monitors that measure criteria pollutants. The two additional analyses are: federal regulation analysis and emission tracer analysis.

3.6.1 Federal Regulation Analysis

As stated earlier, urban air toxics are emitted from a variety of stationary industrial and commercial processes and mobile sources. Many of these emission sources in the areas surrounding the monitoring sites are already subject to emission limitations. Consequently, the ambient concentrations of UATMP compounds recorded at the monitoring sites reflect, to some degree, the emission limitations required by facilities and mobile sources in response to existing air regulations. As additional regulations are implemented, the concentrations of urban air toxics compounds in the ambient air surrounding the monitoring sites should decrease as facilities and mobile sources achieve compliance with the new regulations.

3.6.1.1 Regulations for Stationary Sources

The national regulations that have the potential to reduce emissions of UATMP pollutants from stationary sources are standards for air toxics developed under section 112(d) of the CAA (Hazardous Air Pollutants, Emission Standards). VOC rules under section 183 are no longer included in the UATMP reports because they apply to products and coatings manufactured after 1999, and have been fully implemented.

As required by section 112 of the CAA, EPA published a list of industrial source categories that emit one or more of the 188 air toxics (see Section 112(b) of the CAA). (The initial list was published on July 16, 1992 and has undergone several revisions since that date.) The EPA has developed (or is in the process of developing) National Emission Standards for Hazardous Air Pollutants (NESHAP) for all major sources (those that emit 10 tons/year or more of a listed pollutant or 25 tons/year or more of a combination of listed pollutants) of air toxics and some area sources that are of particular concern. Please refer to Section 3.6.1.3 for further details.

3.6.1.2 Regulations for Mobile Sources

For mobile sources, two sets of regulations have the potential to reduce ambient concentrations of UATMP pollutants: federal and California motor vehicle emissions standards (Tier I and II, CA LEV and LEV II, and NLEV) and Phase II Reformulated Gasoline, which is discussed in Section 3.4.4 of this report.

Sections 202(g) and 202(h) of the 1990 CAA directs EPA to establish motor vehicle emission standards, and section 202(i) directs EPA to determine if further regulations are warranted. The federally mandated tailpipe emission standards, or Tier I standards, were phased in between 1994 and model year 1997. The State of California developed its own, more stringent standards (CA LEV) in 1990 that were phased in through model year 2003 (DieselNet, 2005).

As a segway between CA LEV and Tier I standards and prior to implementation of the Tier II standards (see below), the National Low Emissions Vehicles (NLEV) program was developed. The NLEV program is a voluntary nationwide program designed to reduce nonmethane organic compound (NMOC) emissions and NO_x emissions from new cars. The NLEV program is expected to reduce emissions of air toxics such as benzene, formaldehyde, acetaldehyde, and 1,3-butadiene. The program started in the Northeastern states that are part of the Ozone Transport Commission (OTC) in model year 1999 and nationally in 2001. Once adopted, the standards are enforceable in the same manner that other federal motor vehicle

emissions control requirements are enforceable. Under section 177 of the CAA amendments, all states were required to choose and implement either NLEV or CA LEV standards. New York, Massachusetts, Vermont, and Maine opted to adopt California's standards (US EPA, 2003c).

Under the NLEV program, car manufacturers voluntarily agreed to meet tailpipe standards for cars and light-duty trucks that are more stringent than EPA can mandate prior to model year 2004. The EPA projects that vehicles produced under the NLEV program will be approximately 70 percent cleaner than 1998 model year cars. These cleaner vehicles will achieve reductions of approximately 311 tons of VOC per day in 2007 (based on a program start date of model year 1999 in the Northeast and model year 2001 nationwide).

In 1998, California adopted LEV II standards, which are even more stringent than the original standards, to be phased between 2004 and 2007. Federal Tier II standards were adopted in 1999 and are to be phased in between 2004 and 2010. Both of these standards will apply to all vehicle weight classes (under 8500 lbs), including SUVs, and diesel-powered vehicles (DieselNet, 2005).

3.6.1.3 Future Regulation Analysis

To assess the potential reduction in ambient concentrations of UATMP compounds attributable to future regulations, an analysis of the facilities, emissions, and potentially applicable regulations was conducted for the areas surrounding each of the NATTS sites, as identified in Table 2-2. For this analysis, facilities located within 10 miles of each monitoring site were identified using GIS (Geographic Information System) software and the 2002 NEI (National Emissions Inventory). Emission records for UATMP compounds and their associated Maximum Available Control Technology (MACT) ID codes at these facilities were then retrieved from the NEI. However, these records were limited to what the site actually sampled. For example, BOMA sampled only for metals, and only the UATMP metal compound emission records and the associated MACT ID codes were retrieved.

These MACT codes correlate directly to a specific NESHAP regulations. Only MACT codes corresponding to NESHAPs implemented after 2002 or later were considered in this analysis. It is assumed that NESHAPs implemented prior to 2003 will be reflected in the 2002 emission estimates from the NEI. Regulations with earlier compliance dates would already be in place and no future emission reduction would be achieved. For this analysis, New Source Performance Standards (NSPS) were not included since projections of new source construction are not available for the target areas. Additionally, since data on traffic patterns around the monitoring sites are not available, projections of the emission trends associated with the mobile source regulations were also not included in this analysis. These air regulations were reviewed to determine the types of sources and pollutants they applied to, percent reduction expected, and date compliance is required. Information about these regulations is provided in Table 3-9.

Anticipated reduction percentages were then applied to the applicable pollutant emissions at each facility. For example, if a regulation covered emissions of toluene and xylene and the rule was projected to achieve an average emission reduction of 60 percent, then the toluene and xylene emissions from facilities potentially subject to that rule were reduced by 60 percent. The pollutant emissions reduction at each facility were then summed to the pollutant level, and then summed by pollutant-type (VOC, metals, etc). The pollutant-type emission reductions were finally summed to the NATTS site level. The regulations applicable to each NATTS site and the anticipated reductions are listed in Table 3-10. Further discussion is in each applicable state section.

3.6.2 Emission Tracer Analysis

In this analysis, pollution roses for each of the prevalent compounds were created to help identify the geographical area where the emission sources of these compounds may have originated. A pollution rose is a plot of the ambient concentration versus the unit vector of the wind direction; high concentrations are shown in relation to the direction of potential emissions source. This analysis only reviewed NATTS sites in which a pollutant exceeded the Noncancer

Benchmark. Additionally, the RfC Noncancer Benchmark value is plotted to reflect the noncancer exceedance concentrations. Results are discussed in the individual state sections.

3.7 Analysis of Additional Compound Types

Table 3-11 summarizes the average metal compounds, SVOC, and SNMOC concentrations that were sampled during the 2004 UATMP. Five sites opted to sample for metals, three for SVOC, and eight for SNMOC. S4MO (38.47 ng/m³) measured the highest metal concentrations of the five sites. Of the two Nashville sites, EATN measured a higher average metal compounds concentration than LOTN. YFMI (52.83 ng/m³) measured the highest SVOC concentrations of the three sites. NBIL (161.92 ppbC) measured the highest SNMOC concentrations of the eight sites. Of the two St. Louis sites, S4MO measured a higher average SNMOC concentration than SLMO (although SLMO sampled for a small portion of the year).

3.8 Site Trends Analysis

Table 2-1 represents past UATMP participation for sites also participating in this year's program. For sites that participated prior to 2003 and are still participants through the 2004 program year, a trends analysis was conducted. The trends analyzed are annual averages and seasonal averages at each site for three compounds: 1,3-butadiene, benzene, and formaldehyde.

3.8.1 Site Trends in Annual Averages

Figures 3-27 through 3-50 compare the yearly average concentrations of 1,3-butadiene, benzene, and formaldehyde for each of the twenty-four sites. At sites where all three compounds were sampled, formaldehyde measured the highest average annual concentration at almost all sites, while 1,3-butadiene, with few exceptions, consistently measured the lowest.

Of the 20 sites that consistently sampled for carbonyls, SLMO measured the highest average annual formaldehyde concentrations, with 2001 and 2002 having the highest average concentration. Formaldehyde concentrations were highest in 2004 for seven of the 20 sites. For

CANJ, the site with the most years of participation, the highest average annual formaldehyde concentration was sampled in 2004.

Average annual concentrations of 1,3-butadiene were highest at SFSD in 2002 and PGMS in 2001 (> 1.00 ppbv). These sites had average annual concentrations nearly five times higher than of the other sites. It is important to note that samples of this compound were consistently below the method detection limit (MDL), resulting in low average concentrations for this compound. CANJ sampled its highest average 1,3-butadiene concentration in 1998.

Average annual concentrations of benzene were highest at YFMI, with averages greater than 6.00 ppbv in both 2001 and 2002. Both PSAZ and SPAZ measured annual benzene concentrations greater than 1.00 ppbv during some years. However, at most sites, the average annual benzene concentration was less than 0.50 ppbv. CANJ sampled its highest average benzene concentration in 1996.

3.9 UATMP Historical MSA Trends Analysis

A new analysis added to the 2004 UATMP report is the evaluation of historical concentrations and emissions for MSAs of sites participating in 2004. Since the passage of the 1990 CAA (USEPA, 2005b), EPA has spent considerable time and resources in establishing and enabling federal regulations to reduce emissions for HAPs. The goal of this analysis is to review HAP ambient monitoring and emissions from the last 14 years (1990-2003, if available) across UATMP MSAs with the purpose of characterizing HAP trends at each of these MSAs. This analysis considers the HAP concentration trends at each 2004 participating MSA, the HAP emission trends at each of those MSAs, and if the HAP concentration and emission trends correlate.

3.9.1 Pollutants of Interest

Several EPA programs have been built around subsets of the total HAPs, such as the section 112(c)(6) program (USEPA, 1998), the section 112(k) program (USEPA, 2005c), and the

core HAPs designated by EPA under the National Air Toxics Assessment (NATA) (USEPA, 2005d). Some of these programs examine only carcinogenic and/or non-carcinogenic HAPs, while others may focus on HAPs from mobile sources. For this study, each of the targeted HAPs has corresponding cancer and/or noncancer toxicity factors. The following cancer and noncancer HAPs were chosen to represent stationary and mobile sources: acetaldehyde, benzene, cadmium, ethylbenzene, and formaldehyde. The following noncancer HAPs were also included: lead, mercury, toluene, and xylenes (total). As with the regulation analysis, these records were limited to what the site actually sampled during the 14-year period.

Benzene, ethylbenzene, toluene, acetaldehyde, and formaldehyde do not have multiple isomers or species, and are also considered their own pollutant group. For pollutants that have multiple isomers or species, such as the metallic HAP compounds, lead compound, cadmium compound, and mercury compound averages were computed. For the individual xylene species, the isomer concentrations were summed to compute a total xylene value.

3.9.2 MSA Definitions

Twenty-one (21) MSAs were considered in this analysis, and they are listed in Table 3-12. An MSA is defined by the counties associated with the MSA from the Office of Management and Budget (Census Bureau, 2005). For example, Camden County, NJ (FIPS = 34007), in which CANJ (AQS site ID = 34-007-0003) is a UATMP monitor in that county, is part of the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA. According to the 2003 U.S. Census Bureau, ten other counties are part of this MSA:

- New Castle County, DE (FIPS = 10003);
- Cecil County, MD (24015);
- Burlington County, NJ (34005);
- Gloucester County, NJ (34015);
- Salem County, NJ (34033);
- Bucks County, PA (42017);

- Chester County, PA (42029);
- Delaware County, PA (42045);
- Montgomery County, PA (42091); and
- Philadelphia County, PA (42101).

Ambient monitors sampling in these counties were utilized to calculate the MSA averages.

3.9.3 Time Period of Interest

The time period of interest spanned from 1990-2003. The first HAP emission inventory developed by EPA was for the 1990 base year to coincide the passage of the 1990 CAA amendments. HAP emission inventories were also developed for the 1996, 1999, and 2002 base years, thus providing emissions data before and after several regulations from the CAA amendments were implemented. Specifically over the last 10 years, EPA has implemented several air regulations to target stationary and mobile source HAP emissions, and these reductions should correspond to reductions in ambient monitoring concentrations and emissions.

This time period also captures the period when a number of federal, state, and local agency HAP monitors and networks were placed or expanded across the nation, including the UATMP, PAMS, IMPROVE, and Pilot City. The time period also does not conflict with other EPA work in calculating nationwide HAP trends. Beginning in 2004, EPA established the NATTS monitoring network of 22 sites to serve a similar function as the well-established criteria pollutant monitoring network.

3.9.4 Methodology

In calculating trends for this study, two types of historical information were retrieved from EPA: HAP ambient monitoring data and HAP emissions data.

3.9.4.1 Historical Ambient Monitoring Data

The primary data sources for the historical HAP ambient monitoring data were from the EPA historical archive (USEPA, 2004), the Air Quality Subsystem (AQS) (USEPA, 2005e), and from the IMPROVE network (IMPROVE, 2004). The historical archive contains nationwide HAP data from 1990-2000, the AQS data contains state/local/tribal-submitted data for 2001-2003, and the IMPROVE data covers specific metal HAPs from 2001-2003. In fall 2004, EPA compiled, supplemented, and quality-assured these three data sources into a single comprehensive database. The concentrations were standardized to $\mu\text{g}/\text{m}^3$. Additional quality assurance/quality control (QA/QC) checks were performed on a subset of the entire data set for approximately 30 HAPs.

To evaluate trends, historical annual MSA averages were calculated by first calculating pollutant group averages. As described earlier, the individual metal species were averaged, while the xylene species were summed together. Valid daily site averages from the pollutant group averages were calculated. Most of the data in the merged database were daily samples, and no adjustments were needed. For sub-daily data (hourly, 3-hour, 6-hour, etc.), a minimum of 18 hours of sampling data within a day was needed to establish a valid daily average. Thus, if a site had seventeen 1-hour concentrations in a particular day, the average of those concentrations would not be considered a valid daily average. Lastly, annual MSA averages were calculated from the valid annual site averages. An MSA designation was applied to each of the sites. The valid daily averages for each site within the MSA were averaged together for two time periods: 1990-1994 and 2002-2003.

3.9.4.2 Historical Emissions Data

Data from the NEI (USEPA, 2005a) for base years 1990, 1996, 1999, and 2002 were retrieved from EPA for the targeted HAPs (Emissions data for 1990 are at the county-level, but still delineated between stationary and mobile sources. Emissions data for 1996, 1999, and 2002 contain stationary source data at the facility- and county-level). County-level emissions by HAP were then calculated. Emissions for each base year were summed to the county-level by each

targeted HAP. Stationary and mobile source emission types were retained. Lastly, MSA-level emissions by HAP were computed. Using the MSA-county designations, the MSAs of interest were summed by HAP and emission type.

3.9.4.3 2004 UATMP Ambient Monitoring Data

To compare these historical data with the concentration data for this report, a 2004 MSA concentration was calculated. This concentration was computed using data from all UATMP sites within the specified MSA and that sampled for a particular pollutant type. For example, to determine the 2004 Chicago MSA total xylene concentration, data was used from both SPIL and NBIL (but not INDEM because it did not sample for VOC).

3.9.4.4 Results

Discussion of each MSA takes place in the individual state sections. Tables 3-13a-i summarize the emissions and concentration trends by HAP and MSA. Due to limited availability of ambient monitoring data, average concentrations from 1990-1994 and 2002-2003 were calculated. A total of 112 MSA and HAP combinations were possible for this analysis.

To evaluate a trend, a comparison of the average concentrations from two time periods was made. For each MSA and HAP, there were 38 combinations that had concentration values during both of these time periods; of those, over 84 percent of the HAPs measured across the MSAs presented a decrease in their HAP concentrations.

These sub-time periods overlap with the NEI base year (1990-1993) and latest year (2002) emissions inventory. When comparing emission estimates from the 1990 NEI and the most recent 2002 NEI, HAP emissions for each MSA decreased substantially; total emissions across the MSAs decreased from 447,173 tpy to 220,924 tpy (51 percent reduction).

3.10 Summary of Additional Analyses

To aid in the review and understanding of this report, Table 3-14 is a summary of the additional analyses by site, as described in Sections 3.6 and 3.9. All sites received the same statistical, meteorological, and background analyses, but some sites had extra analyses due to the nature of the site (NATTS, RFG-area), the pollutants measured (mobile tracer, site-specific trends), and or adverse health concentrations (emission tracer).

Figure 3-1. Comparison of Average Hydrocarbon Concentration vs. Vehicle Registration

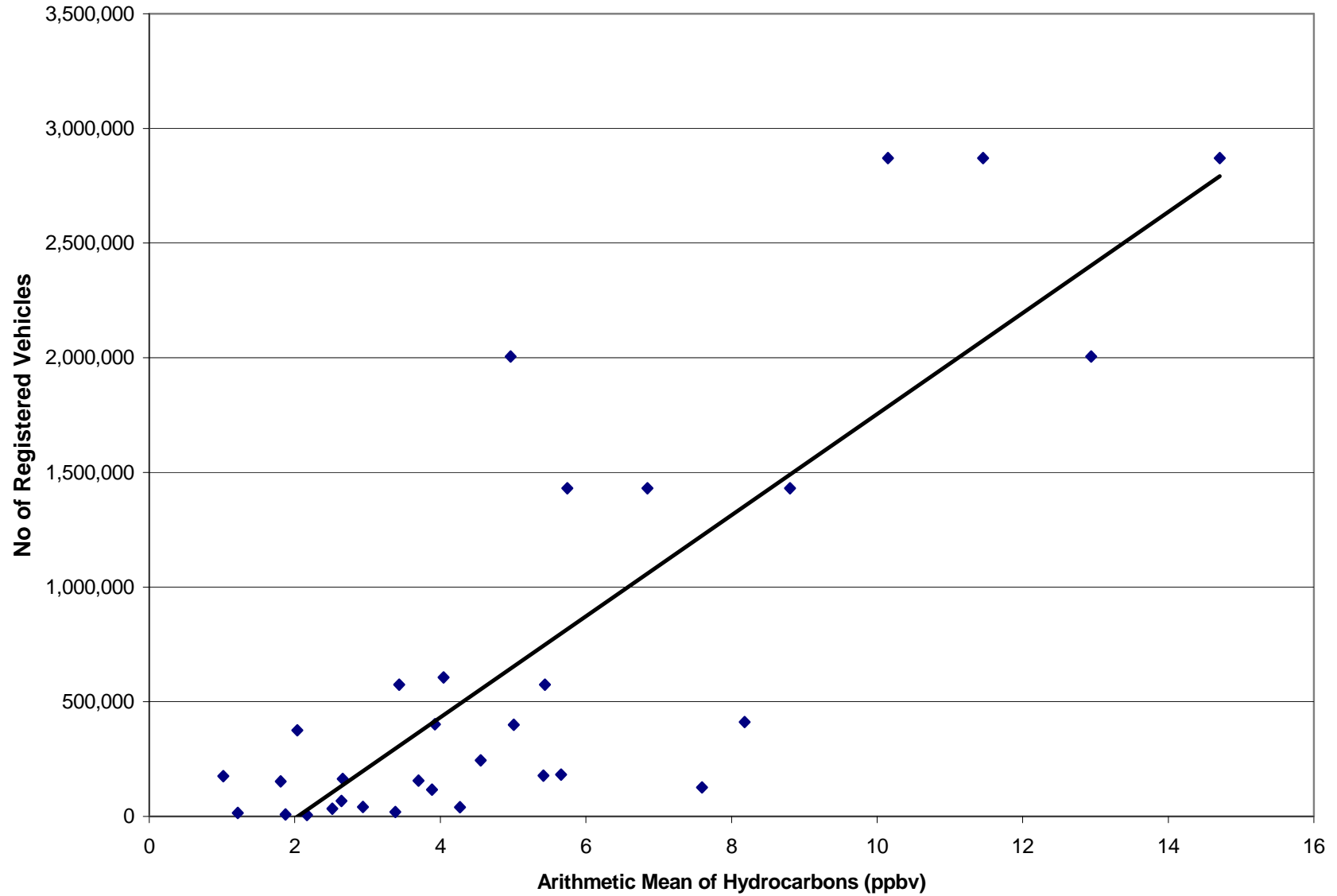
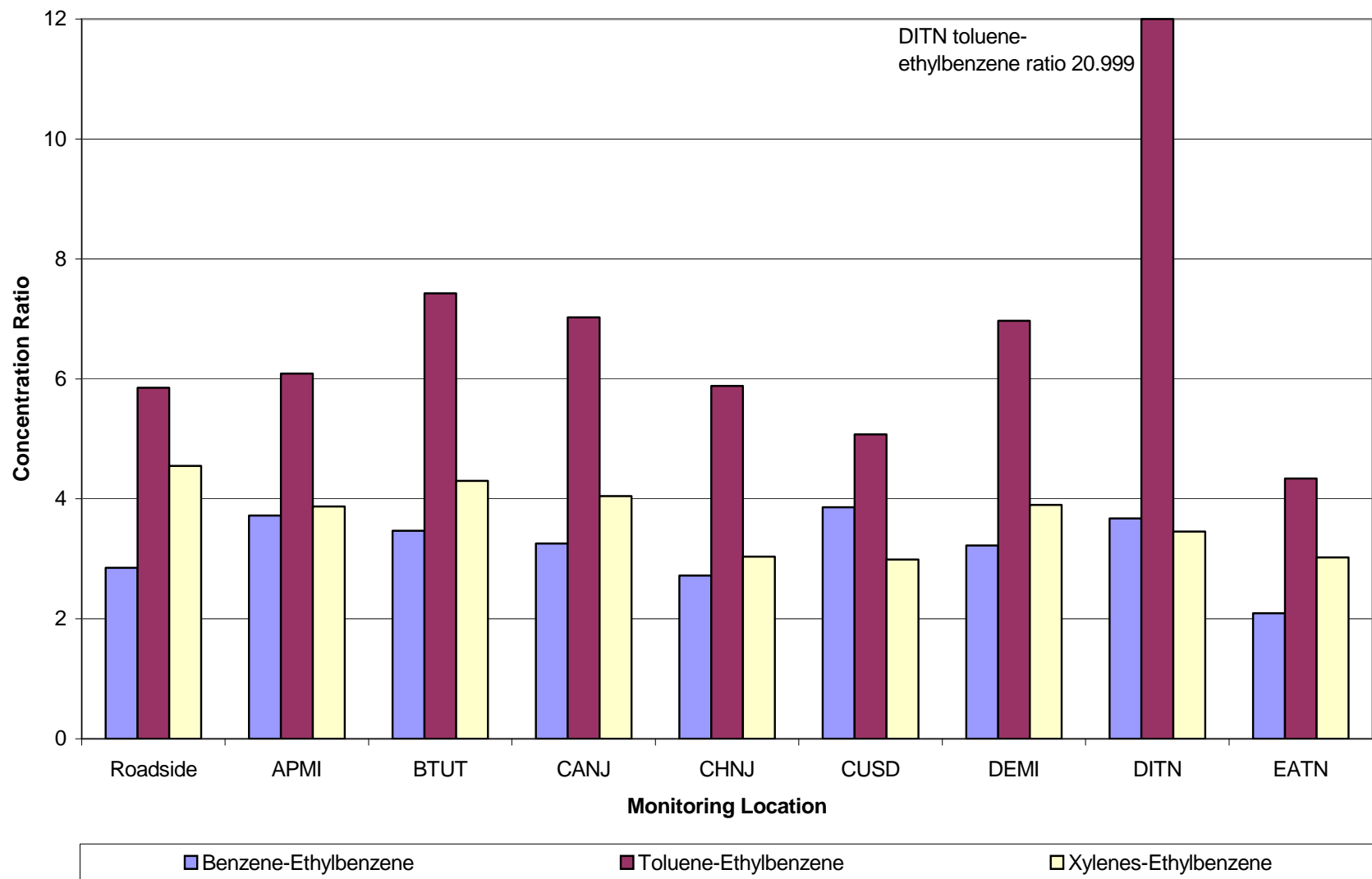
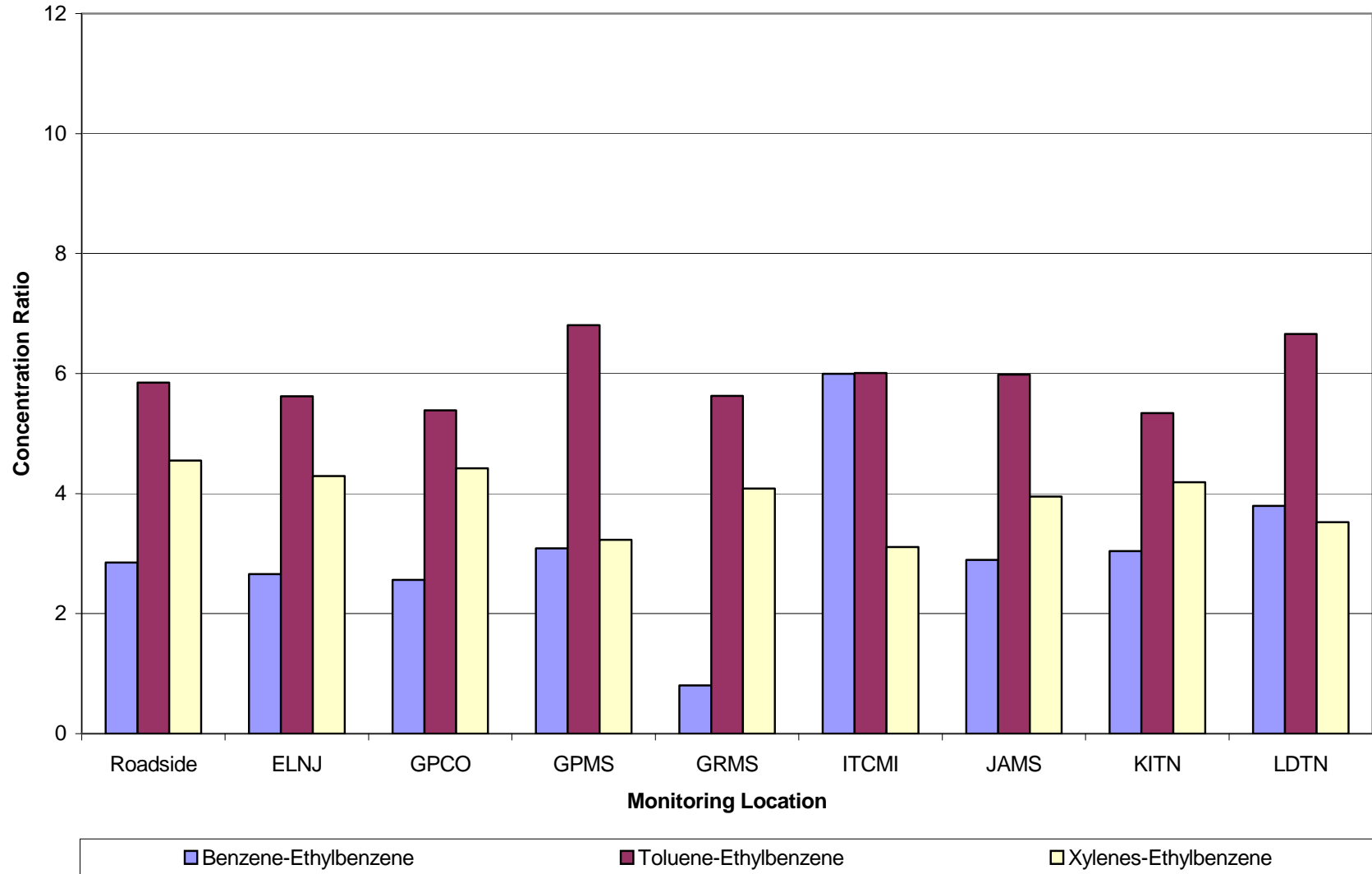


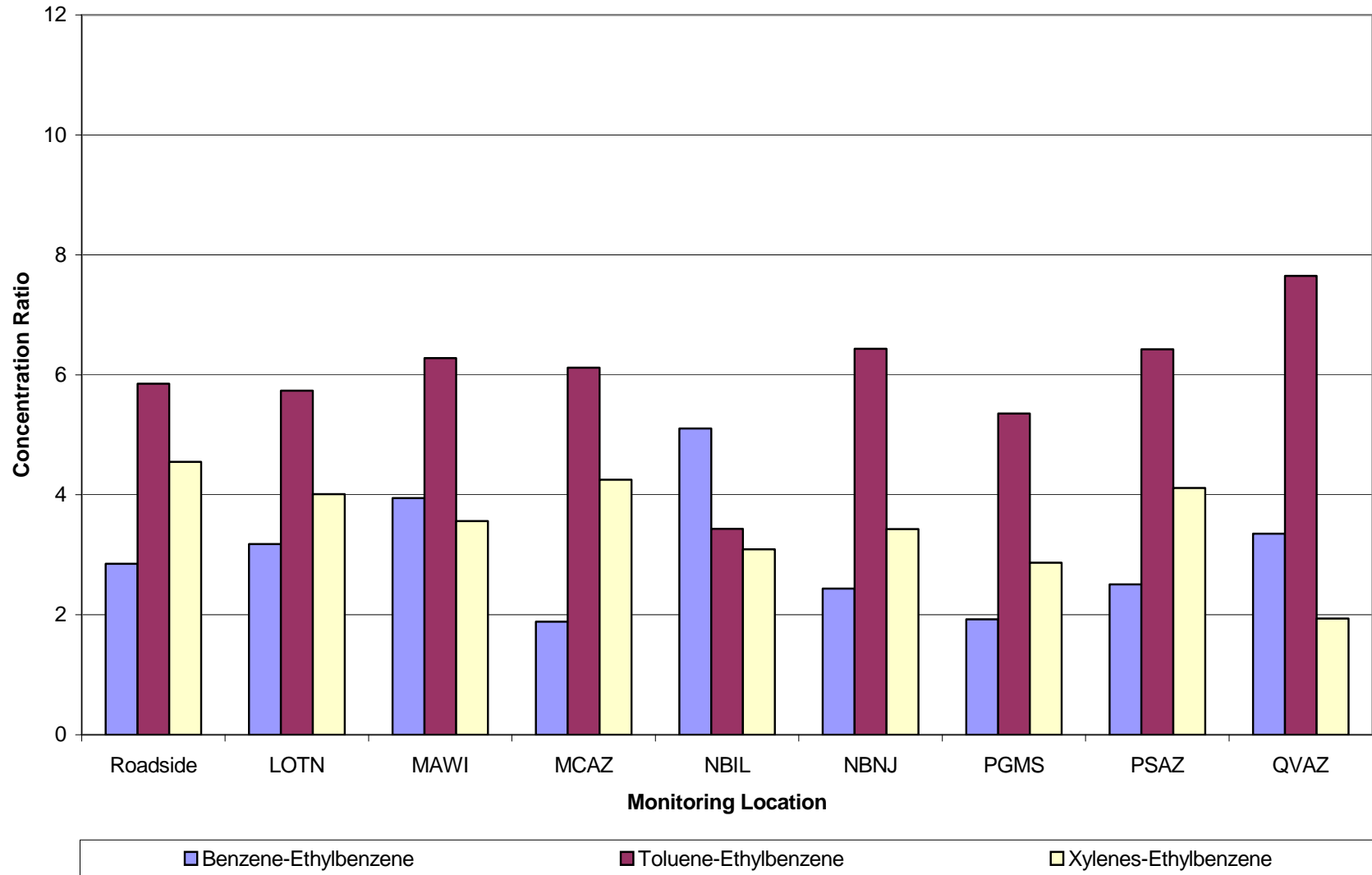
Figure 3-2. Comparison of Concentration Ratios for BTEX Compounds vs. Roadside Study



**Figure 3-2. Comparison of Concentration Ratios for BTEX Compounds vs. Roadside Study
(Continued)**



**Figure 3-2. Comparison of Concentration Ratios for BTEX Compounds vs. Roadside Study
(Continued)**



**Figure 3-2. Comparison of Concentration Ratios for BTEX Compounds vs. Roadside Study
(Continued)**

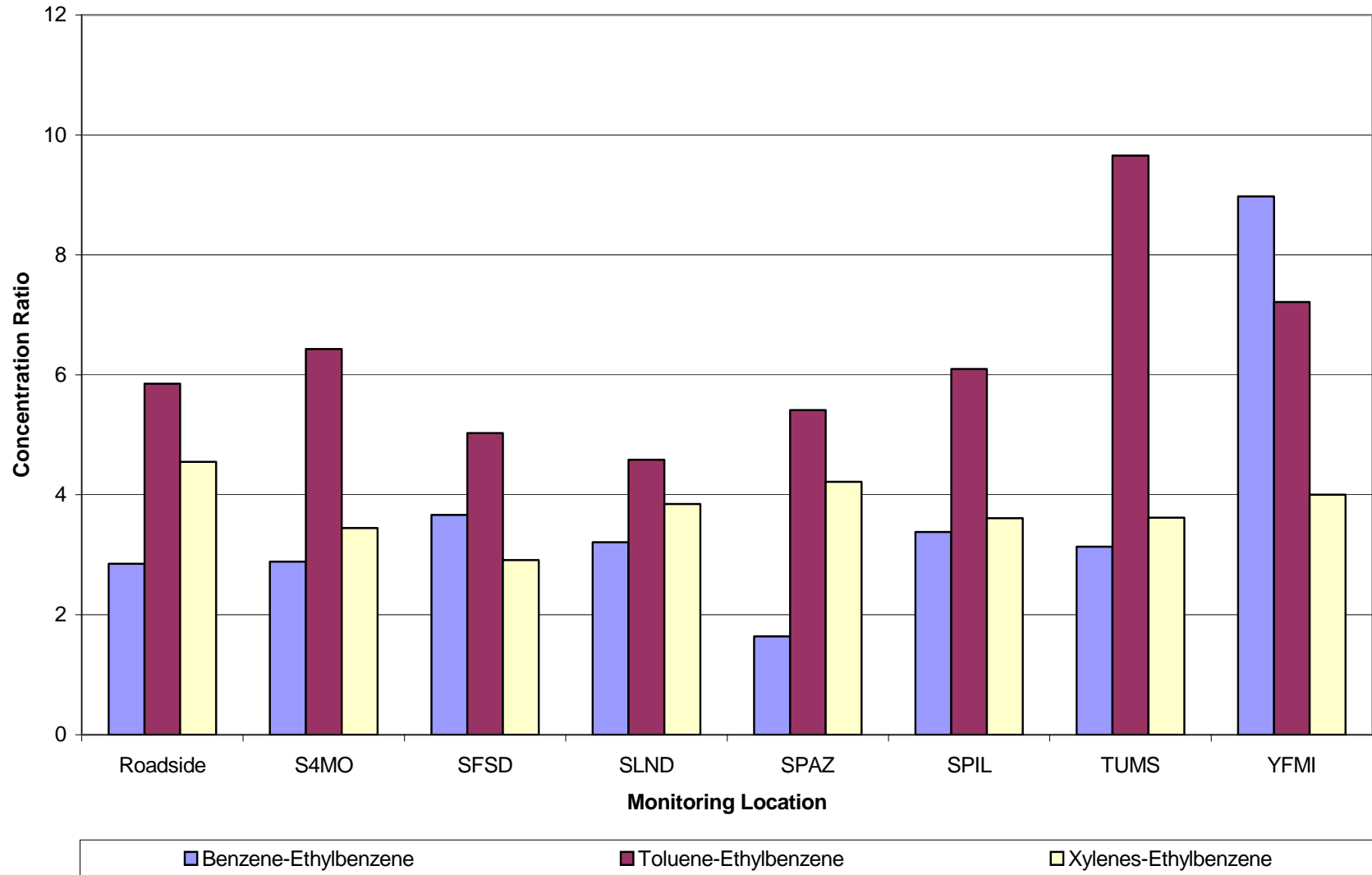


Figure 3-3. Comparison of Average Hydrocarbon Concentration vs. Daily Traffic Counts

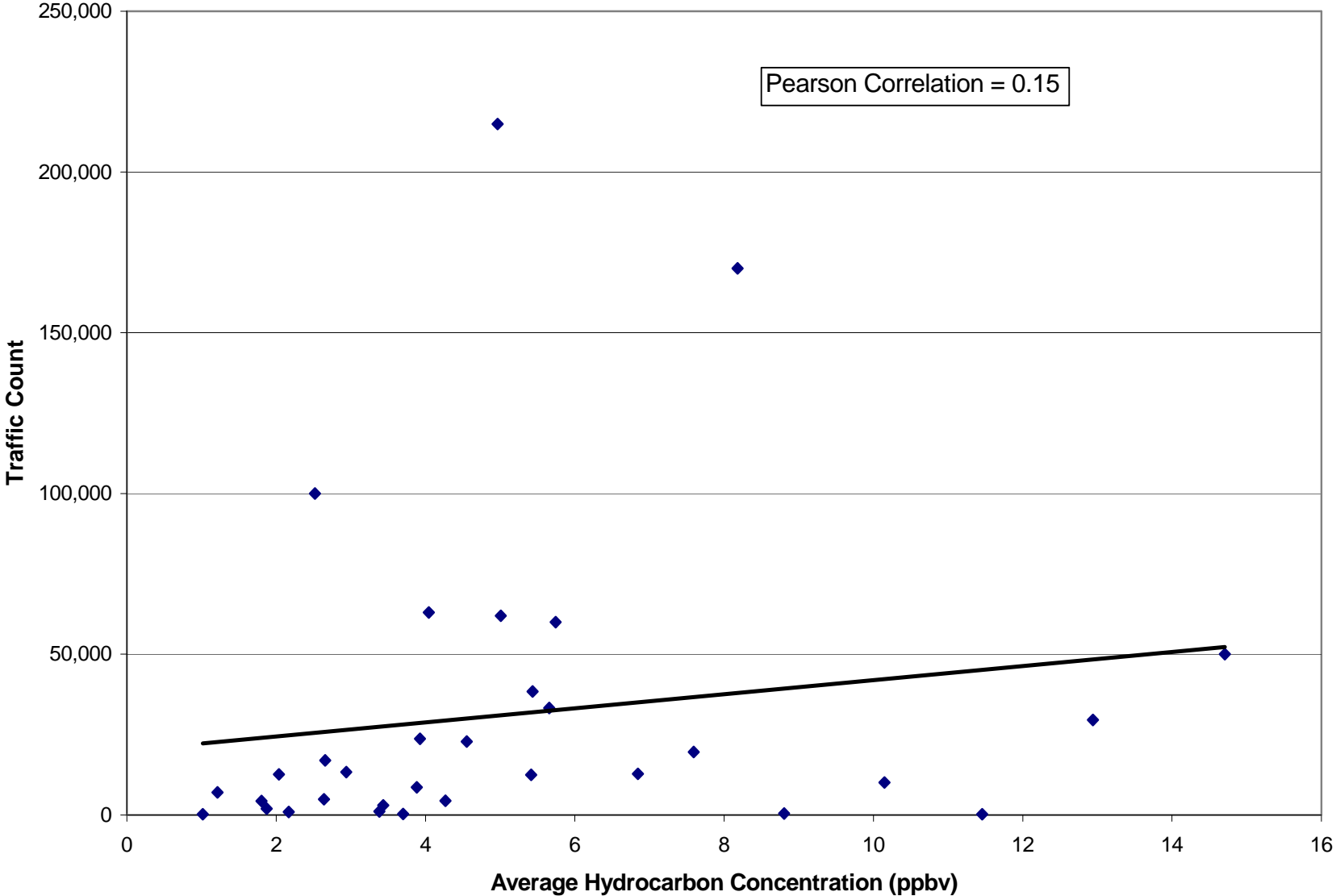


Figure 3-4. Comparison of Average Acetylene Concentration vs. Daily Traffic Counts

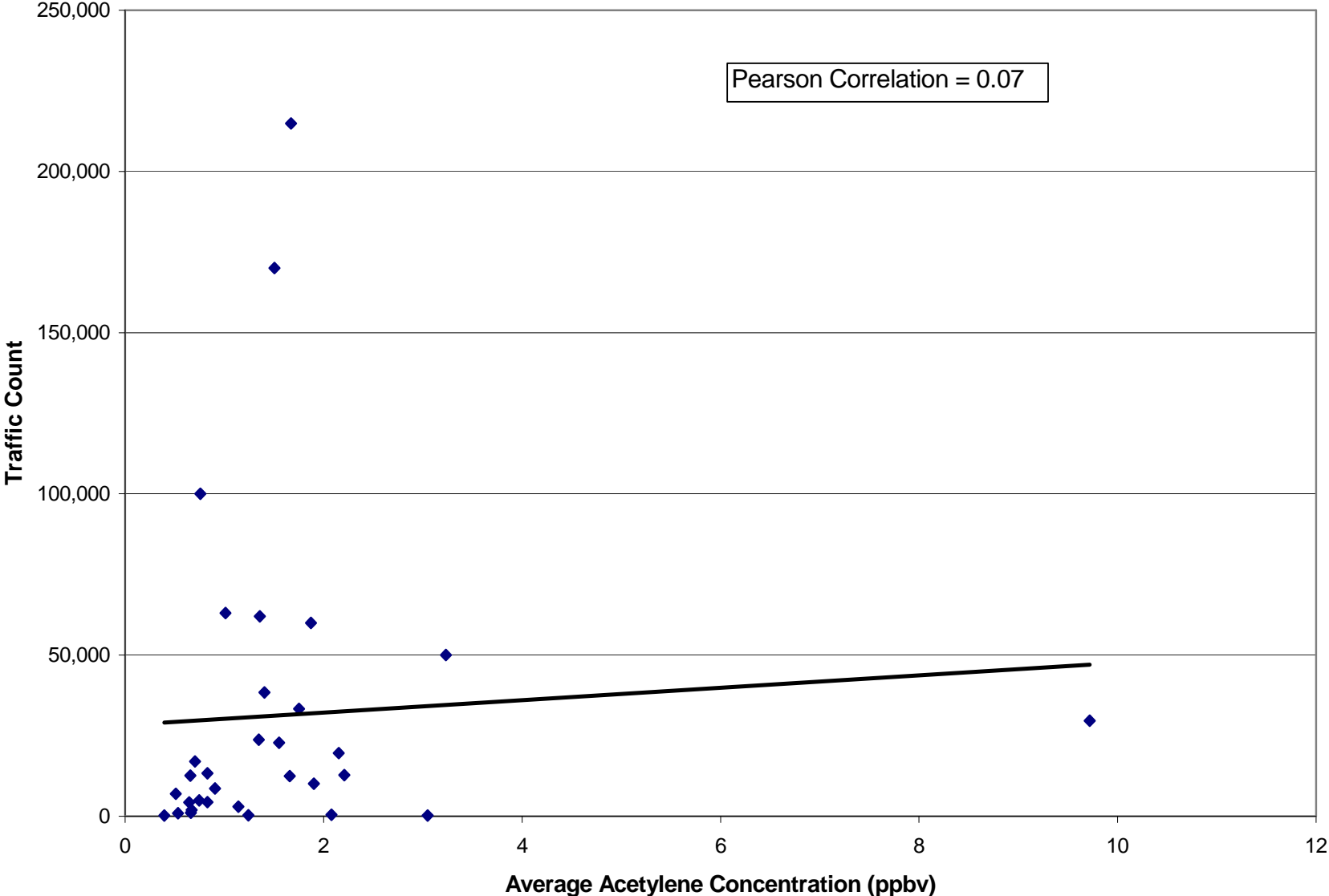


Figure 3-5. Coefficient of Variation Analysis of 1,3-Butadiene Across 27 Sites

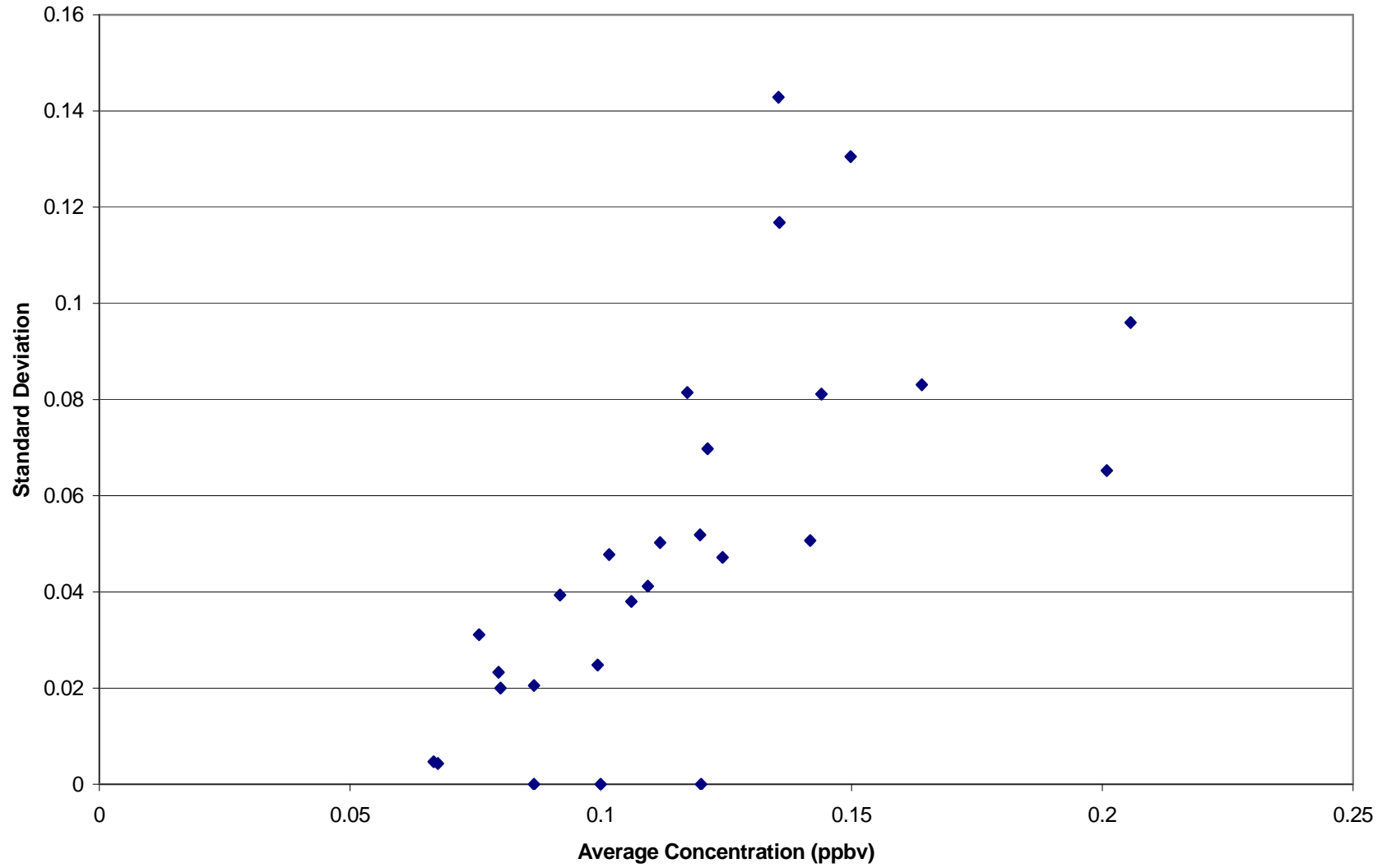


Figure 3-6. Coefficient of Variation Analysis of Acetaldehyde Across 34 Sites

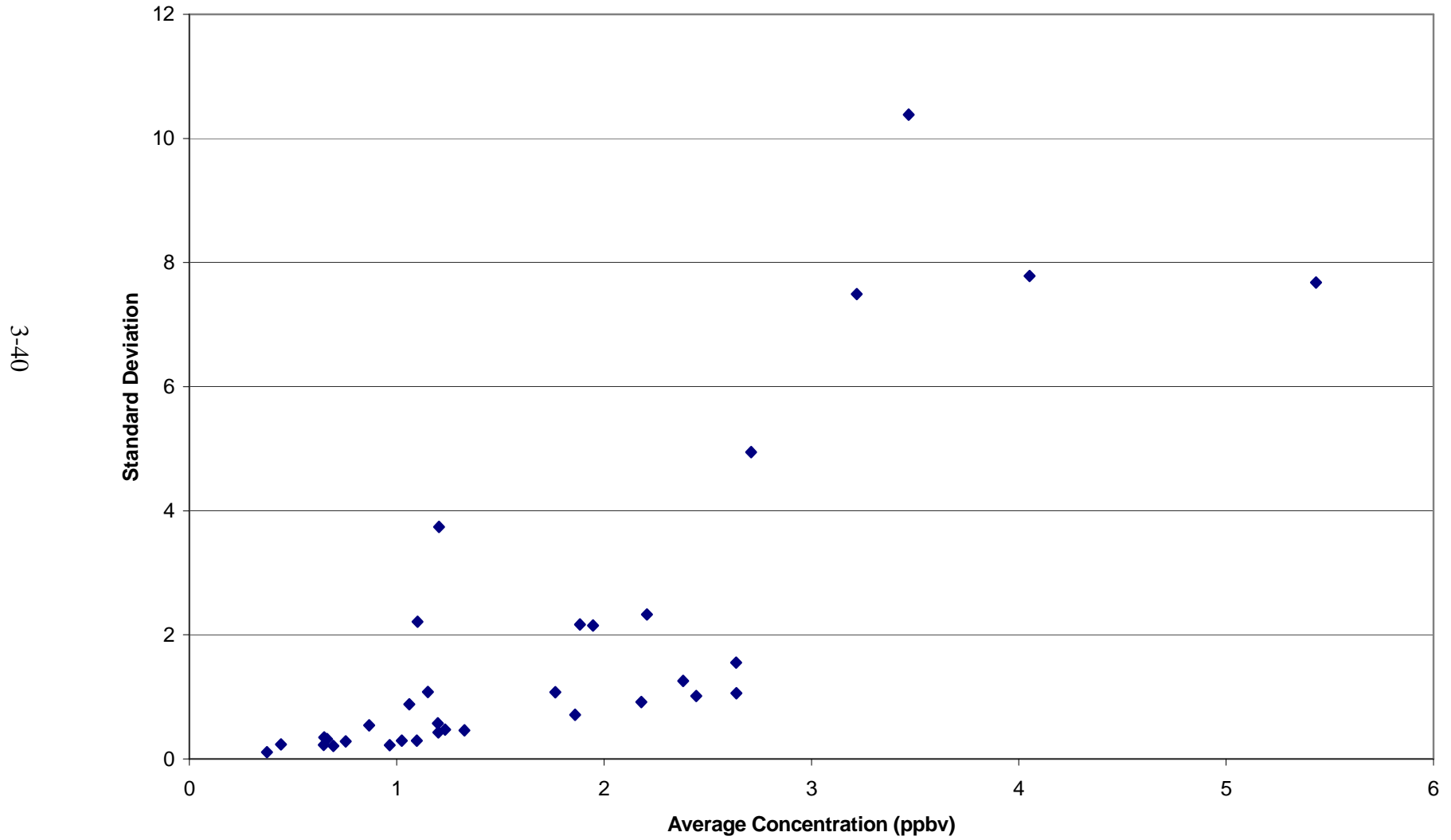


Figure 3-7. Coefficient of Variation Analysis of Acetonitrile Across 28 Sites

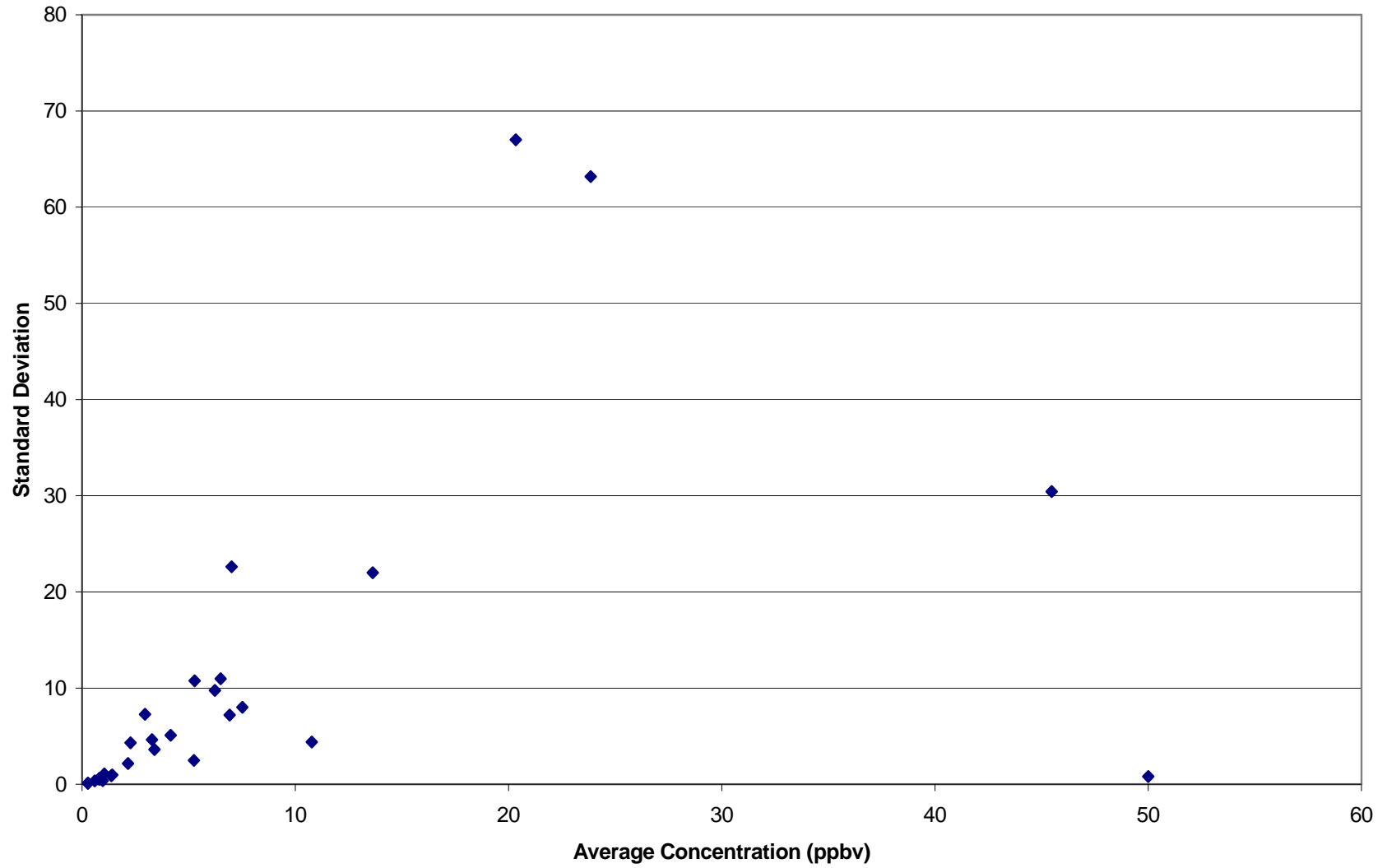


Figure 3-8. Coefficient of Variation Analysis of Acrylonitrile Across 26 Sites

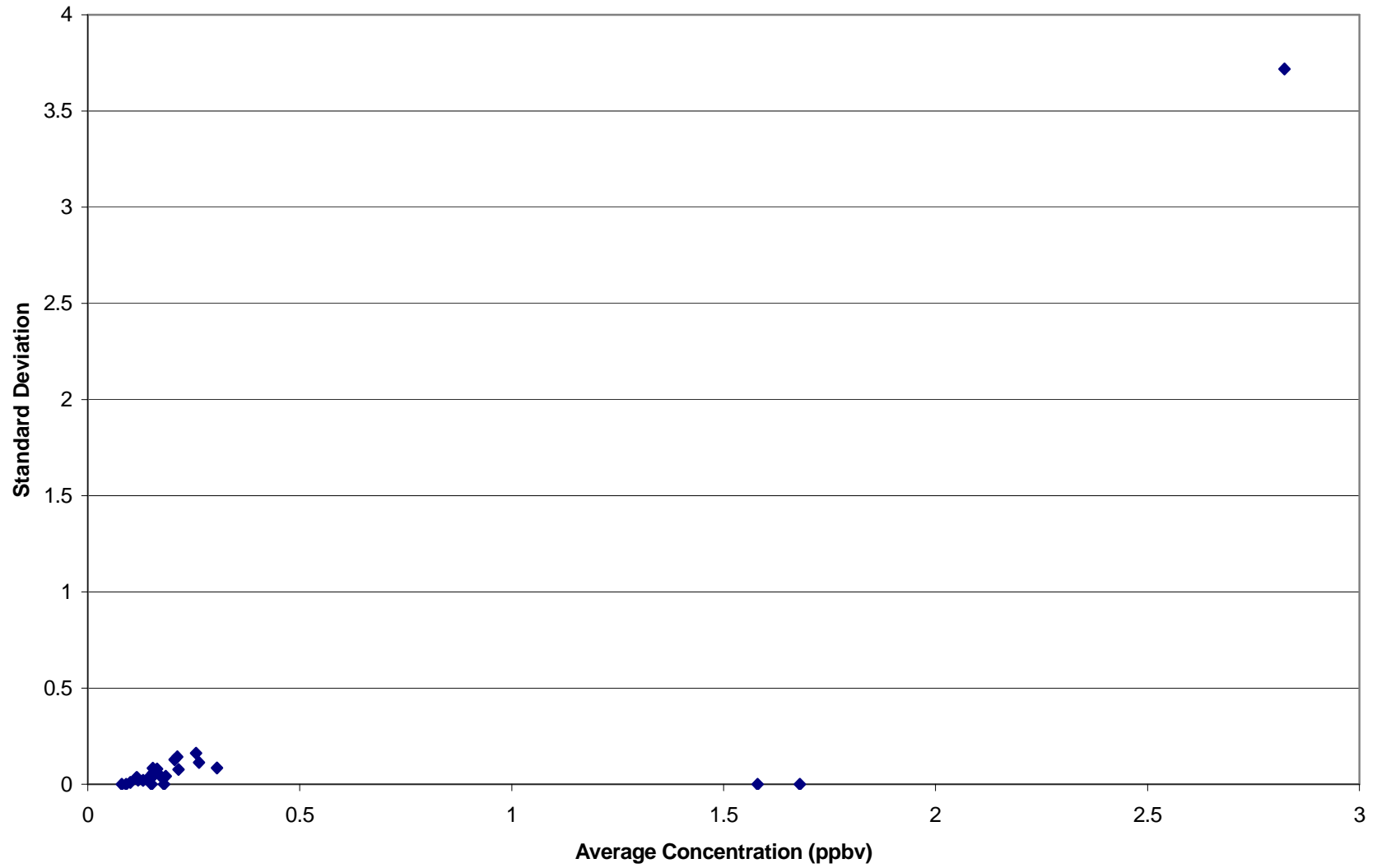


Figure 3-9. Coefficient of Variation Analysis of Benzene Across 33 Sites

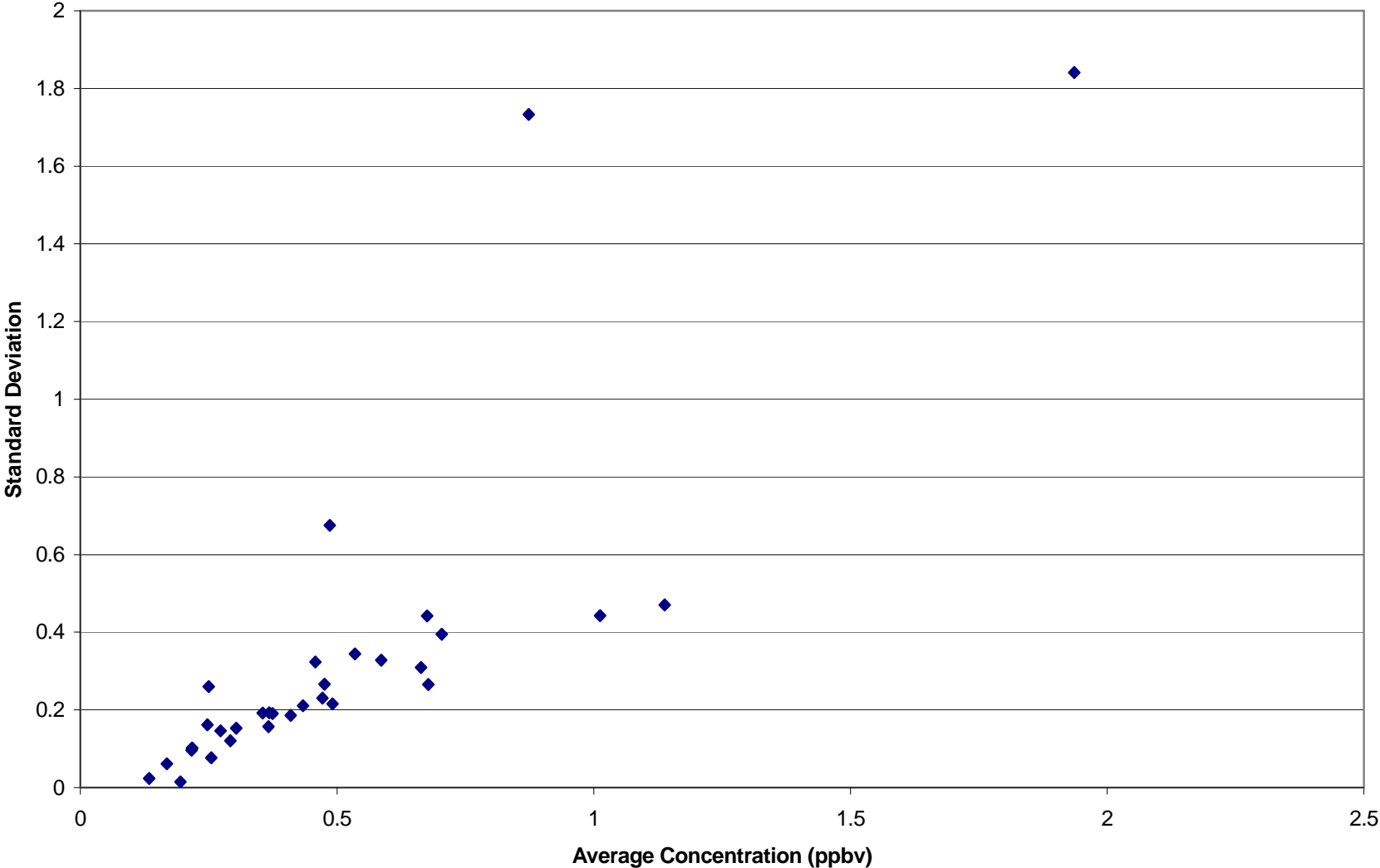


Figure 3-10. Coefficient of Variation Analysis of Bromomethane Across 9 Sites

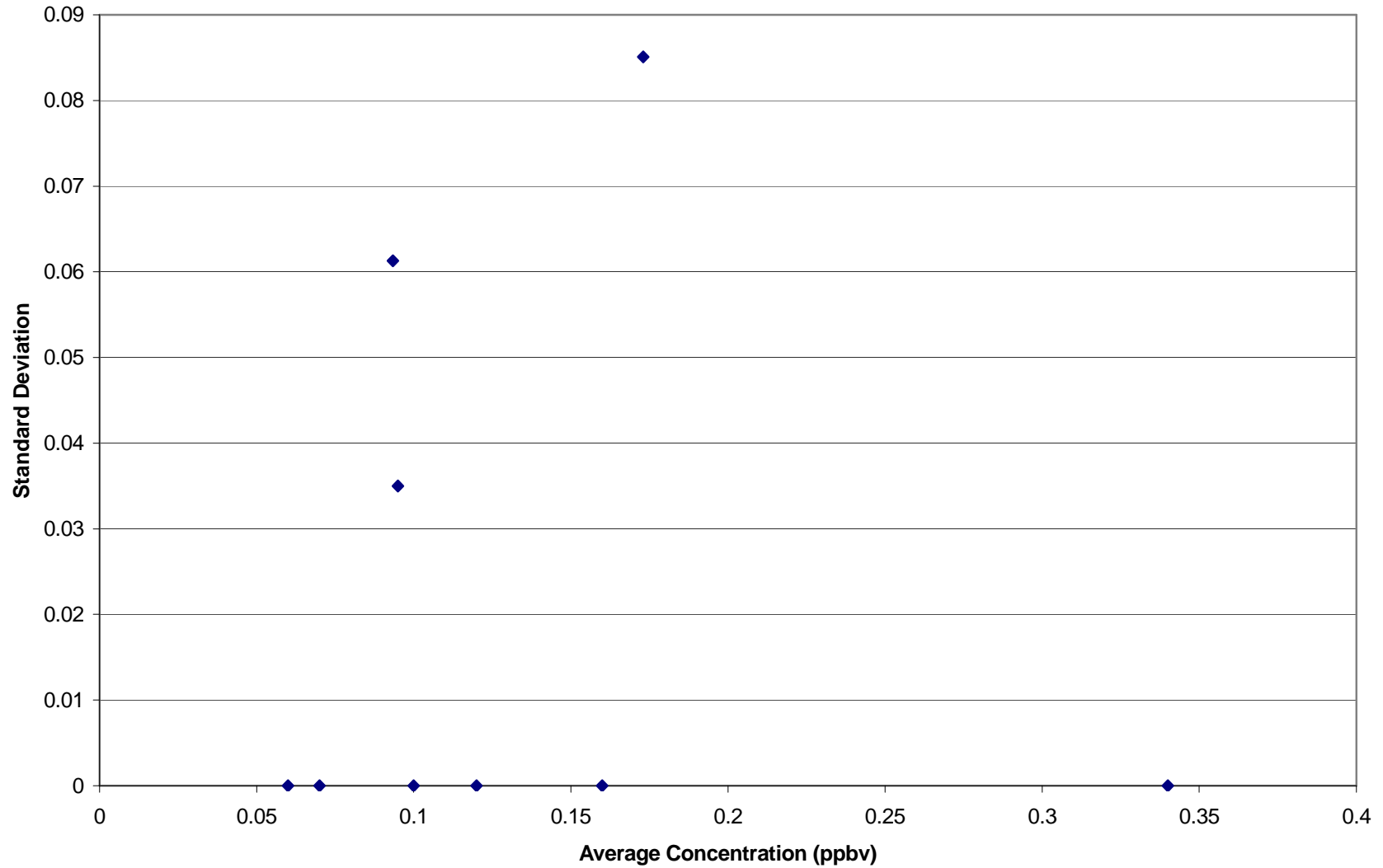


Figure 3-12. Coefficient of Variation Analysis of Formaldehyde Across 34 Sites

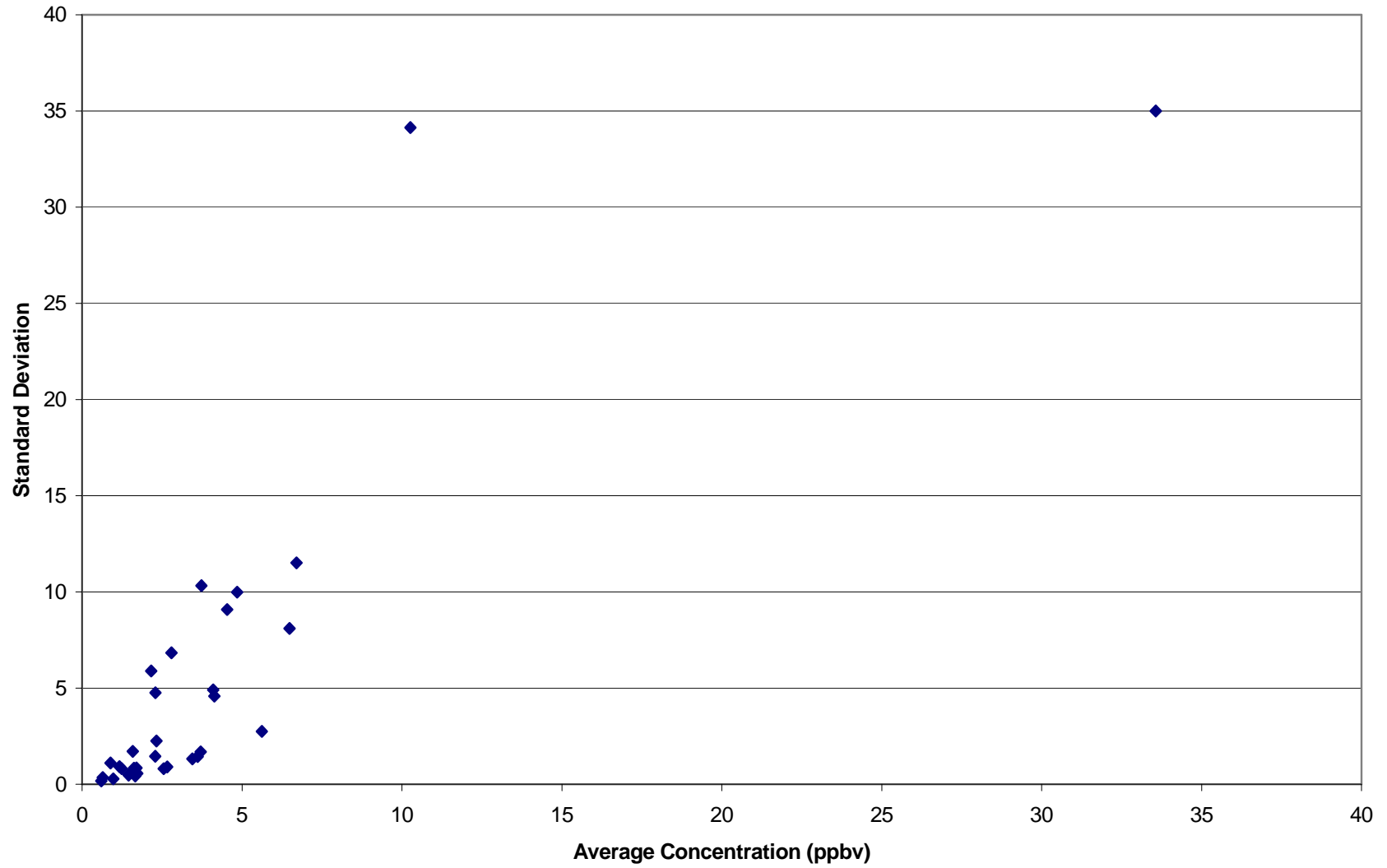


Figure 3-13. Coefficient of Variation Analysis of *p*-Dichlorobenzene Across 17 Sites

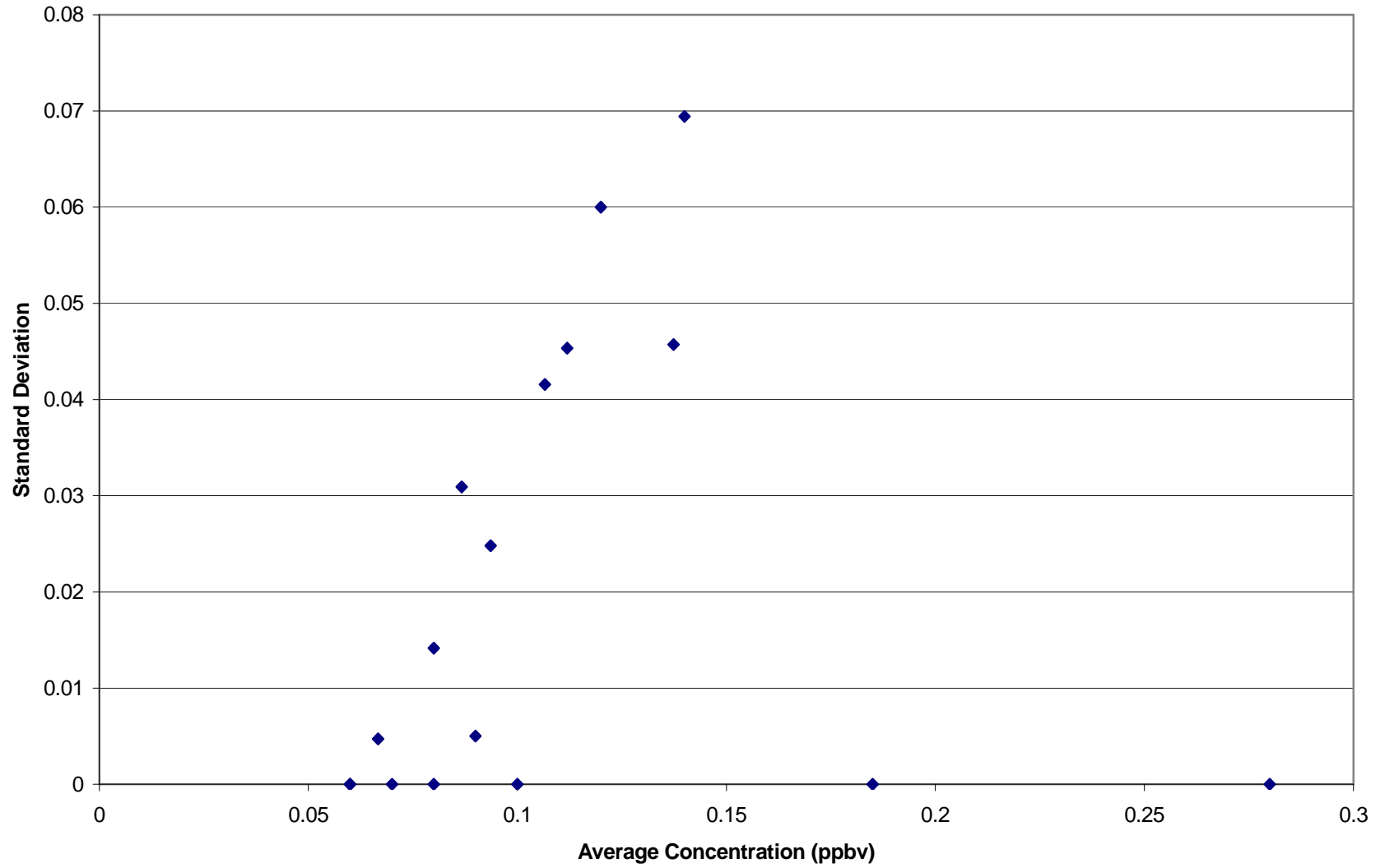


Figure 3-14. Coefficient of Variation Analysis of Tetrachloroethylene Across 25 Sites

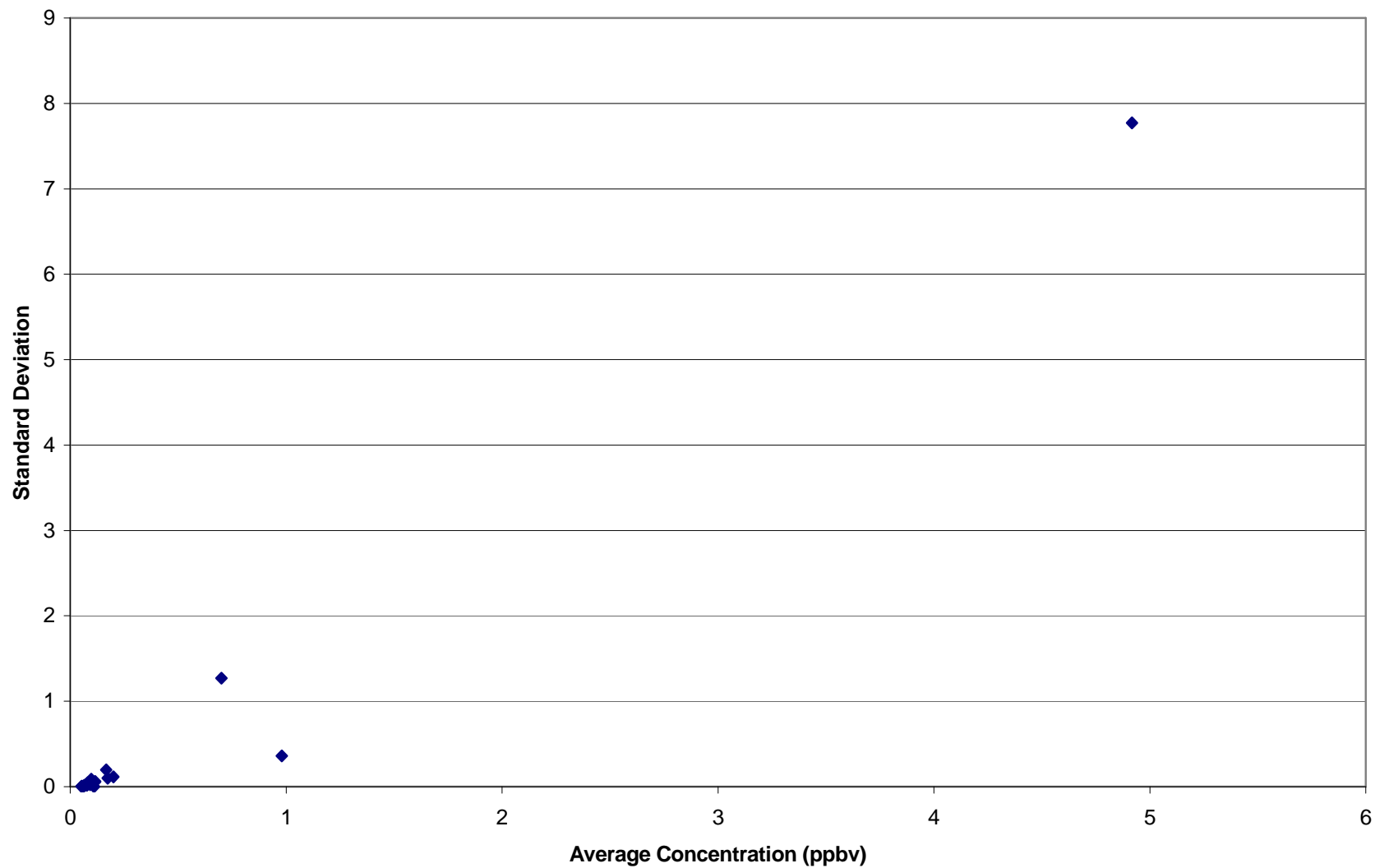


Figure 3-15. Coefficient of Variation Analysis of Xylenes (Total) Across 32 Sites

3-49

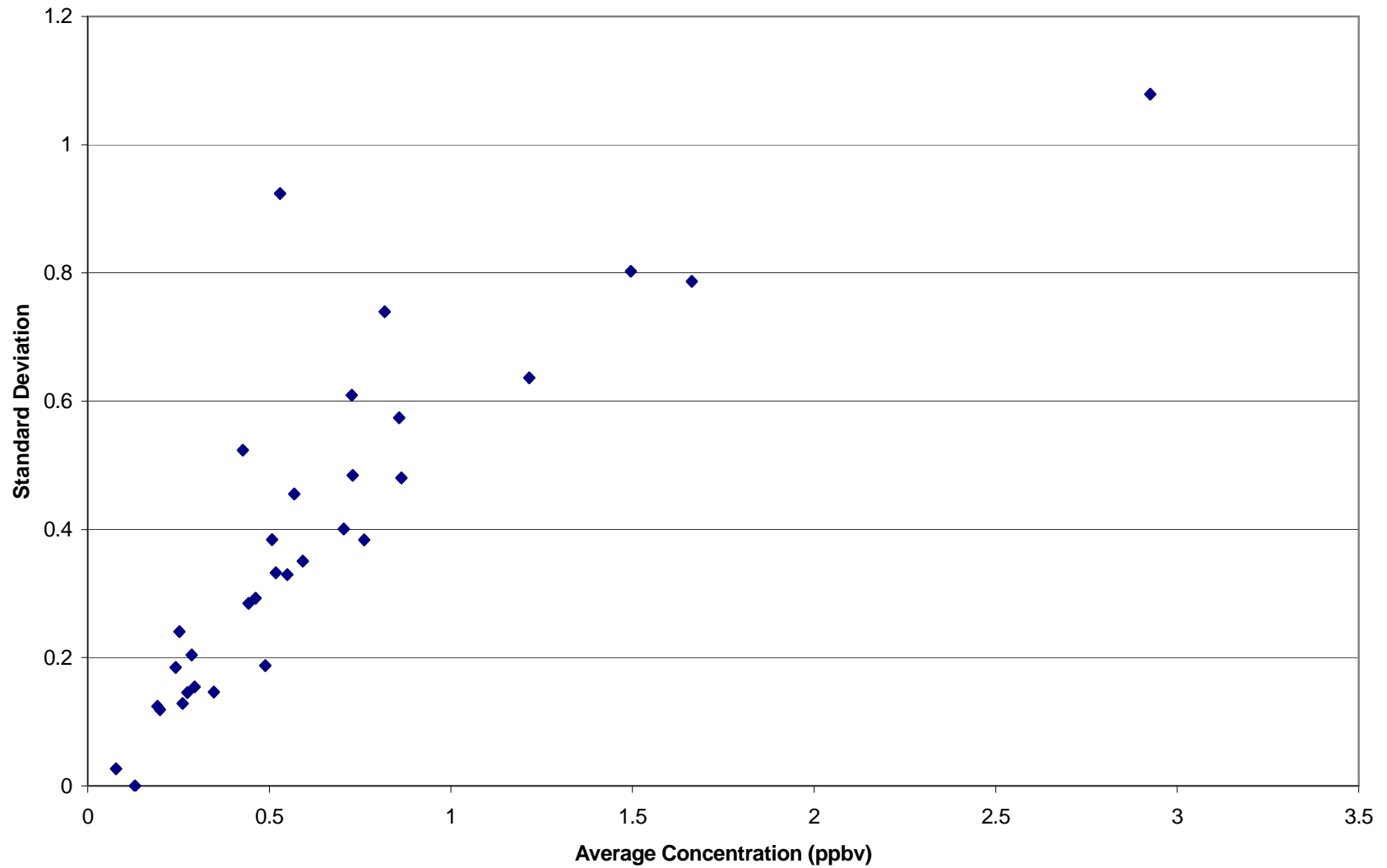


Figure 3-16. Average Seasonal 1,3-Butadiene Concentration Comparison by Season

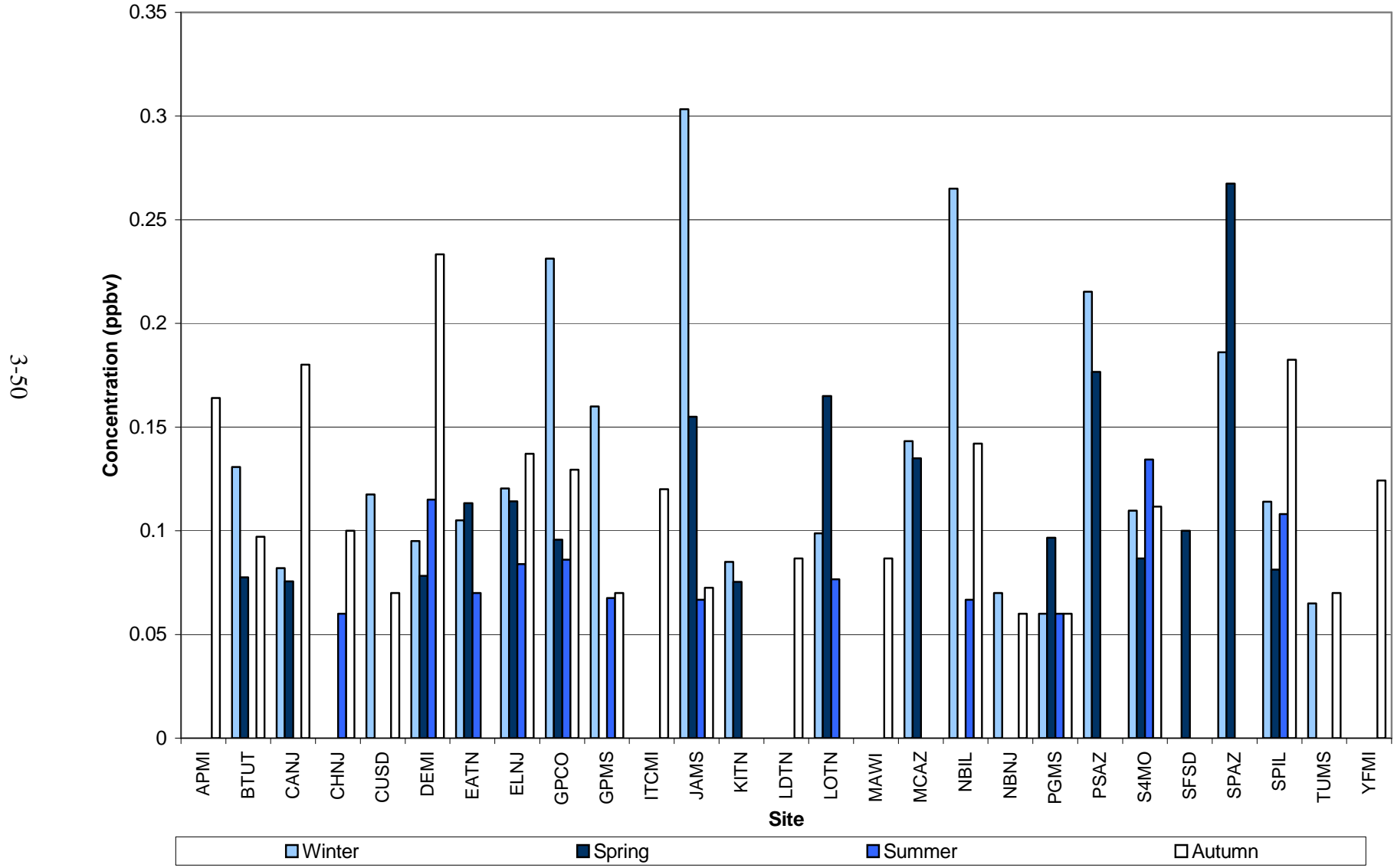


Figure 3-17. Average Seasonal Acetaldehyde Concentration Comparison by Season

3-51

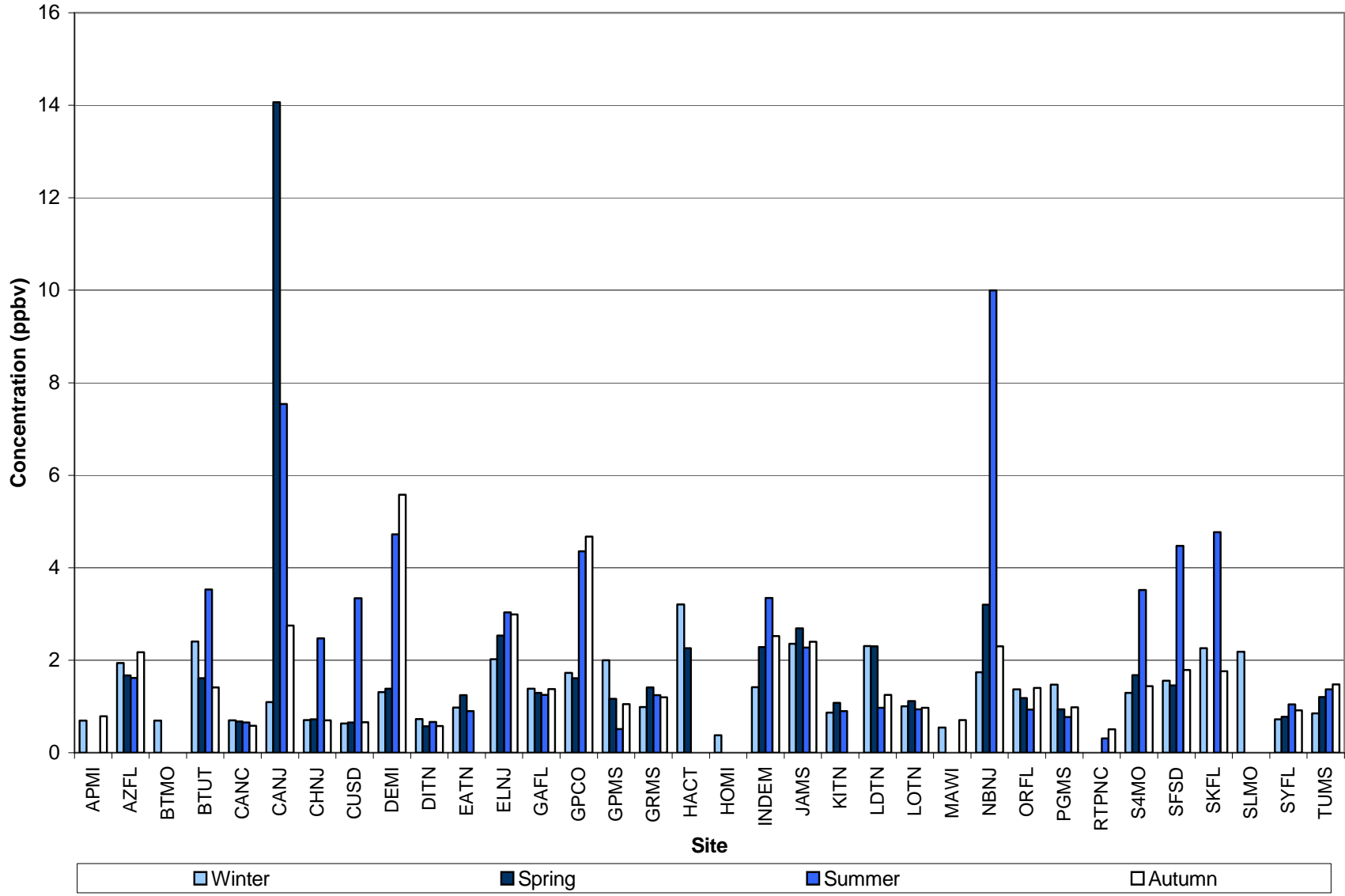


Figure 3-18. Average Seasonal Acetonitrile Concentration Comparison by Season

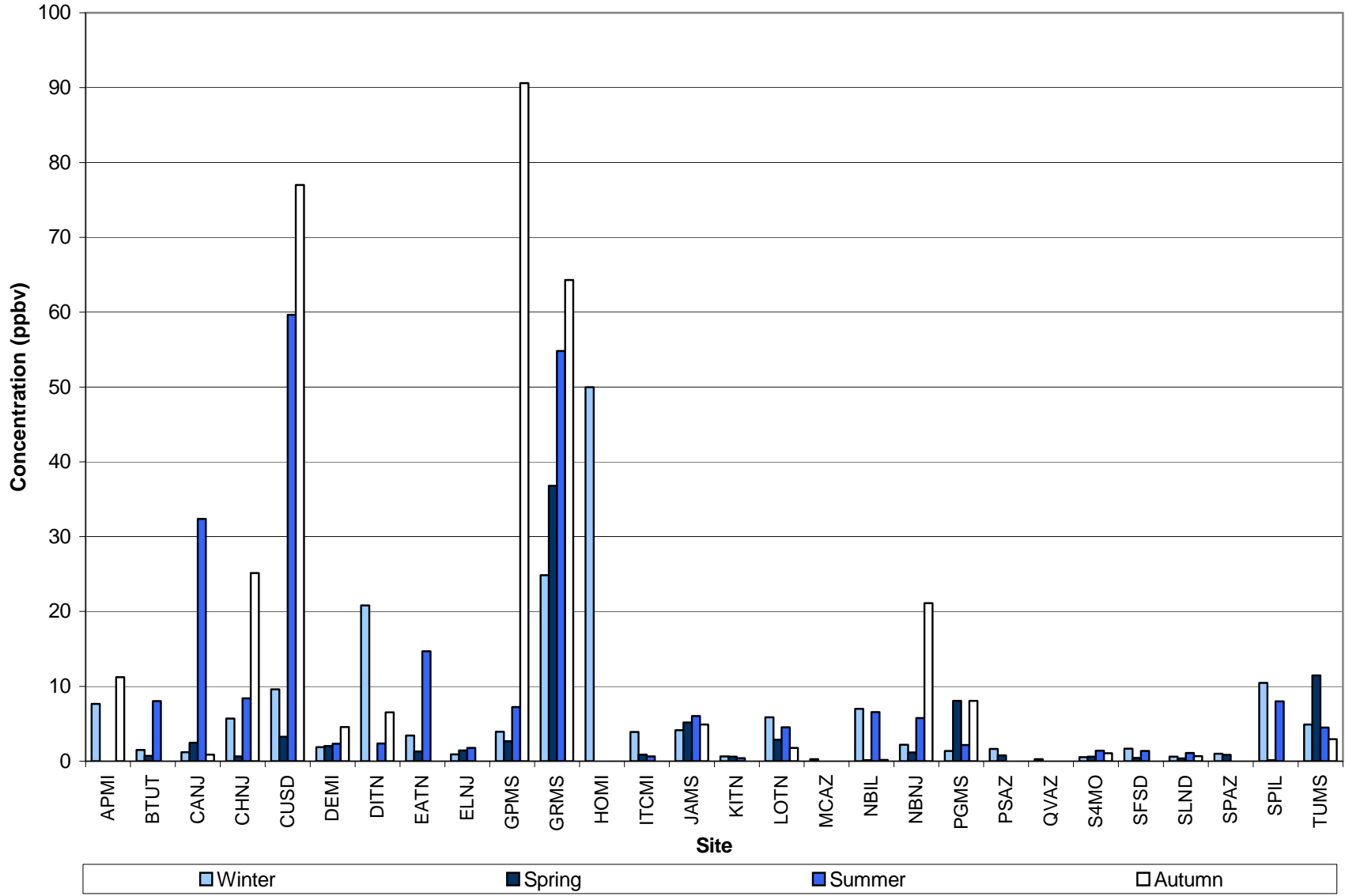


Figure 3-19. Average Seasonal Acrylonitrile Concentration Comparison by Season

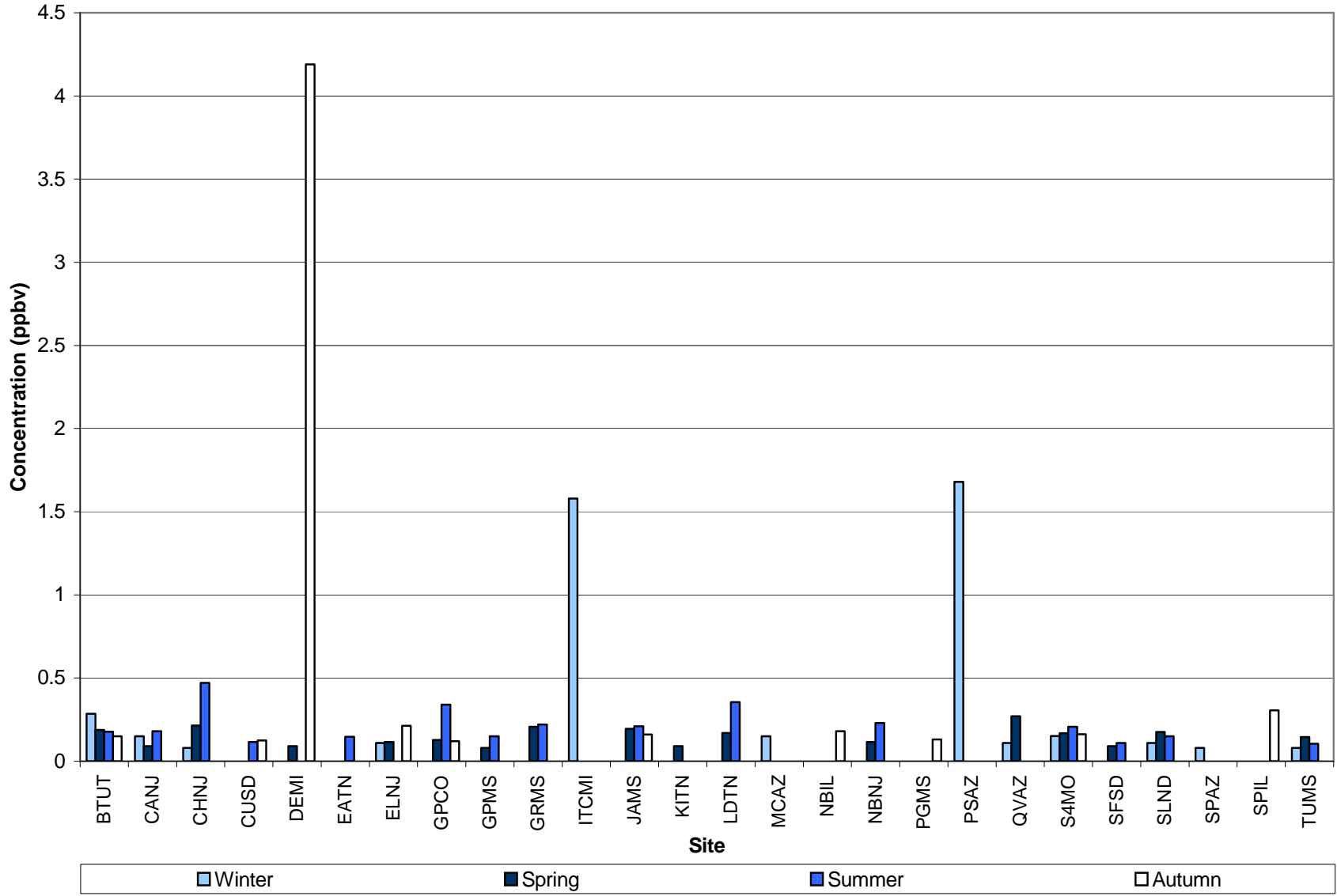


Figure 3-20. Average Seasonal Benzene Concentration Comparison by Season

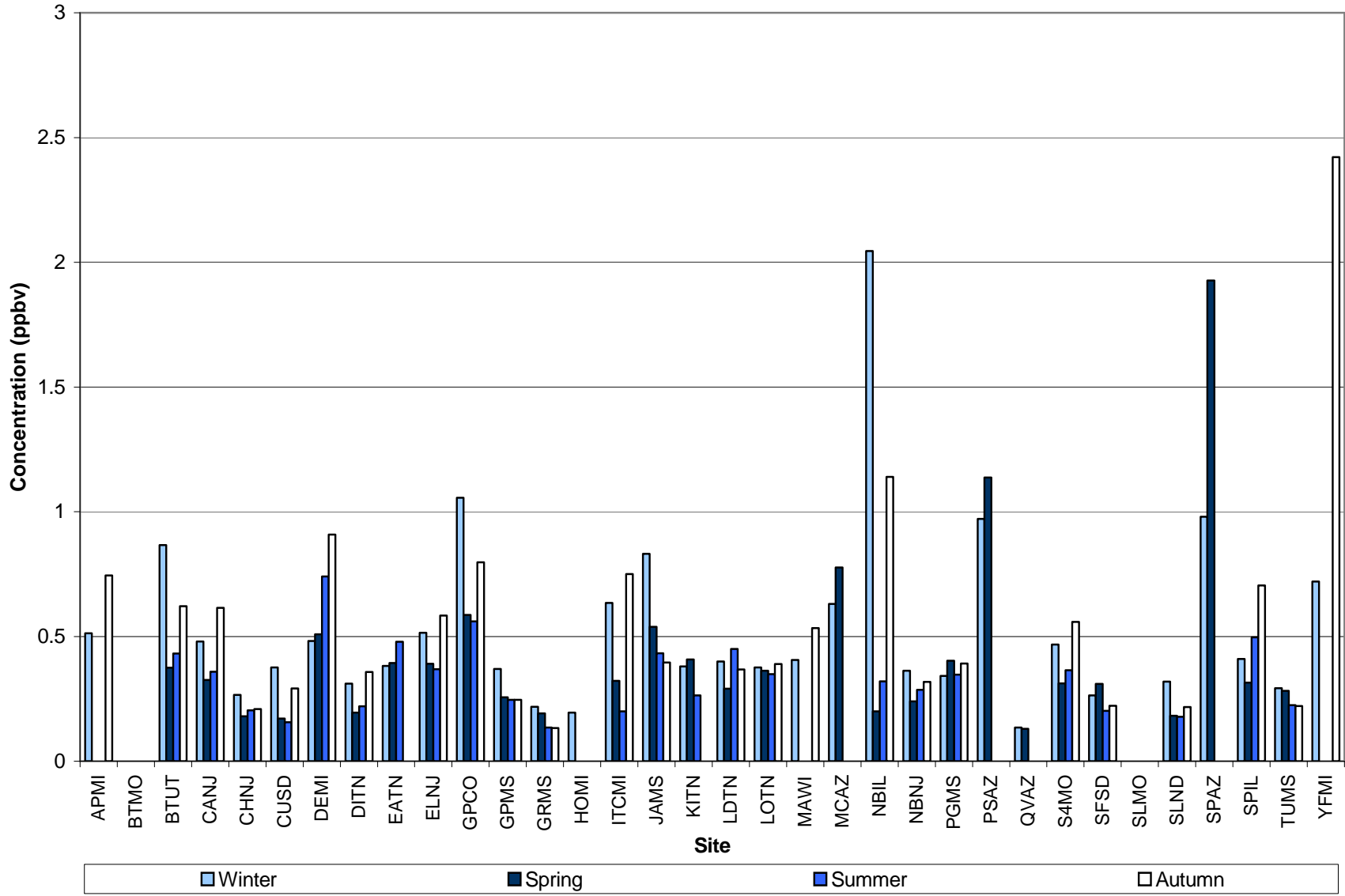


Figure 3-21. Average Seasonal Bromomethane Concentration Comparison by Season

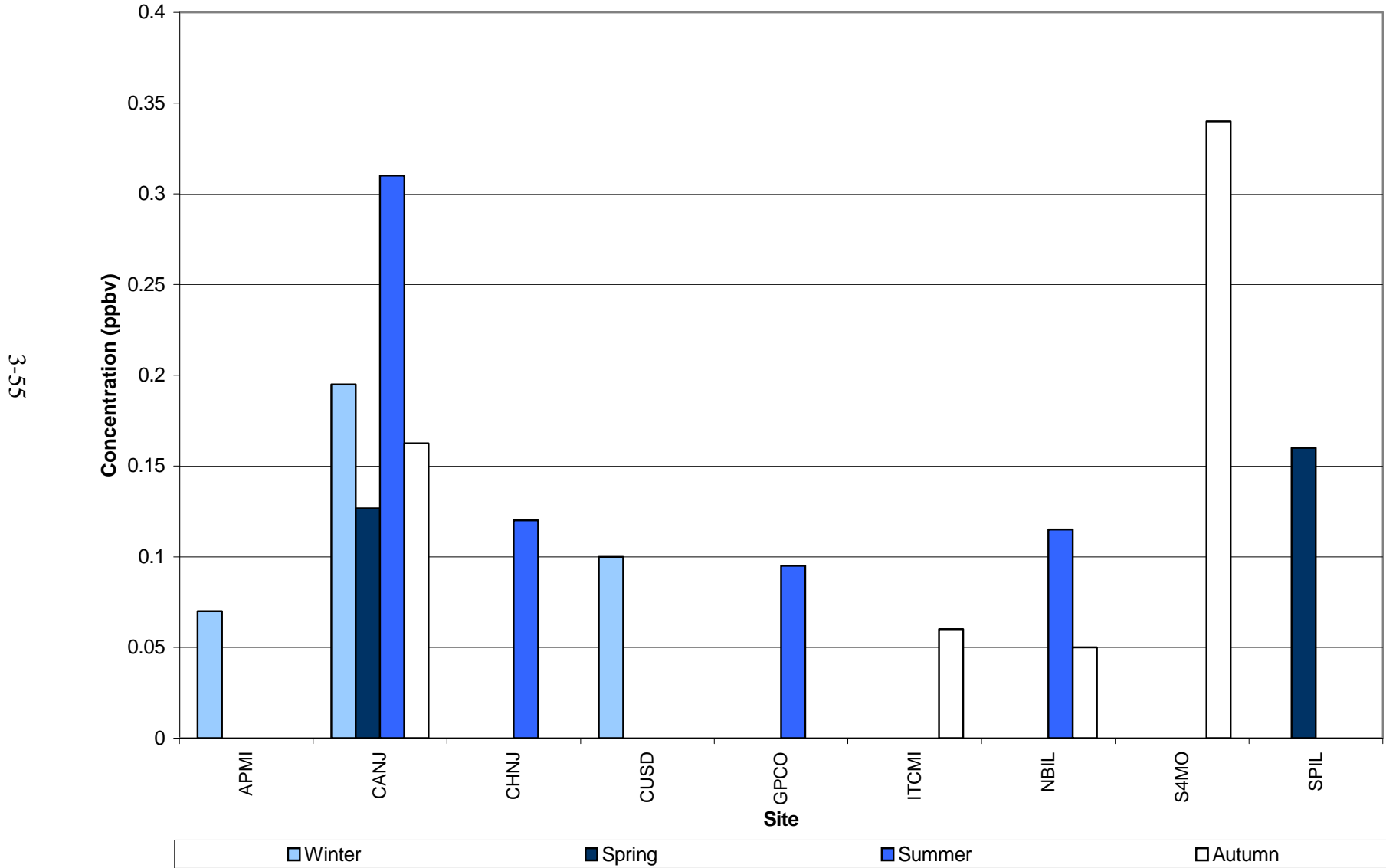


Figure 3-22. Average Seasonal Carbon Tetrachloride Concentration Comparison by Season

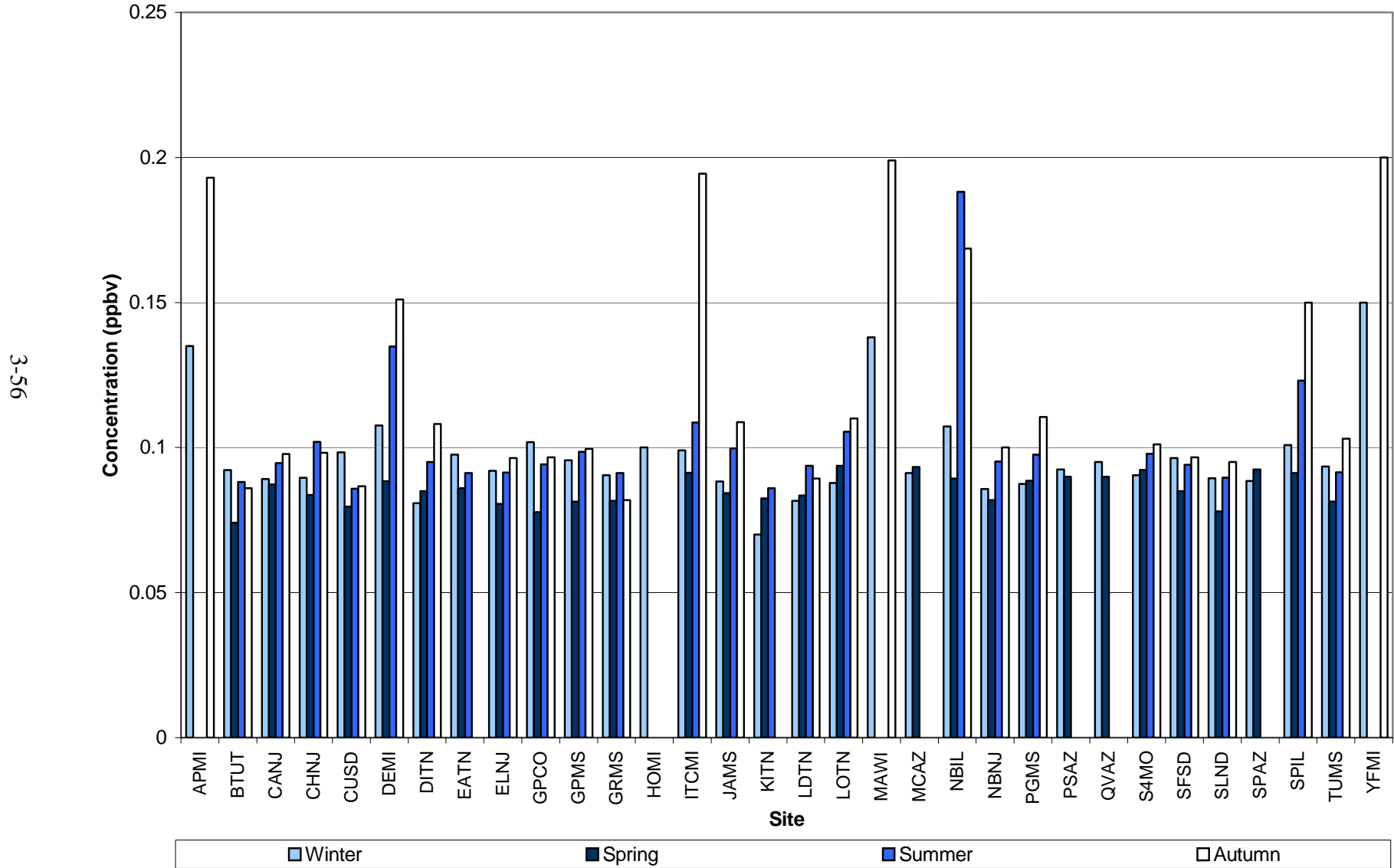


Figure 3-23. Average Seasonal Formaldehyde Concentration Comparison by Season

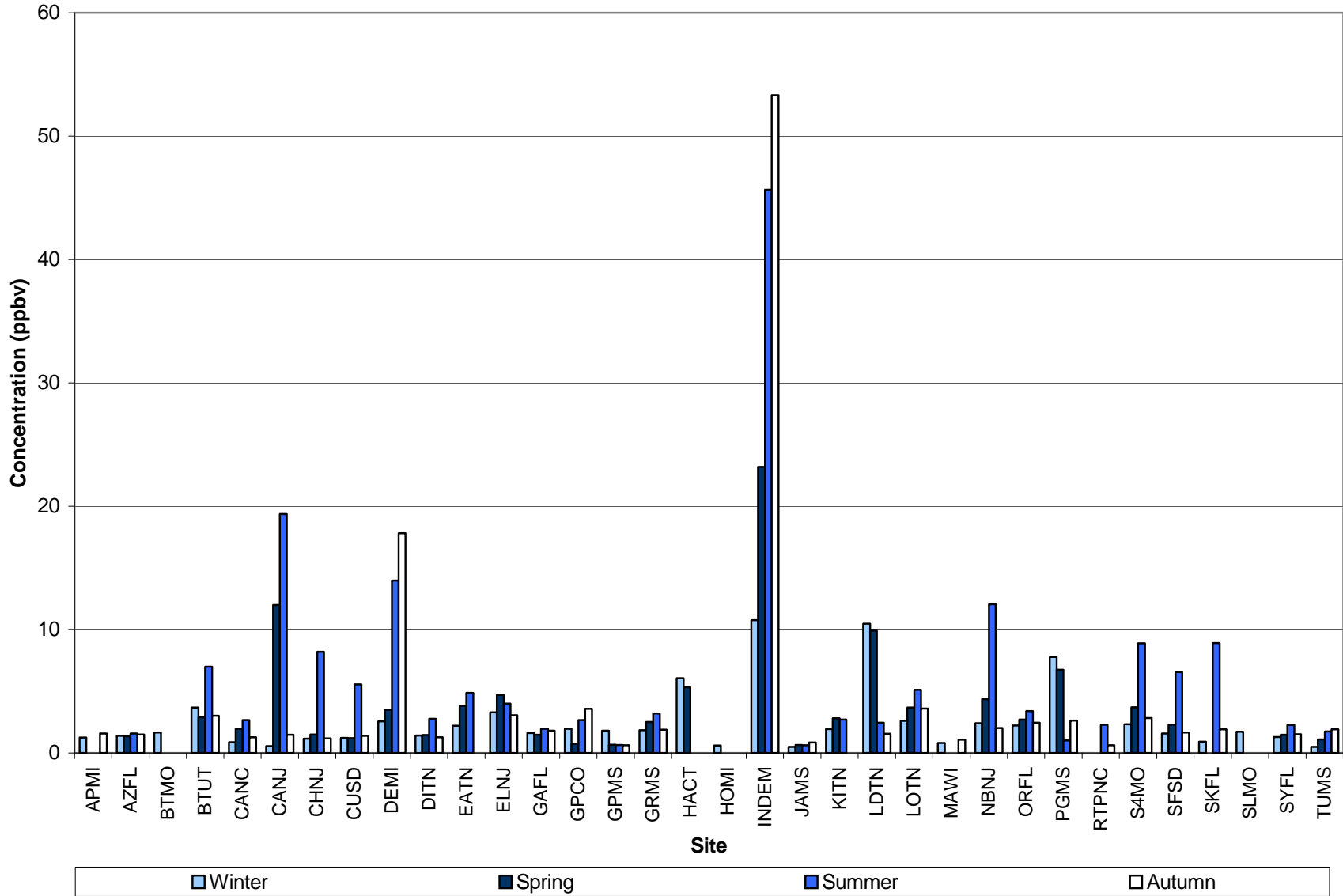


Figure 3-24. Average Seasonal *p*-Dichlorobenzene Concentration Comparison by Season

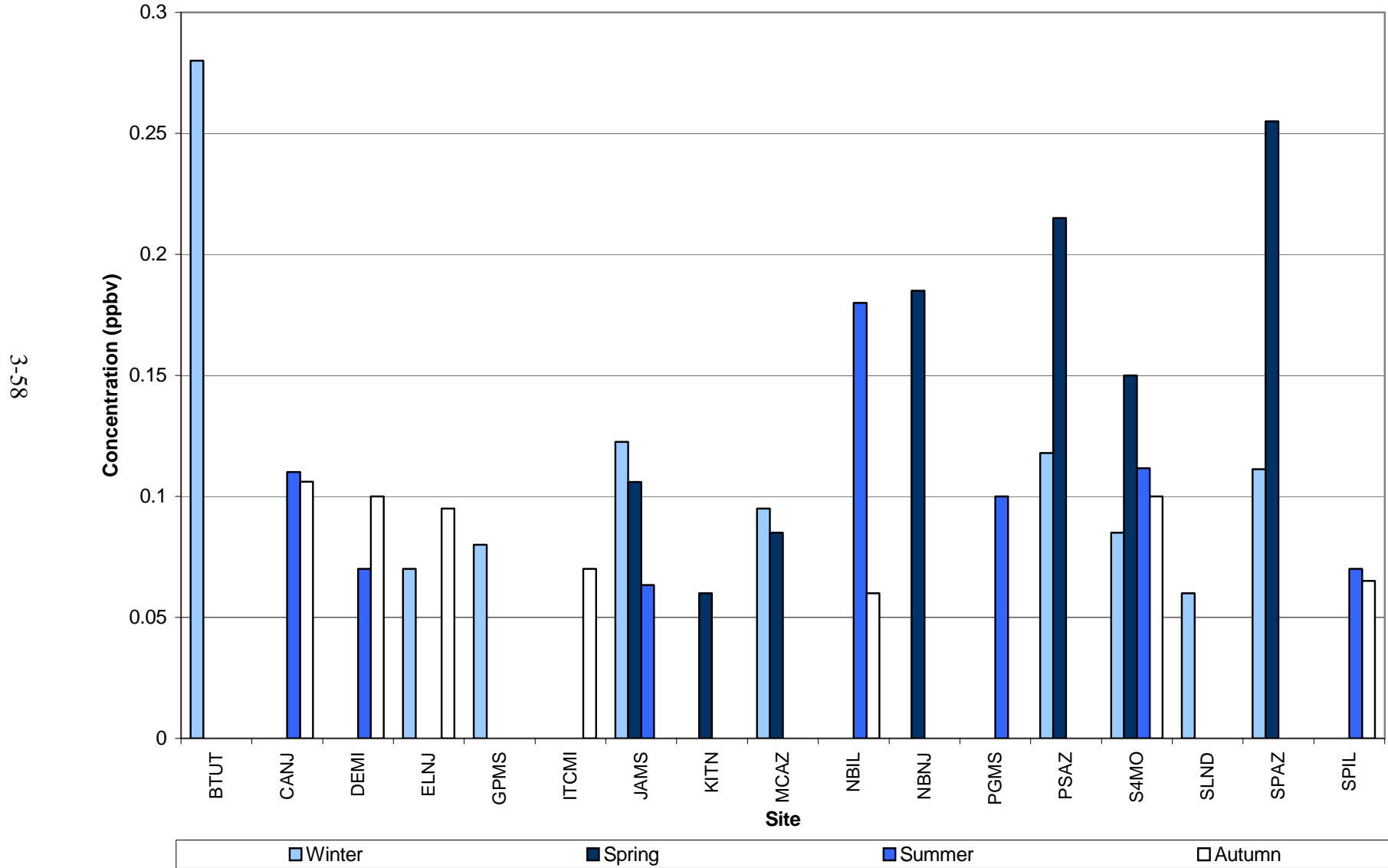


Figure 3-25. Average Seasonal Tetrachloroethylene Concentration Comparison by Season

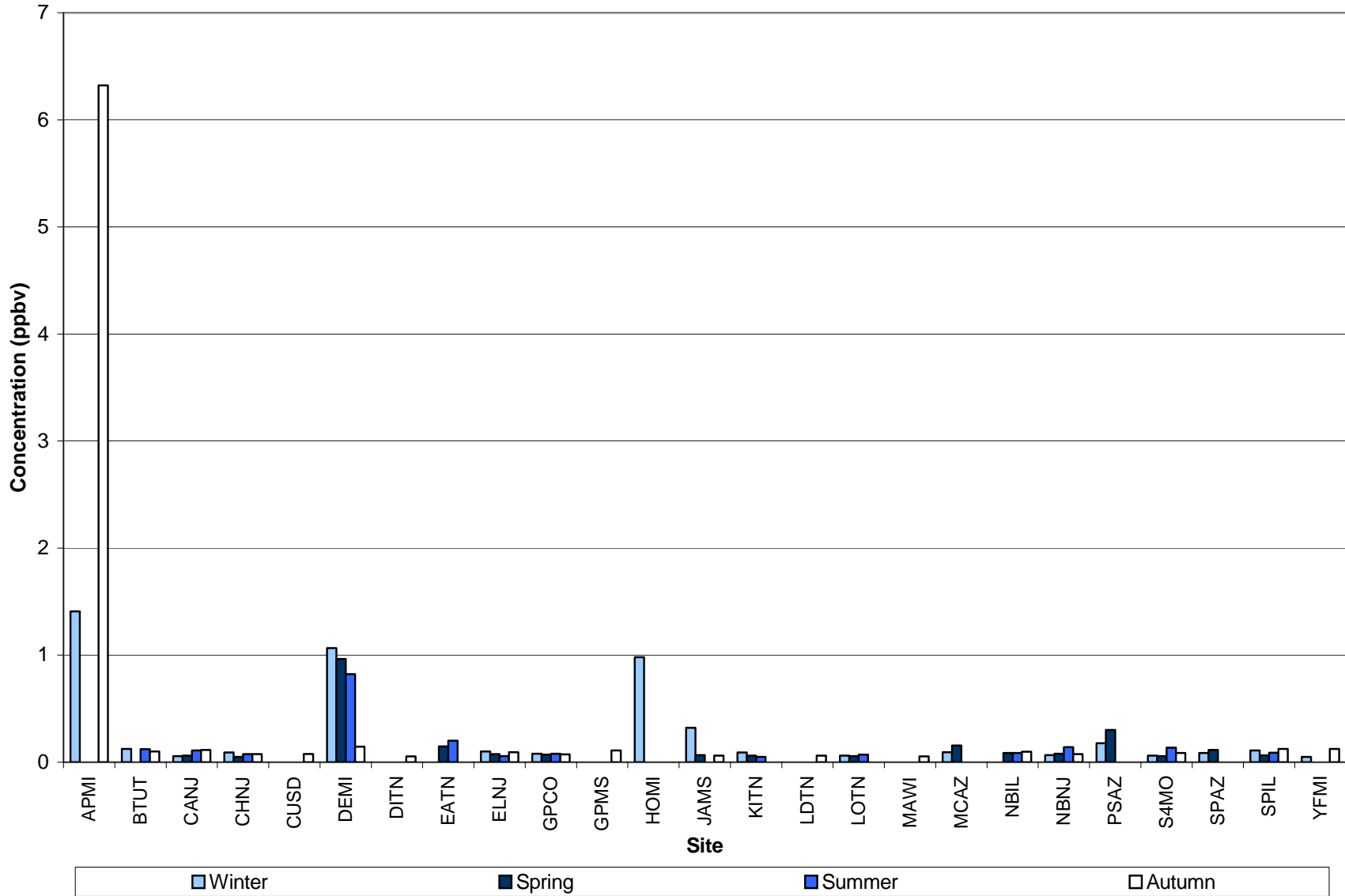


Figure 3-26. Average Seasonal Xylenes (Total) Concentration Comparison by Season

3-60

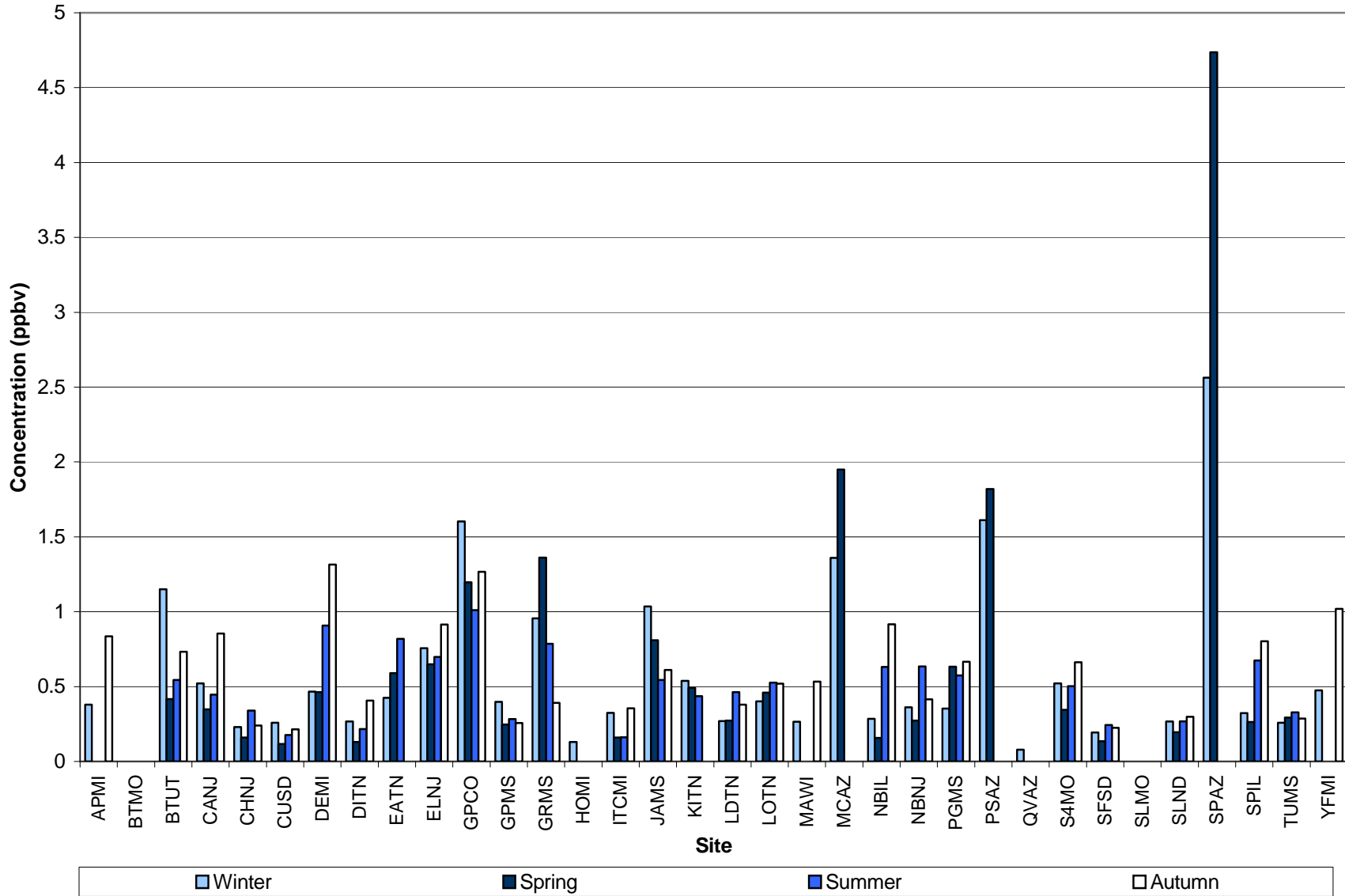


Figure 3-27. Comparison of Yearly Averages for the APMI Monitoring Site

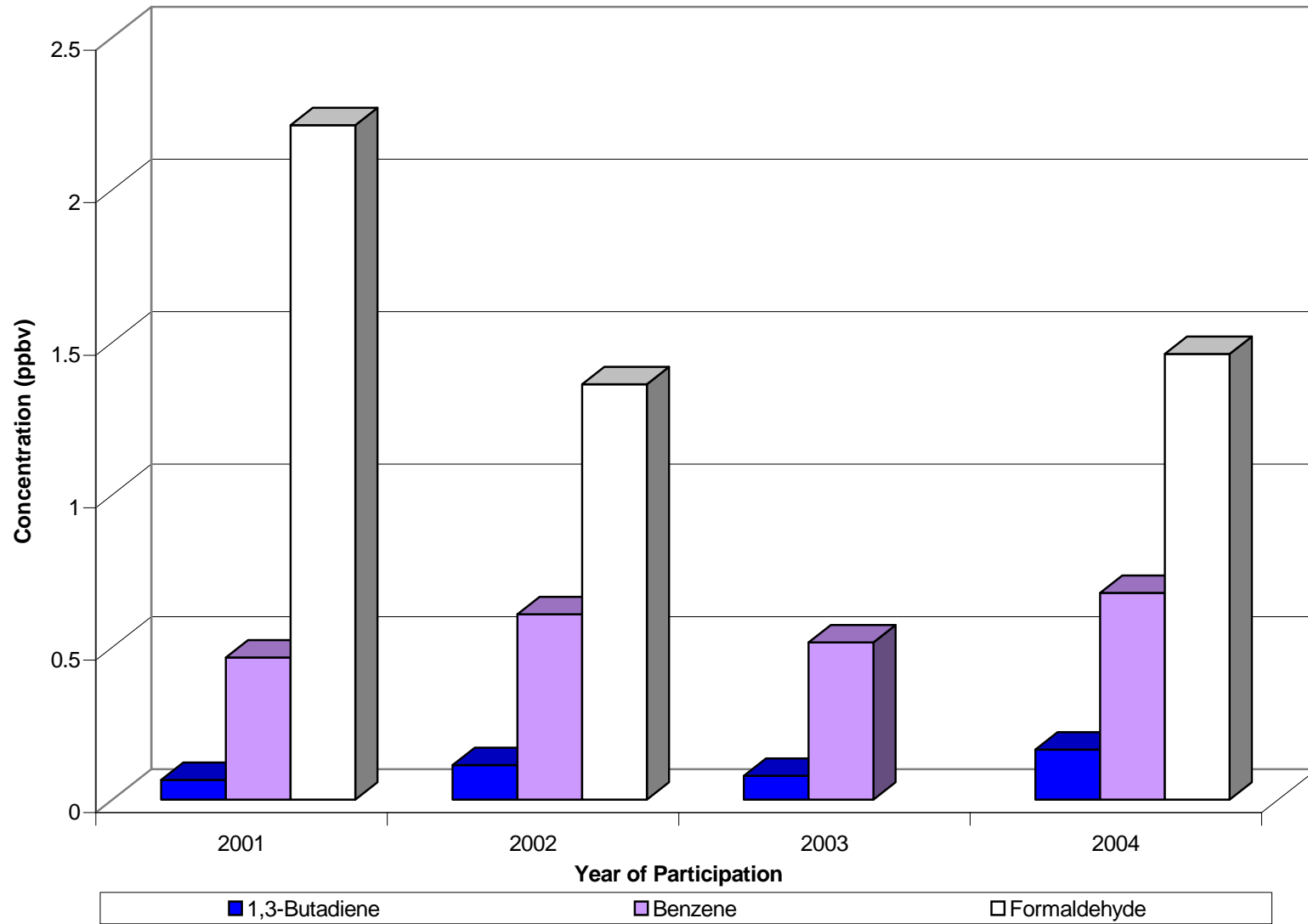


Figure 3-28. Comparison of Yearly Averages for the AZFL Monitoring Site

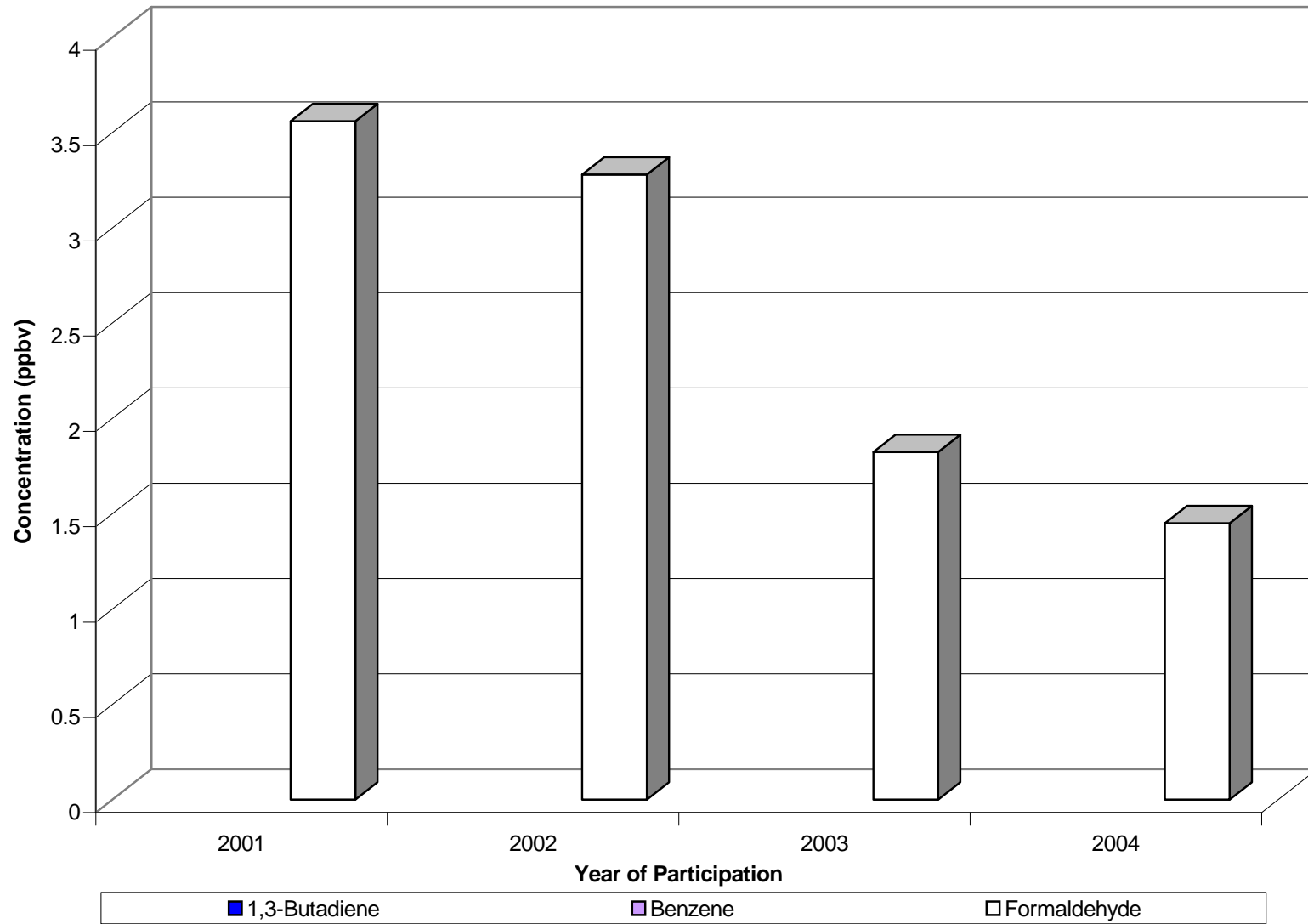
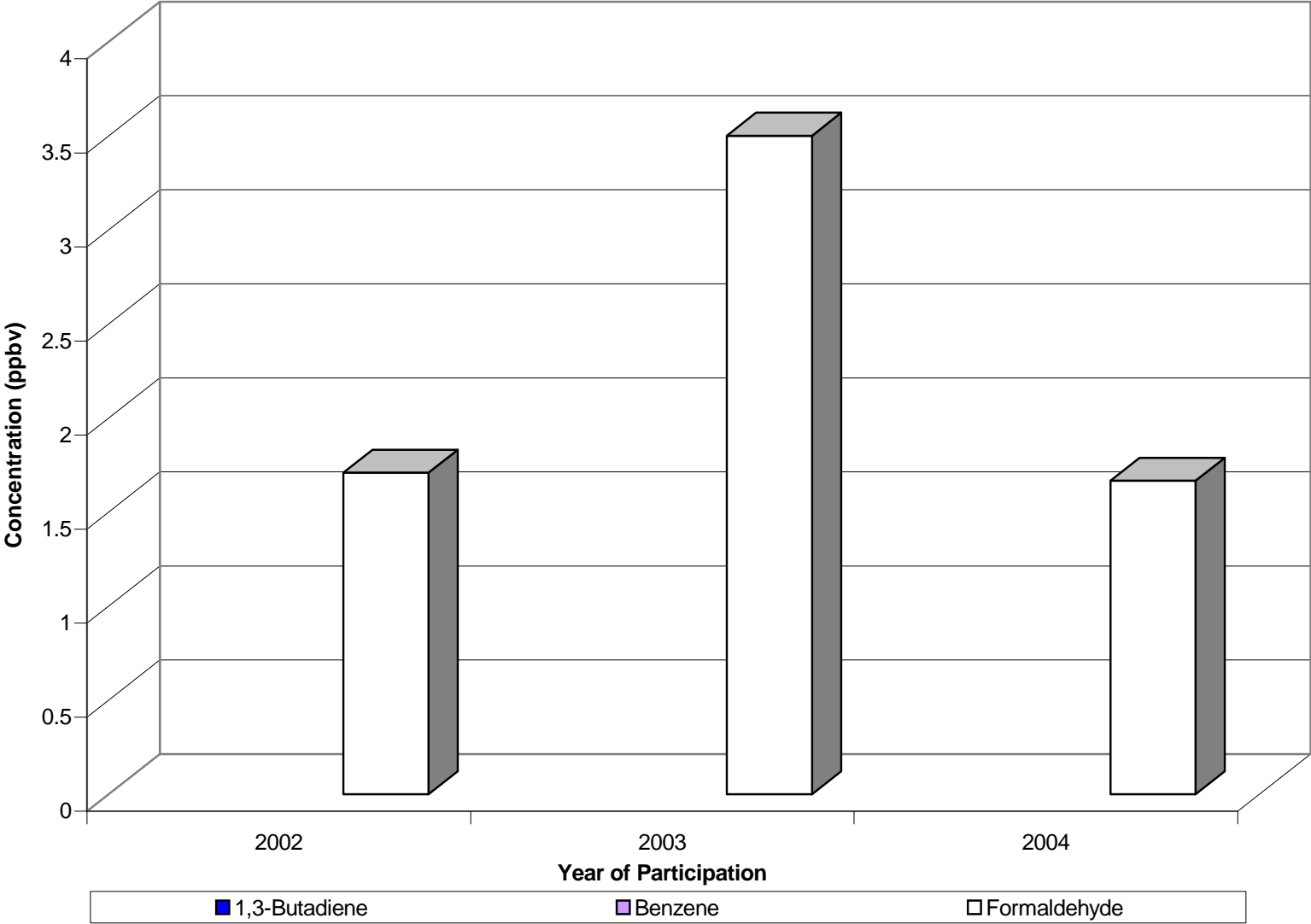


Figure 3-29. Comparison of Yearly Averages for the BTMO Monitoring Site



3-63

Figure 3-30. Comparison of Yearly Averages for the CANJ Monitoring Site

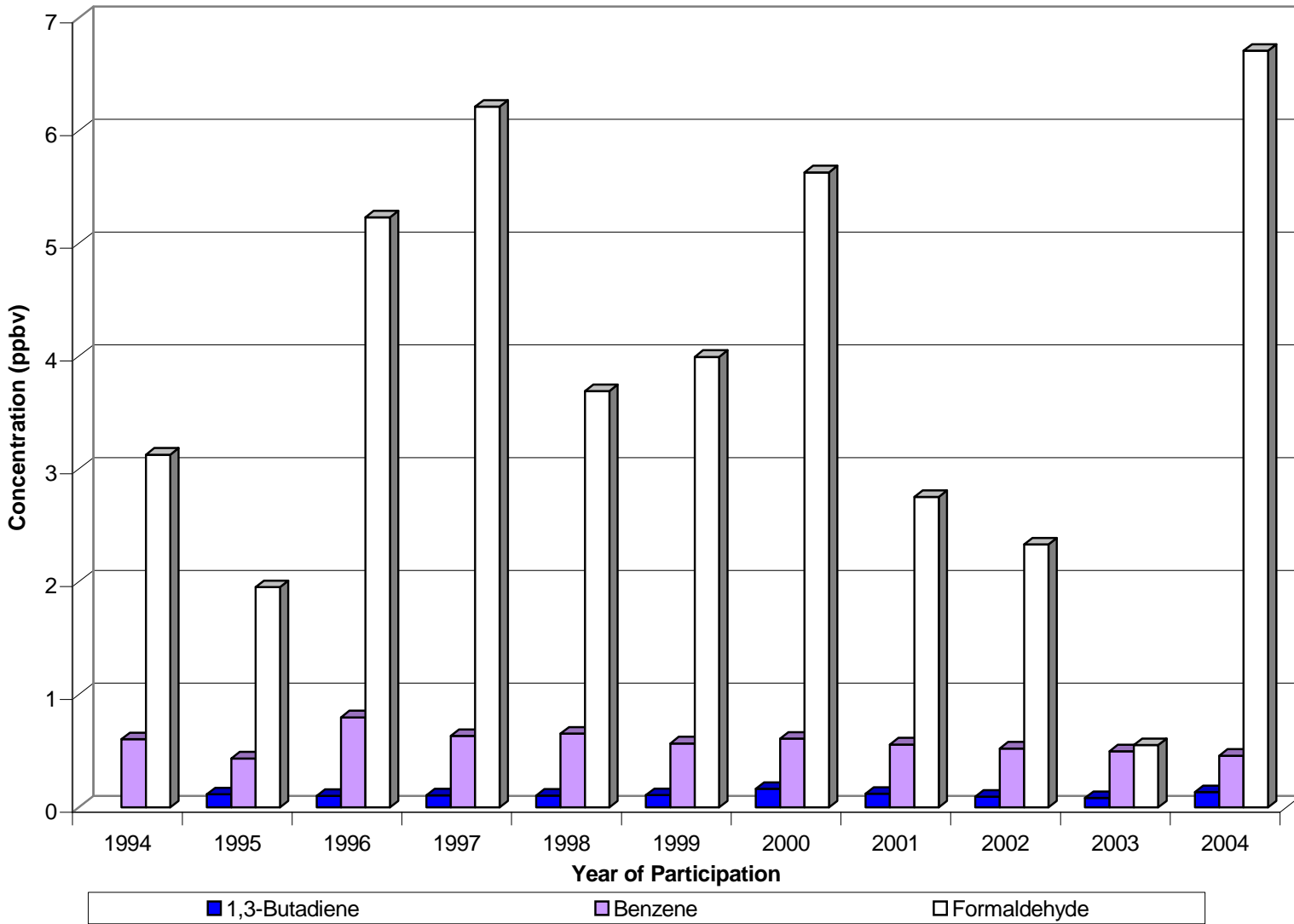
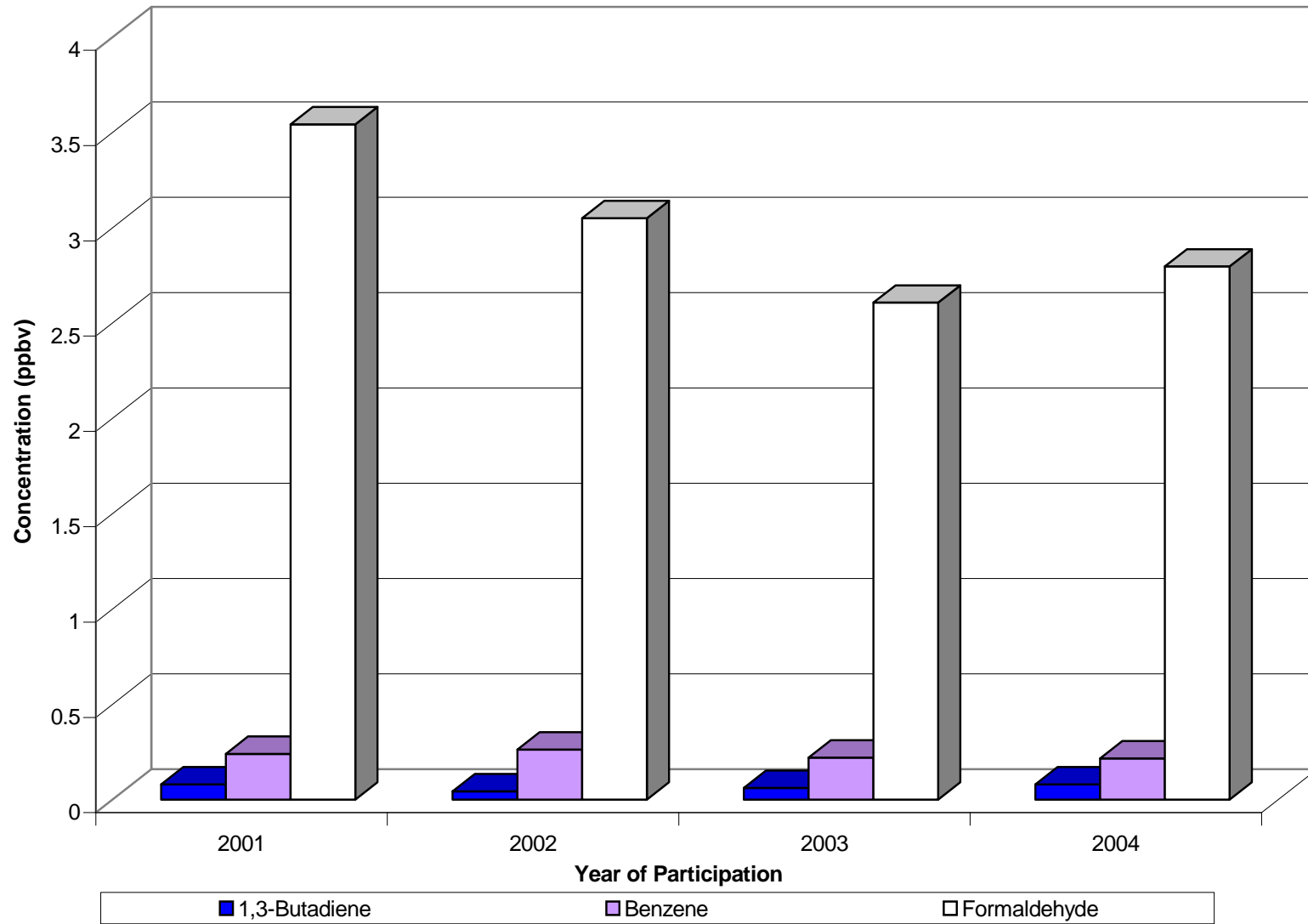


Figure 3-31. Comparison of Yearly Averages for the CHNJ Monitoring Site



3-65

Figure 3-32. Comparison of Yearly Averages for the CUSD Monitoring Site

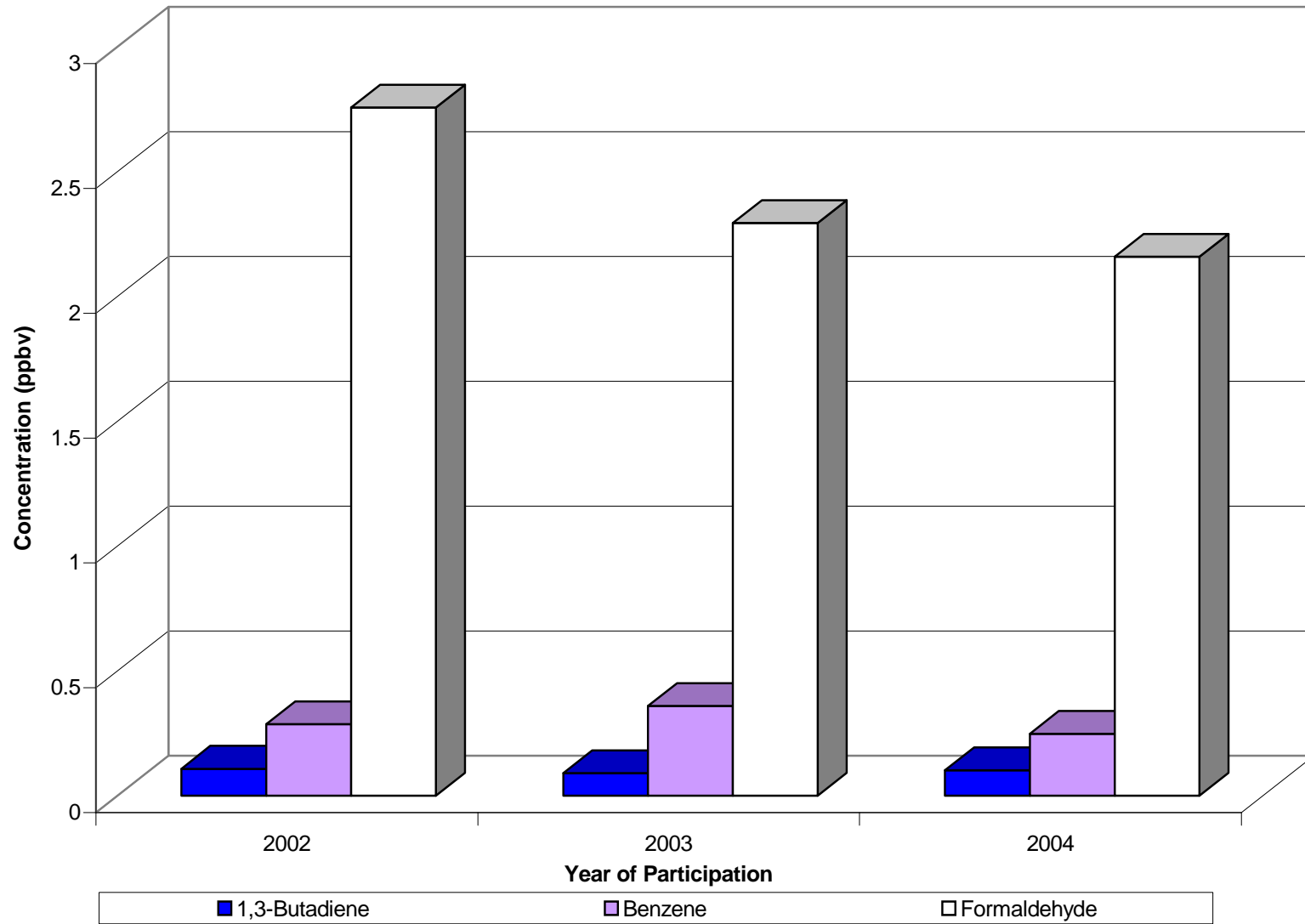
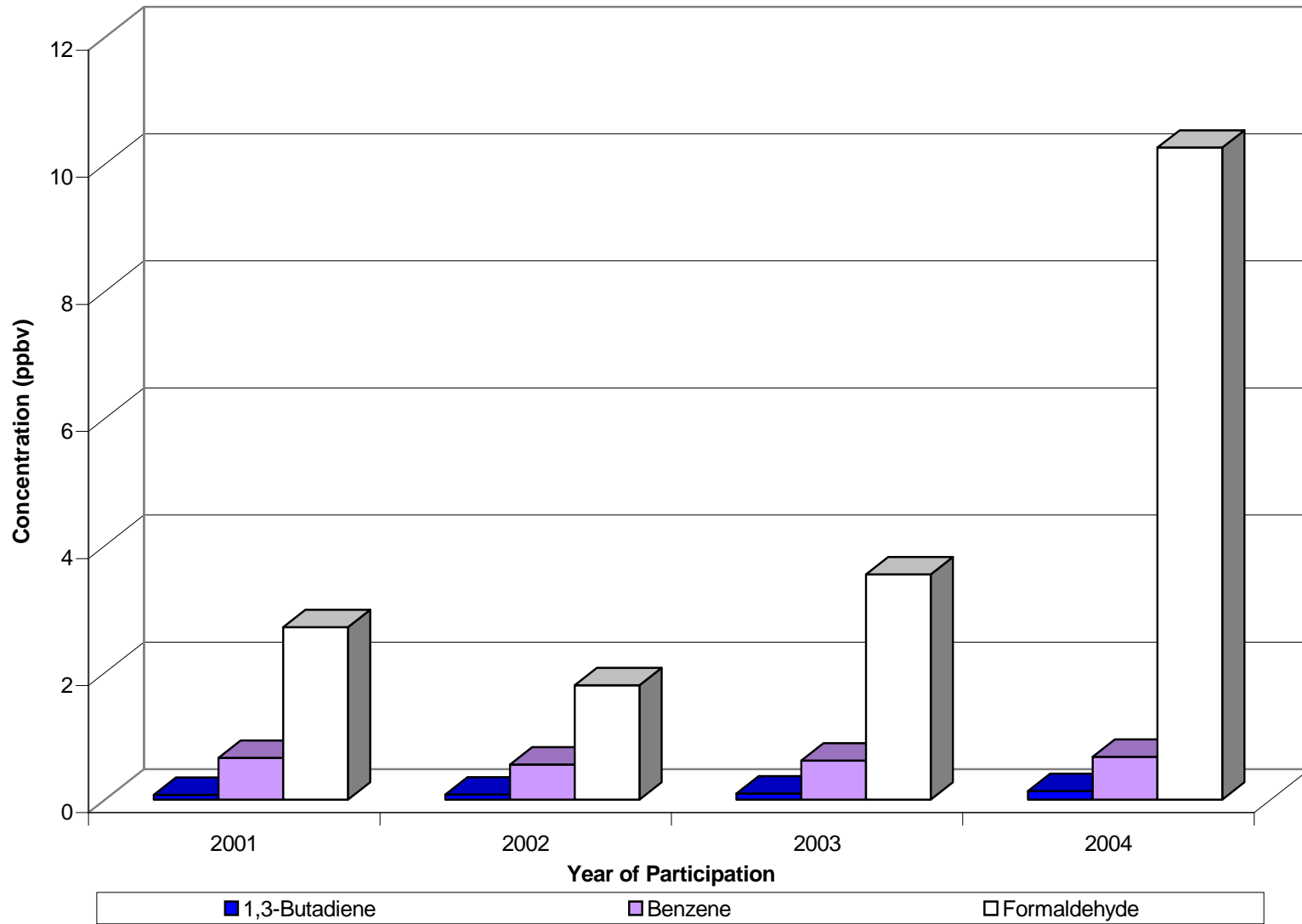


Figure 3-33. Comparison of Yearly Averages for the DEMI Monitoring Site



3-67

Figure 3-34. Comparison of Yearly Averages for the EATN Monitoring Site

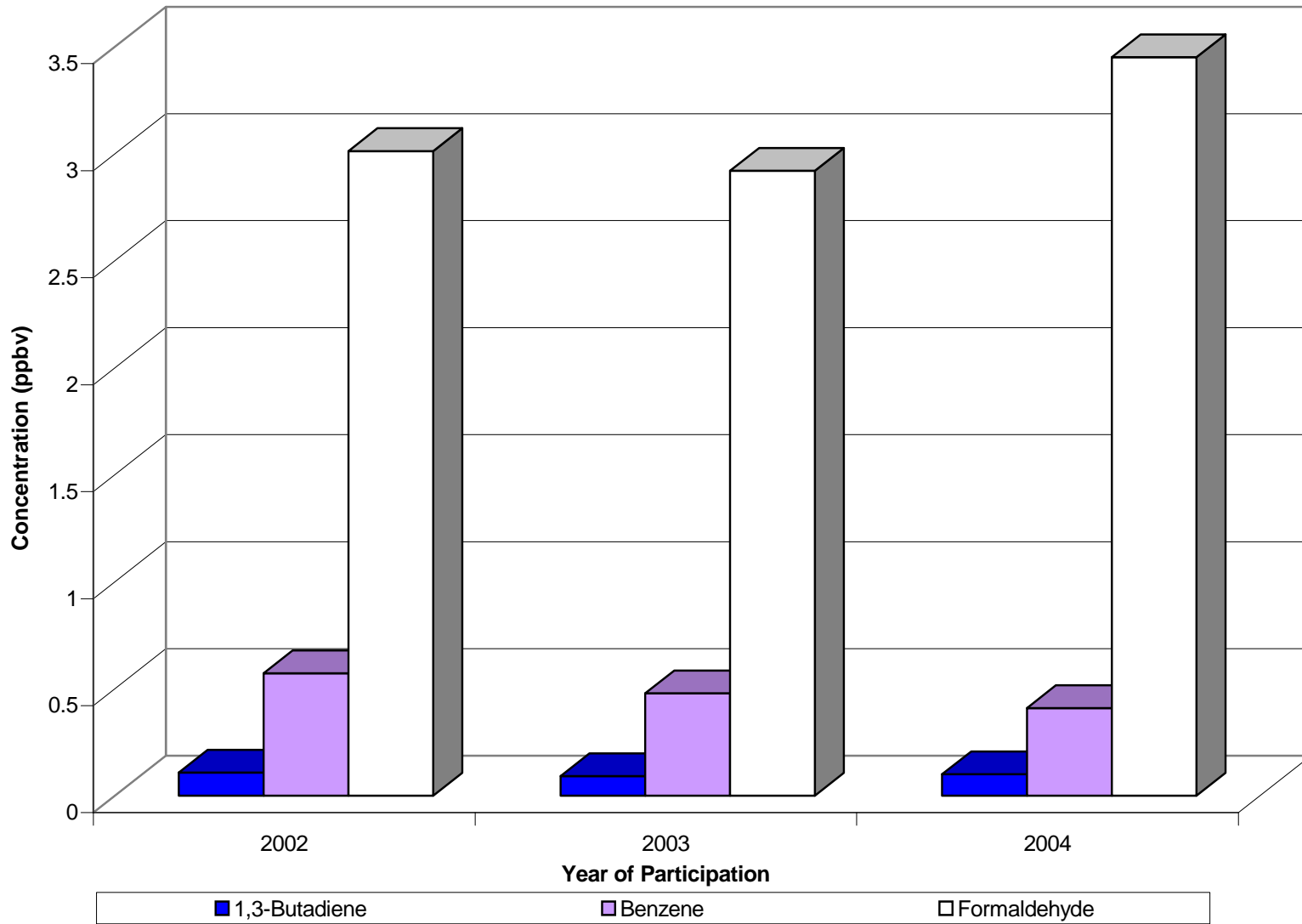


Figure 3-35. Comparison of Yearly Averages for the ELNJ Monitoring Site

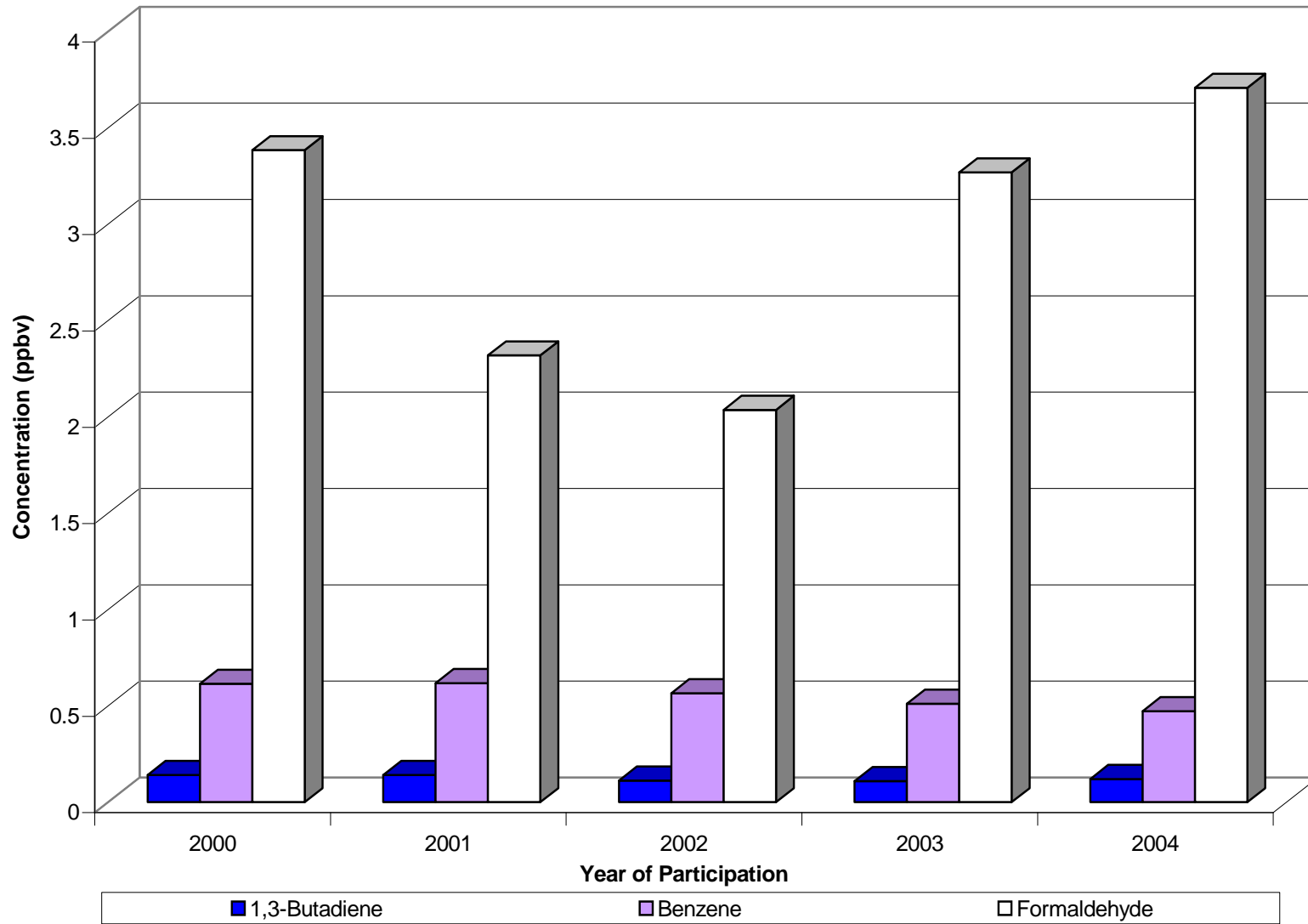
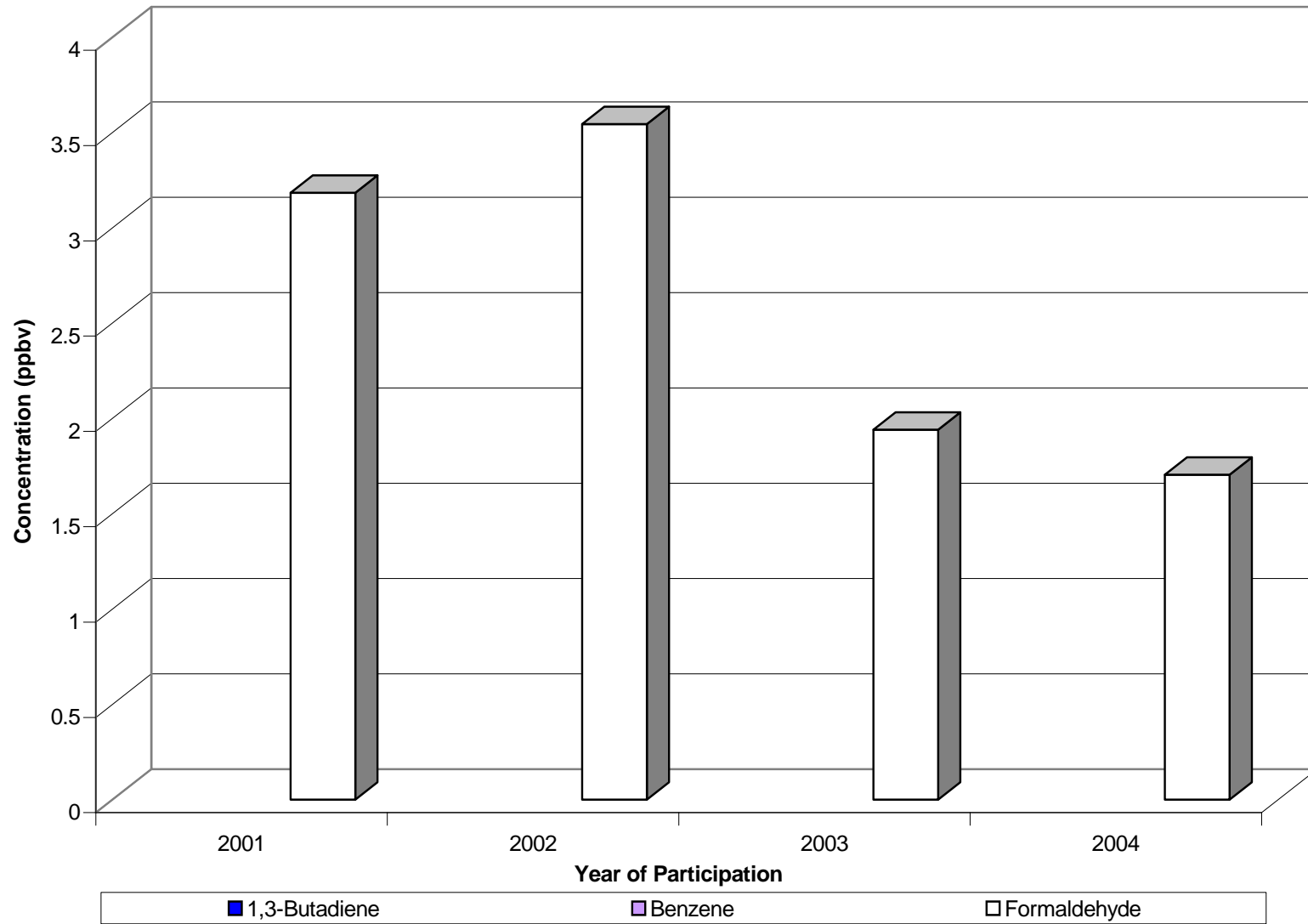
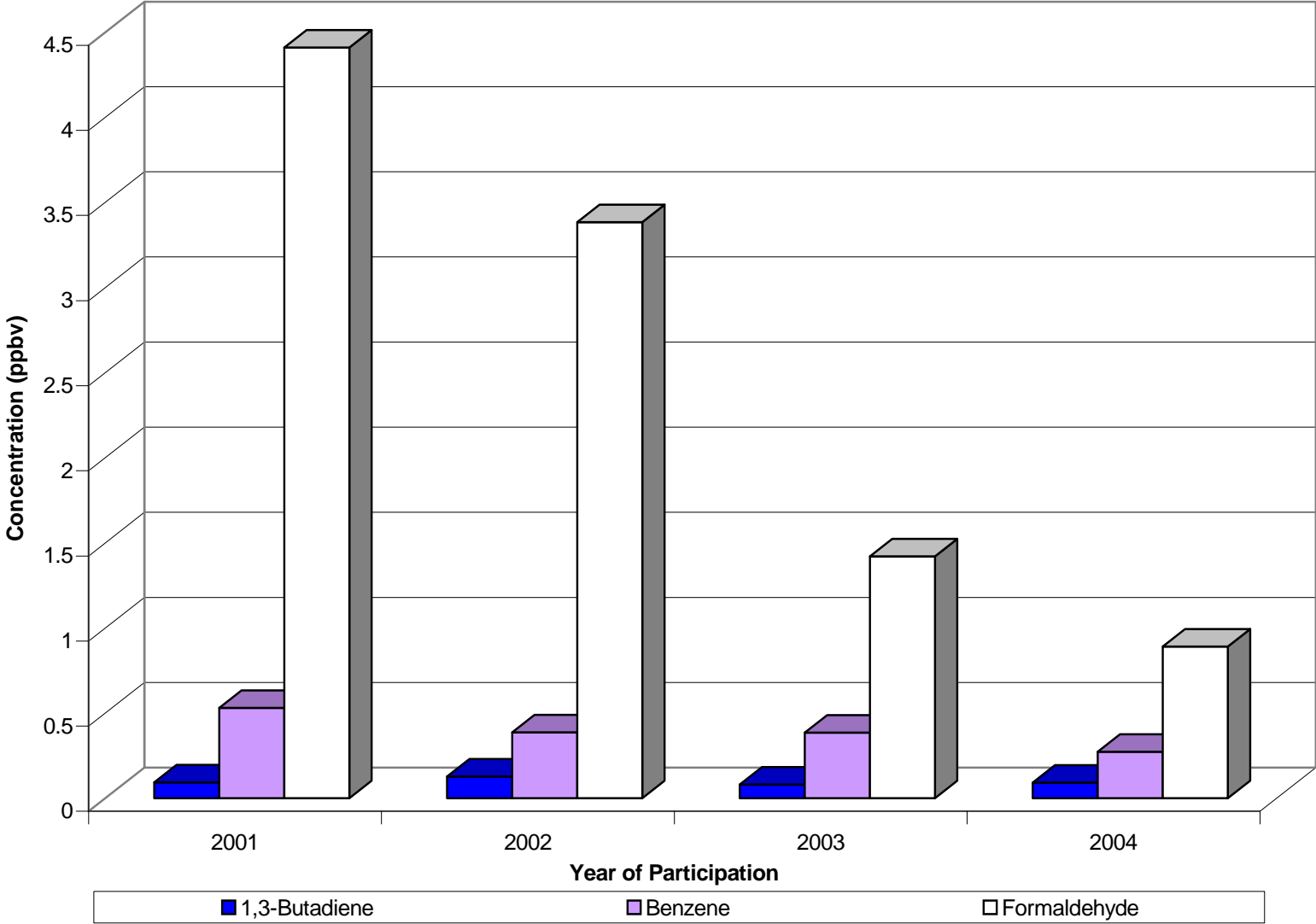


Figure 3-36. Comparison of Yearly Averages for the GAFL Monitoring Site



3-70

Figure 3-37. Comparison of Yearly Averages for the GPMS Monitoring Site



3-71

Figure 3-38. Comparison of Yearly Averages for the HOMI Monitoring Site

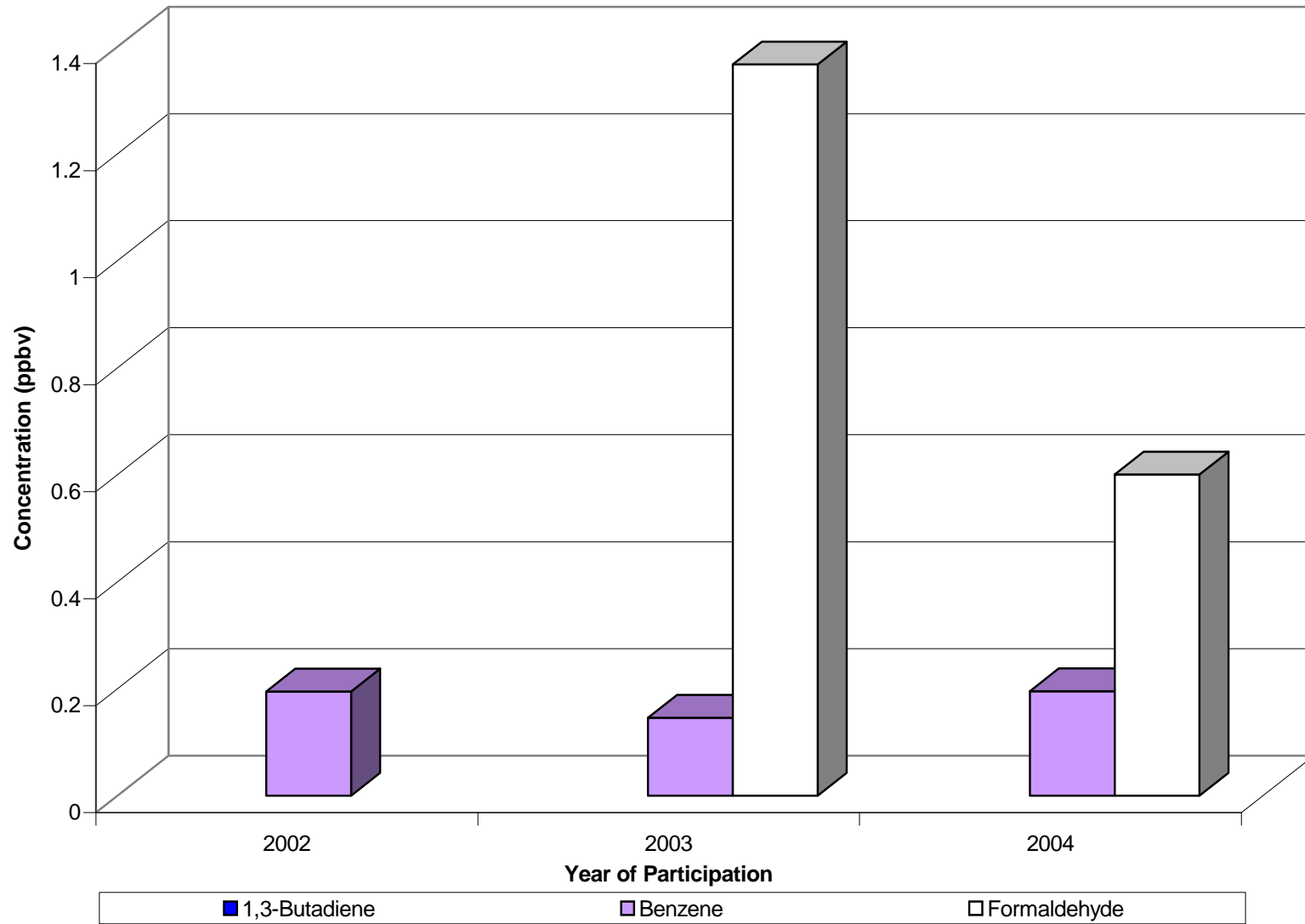


Figure 3-39. Comparison of Yearly Averages for the JAMS Monitoring Site

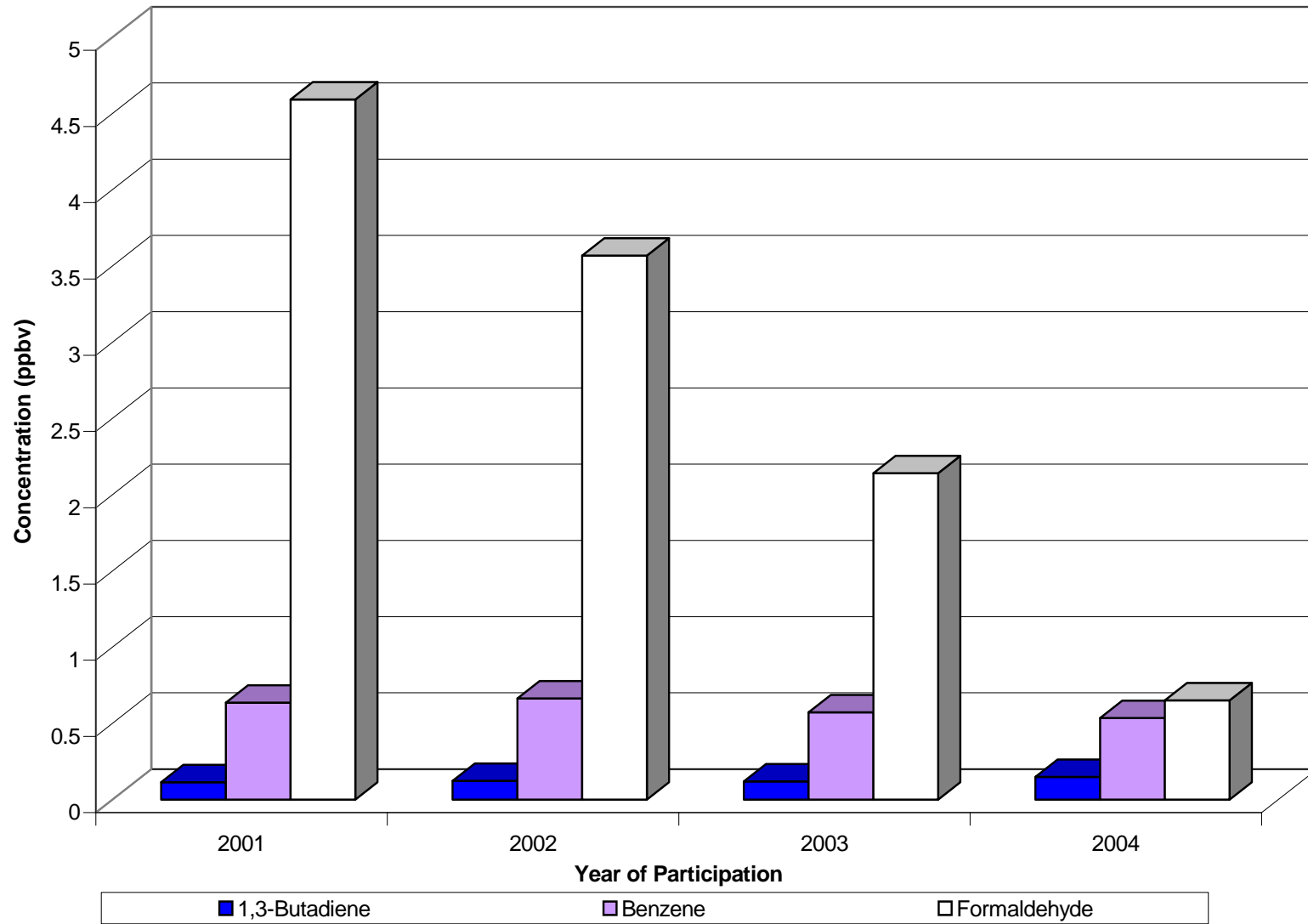


Figure 3-40. Comparison of Yearly Averages for the LOTN Monitoring Site

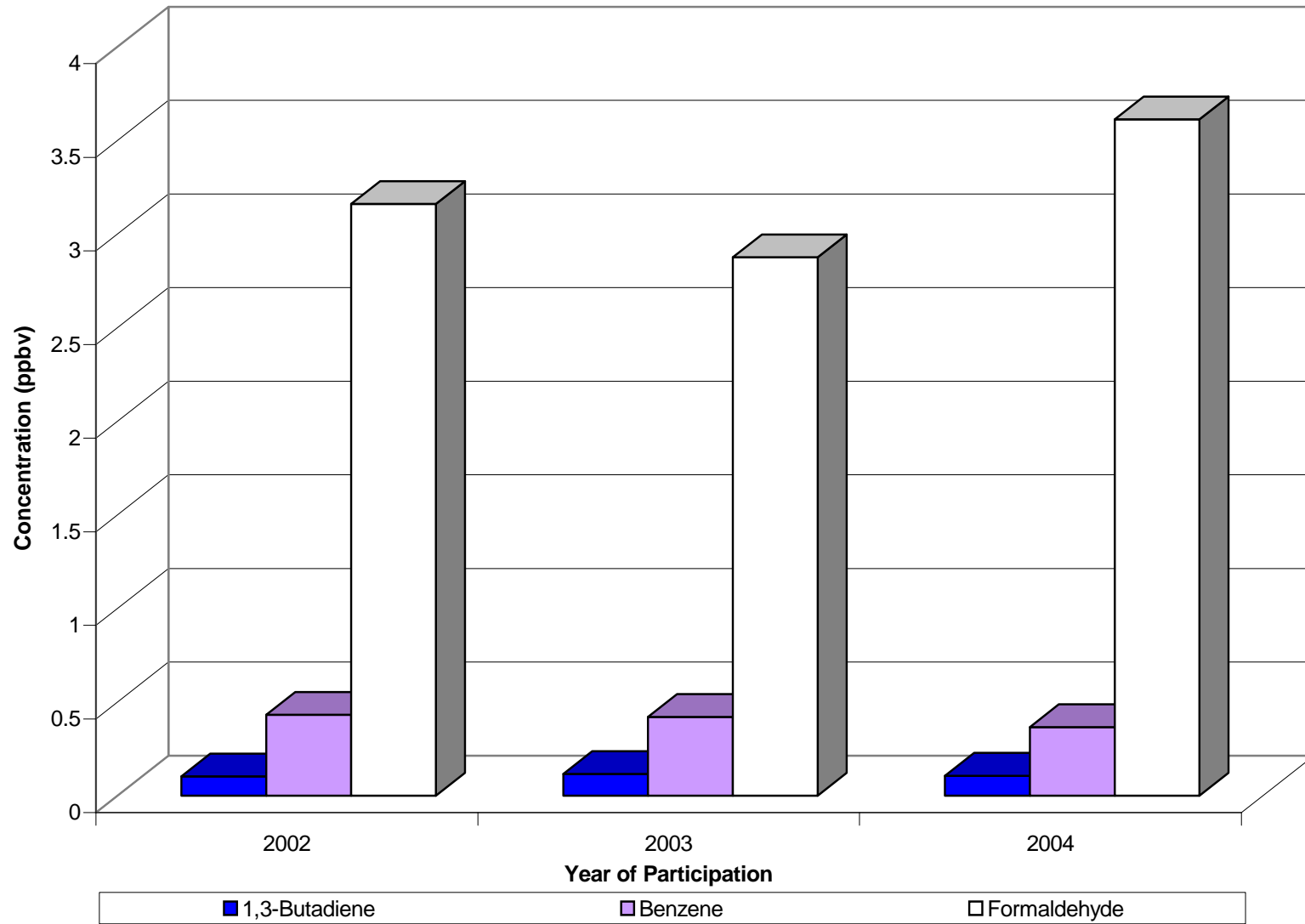
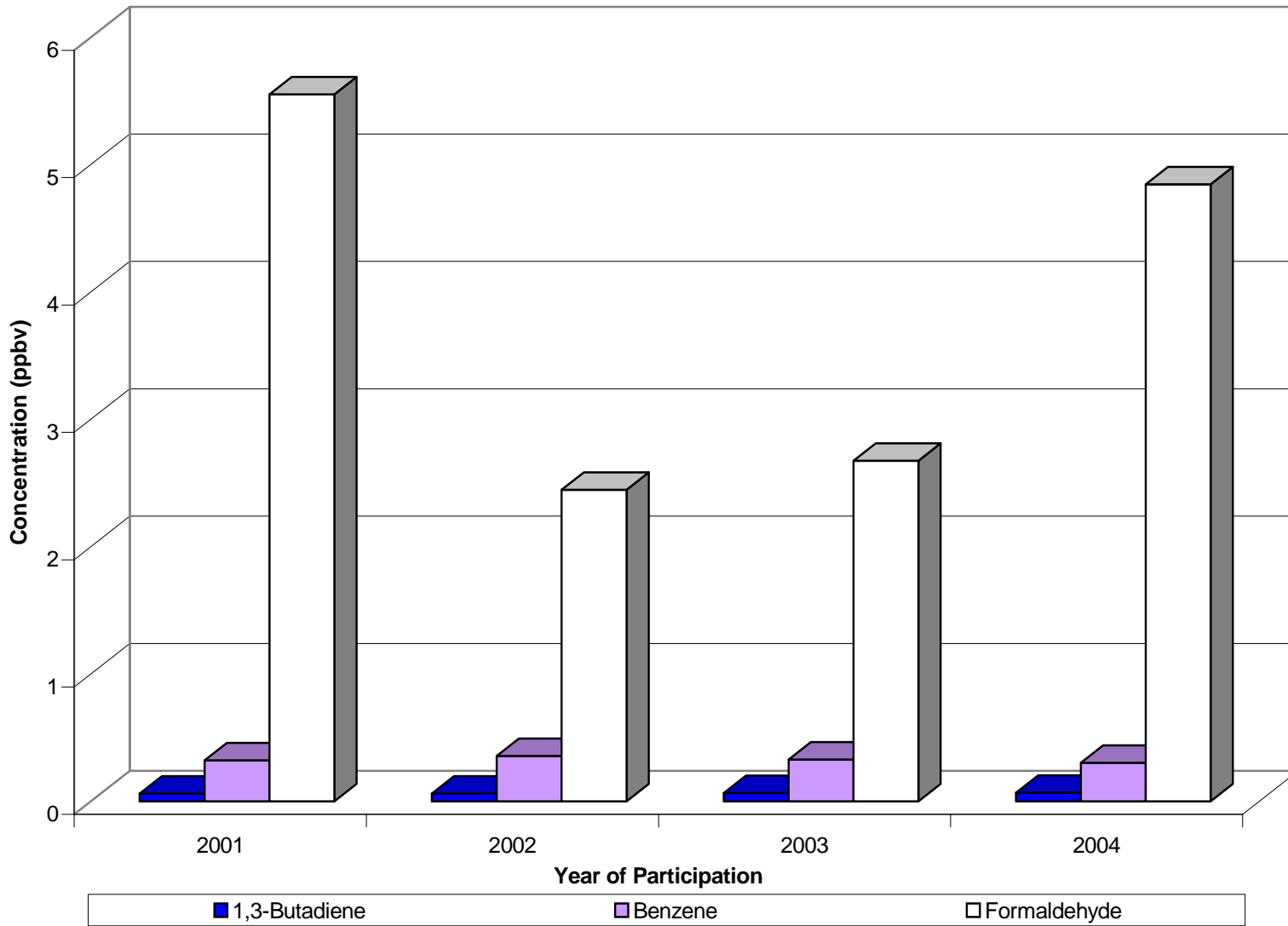
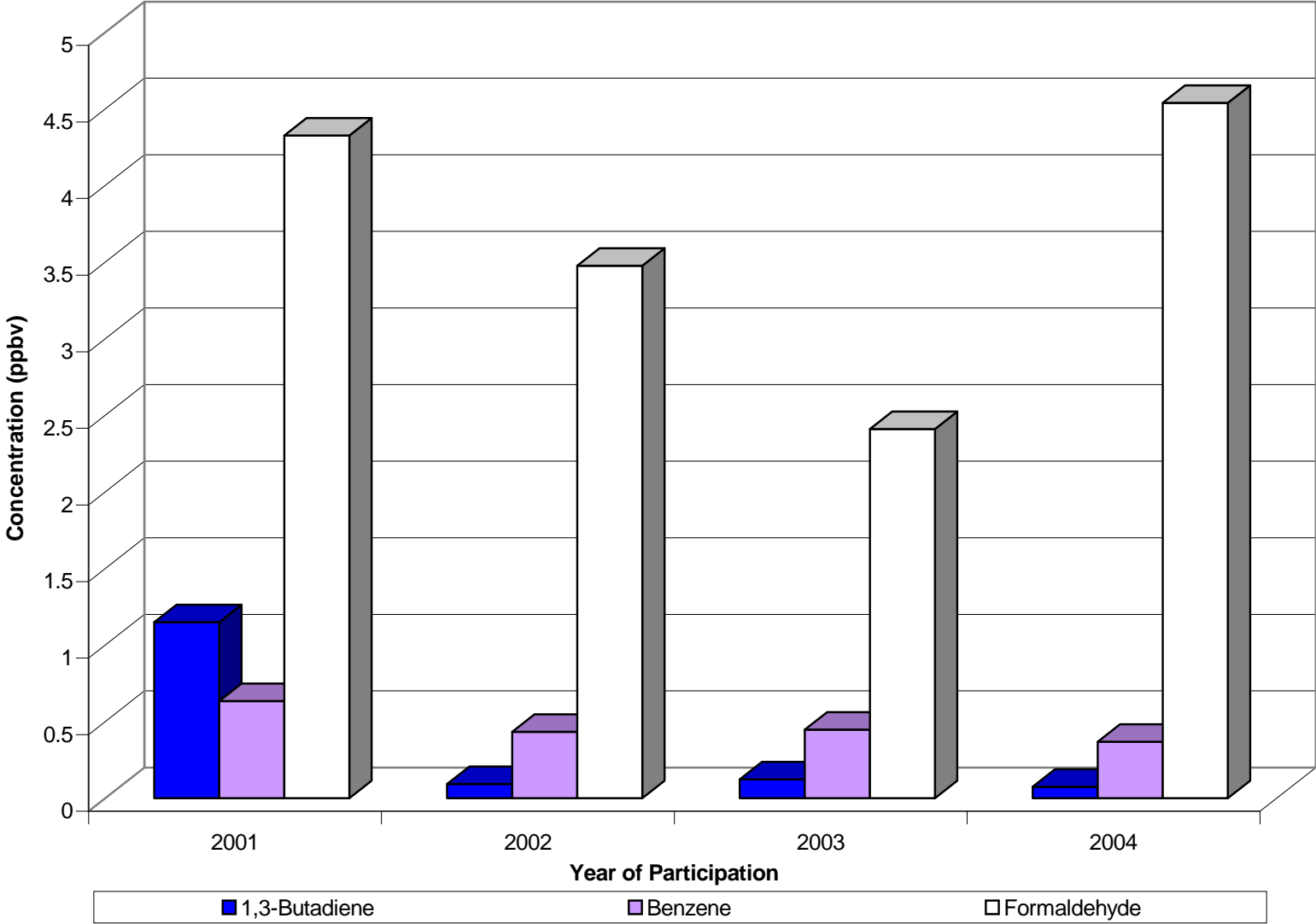


Figure 3-41. Comparison of Yearly Averages for the NBNJ Monitoring Site



3-75

Figure 3-42. Comparison of Yearly Averages for the PGMS Monitoring Site



3-76

Figure 3-43. Comparison of Yearly Averages for the PSAZ Monitoring Site

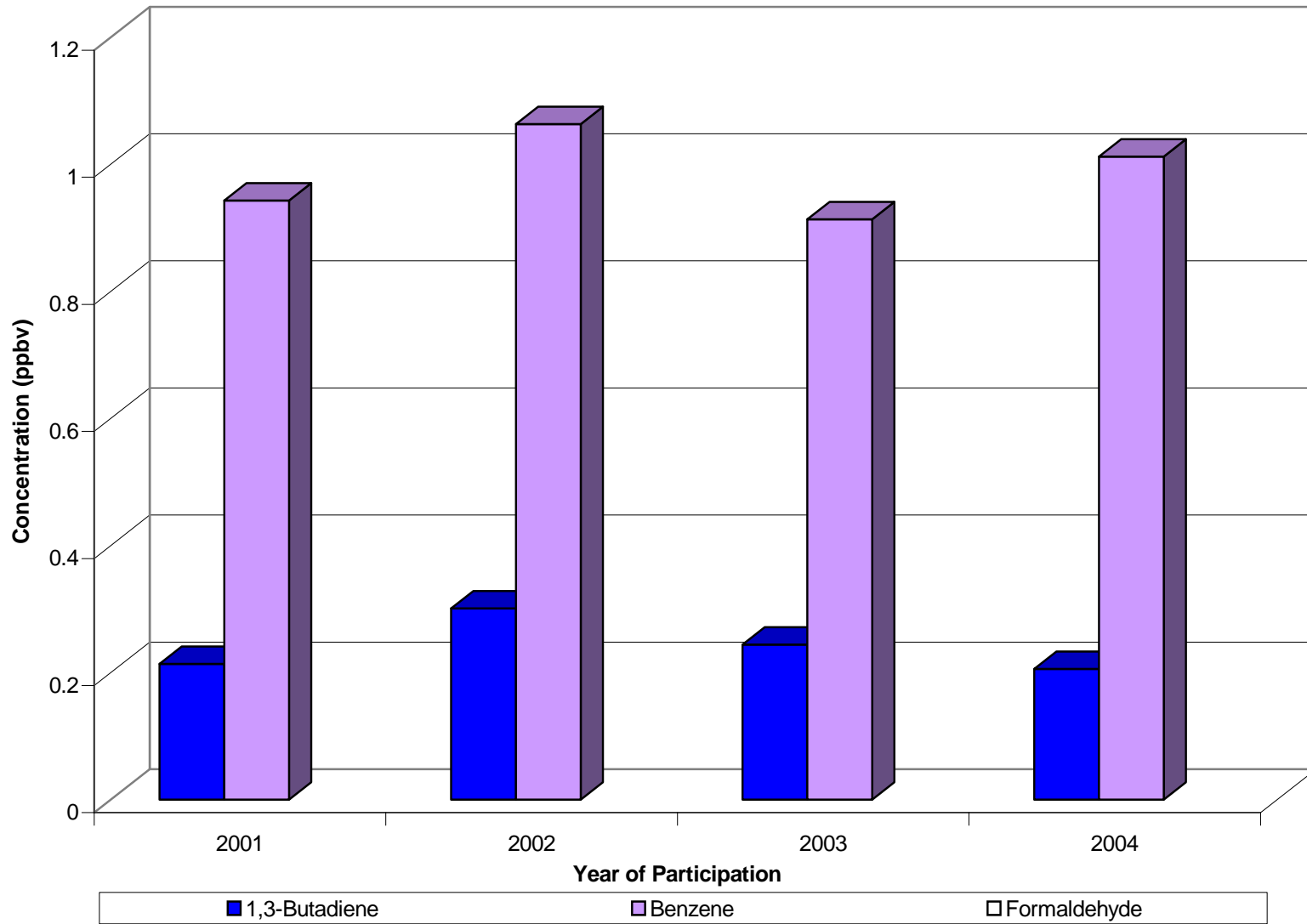


Figure 3-44. Comparison of Yearly Averages for the QVAZ Monitoring Site

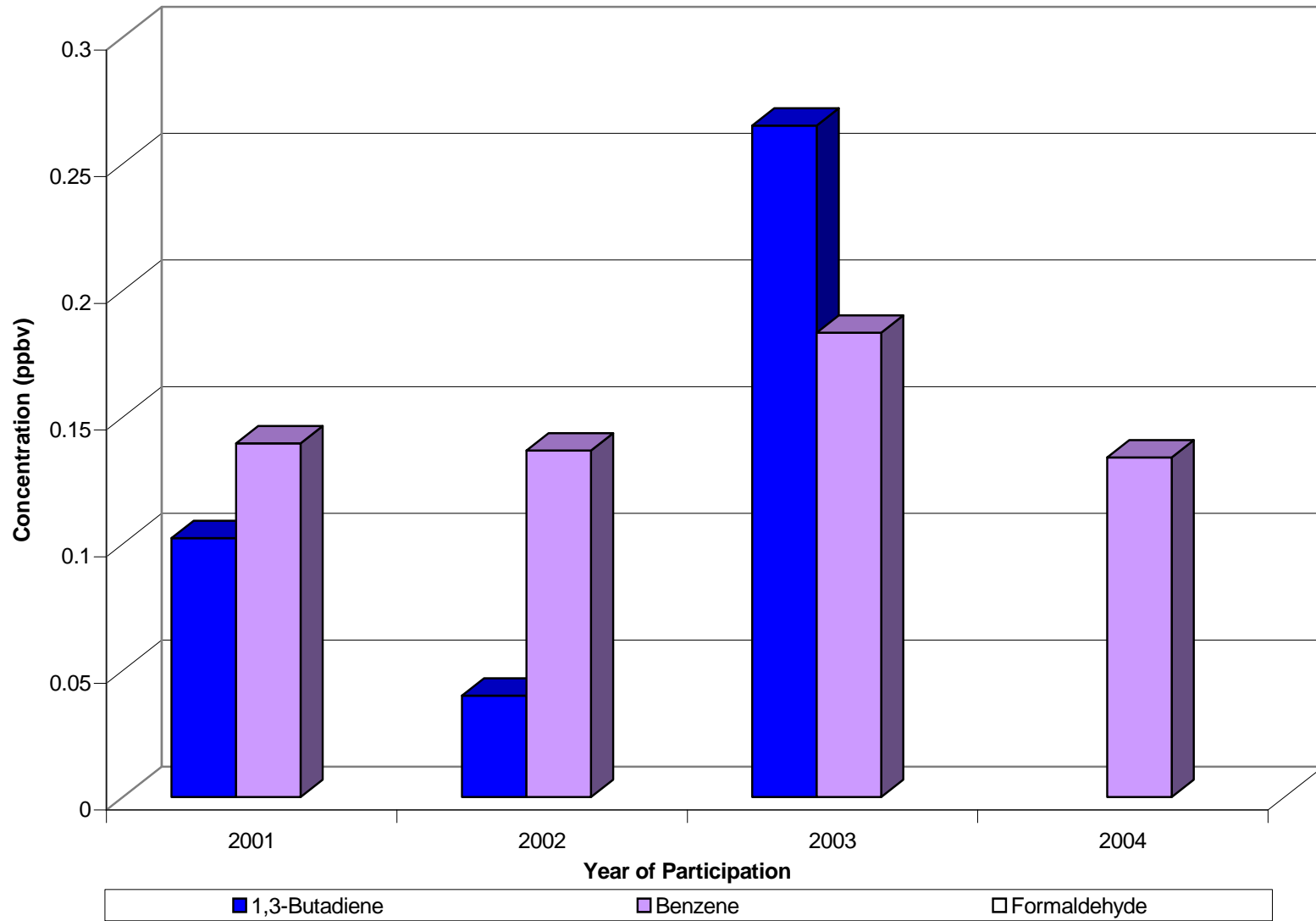


Figure 3-45. Comparison of Yearly Averages for the S4MO Monitoring Site

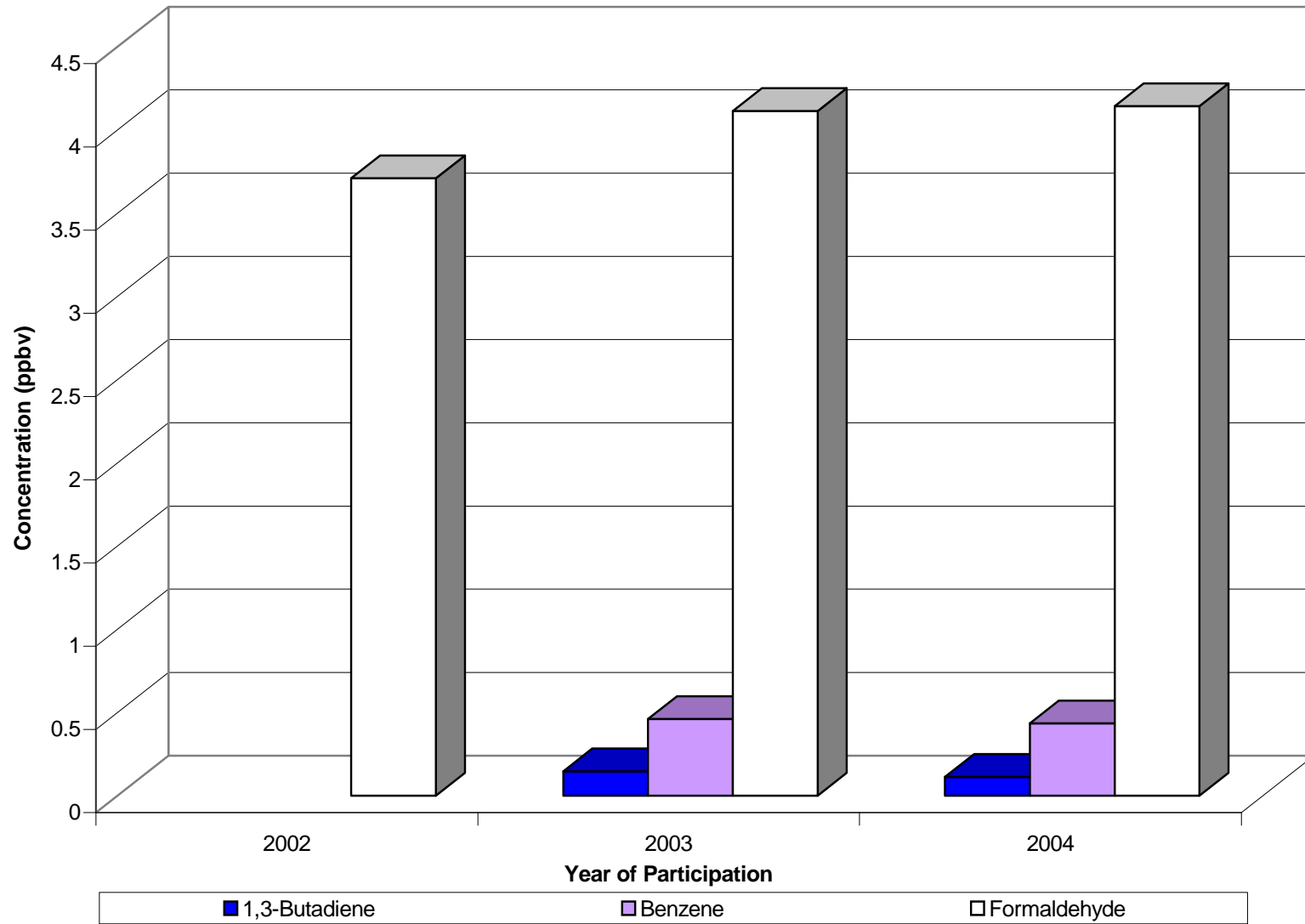


Figure 3-46. Comparison of Yearly Averages for the SFSD Monitoring Site

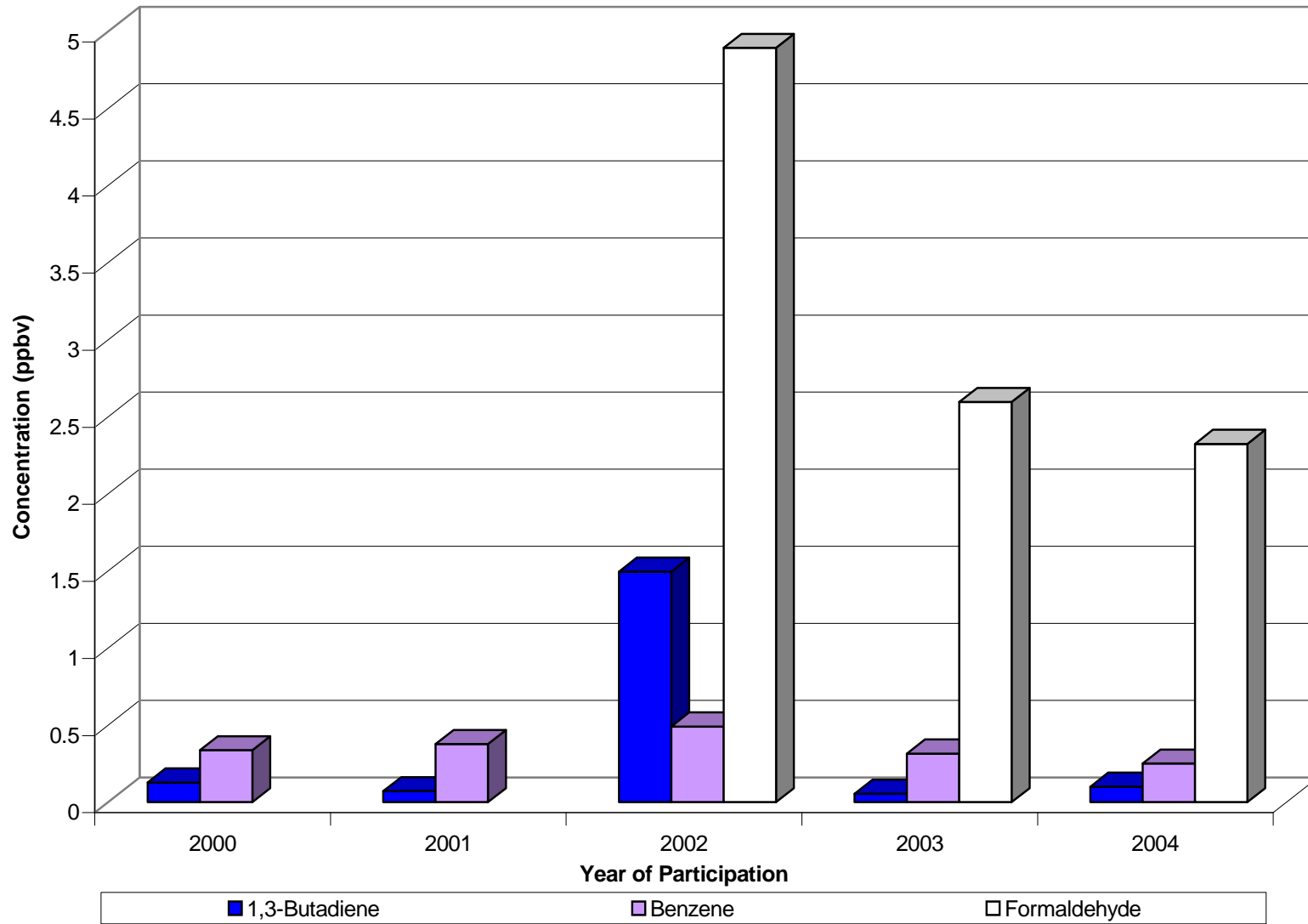
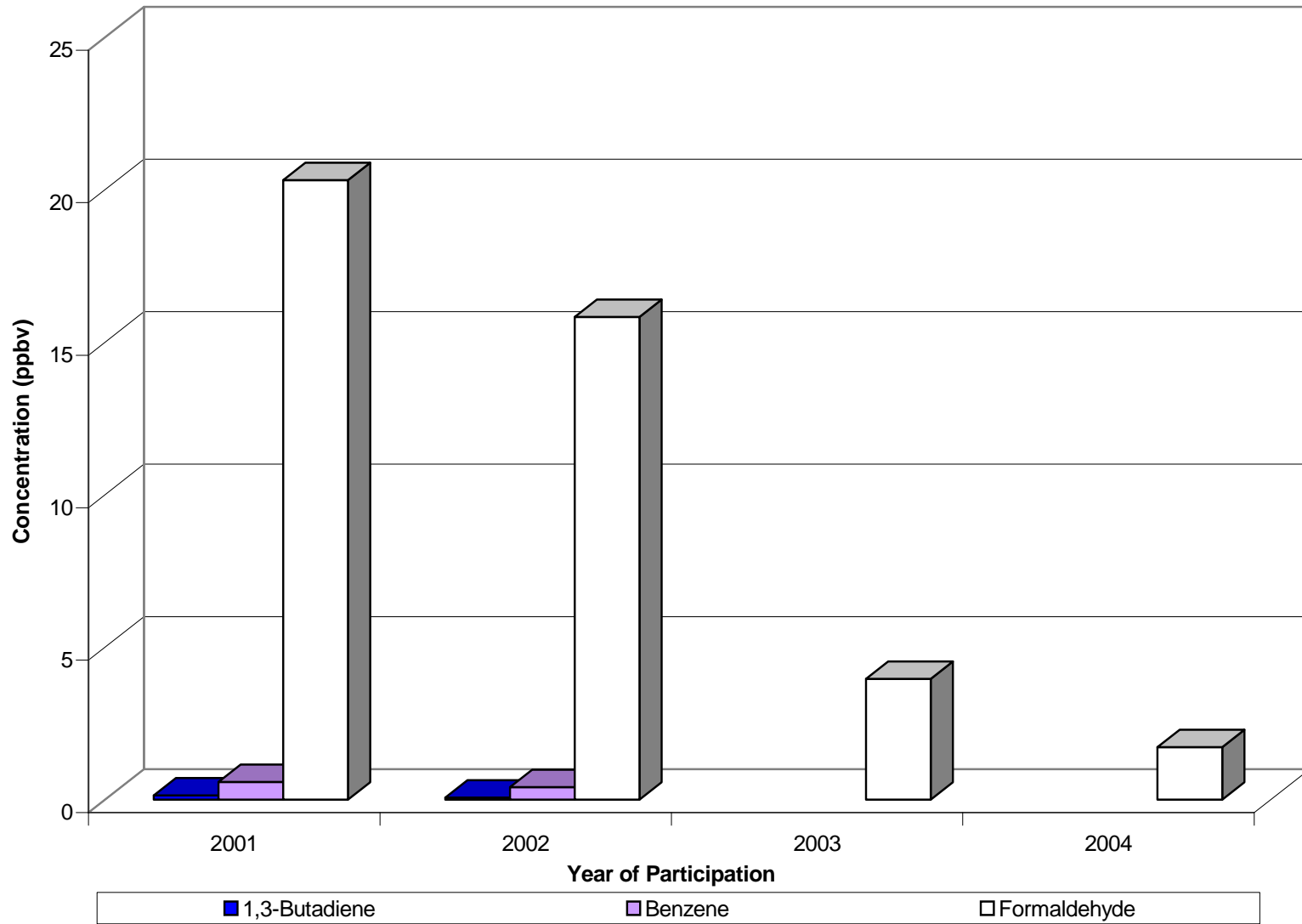


Figure 3-47. Comparison of Yearly Averages for the SLMO Monitoring Site



3-81

Figure 3-48. Comparison of Yearly Averages for the SPAZ Monitoring Site

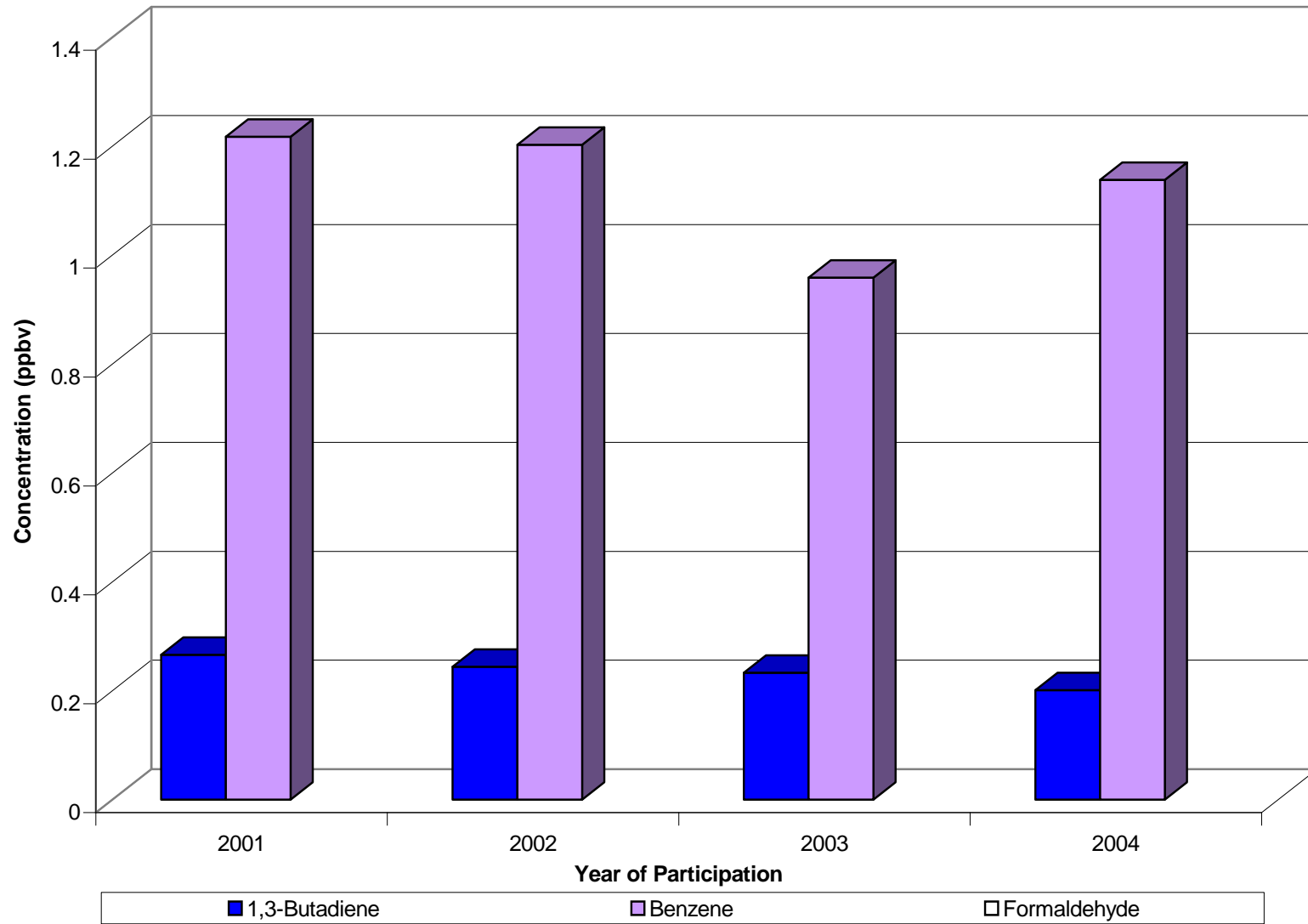


Figure 3-49. Comparison of Yearly Averages for the TUMS Monitoring Site

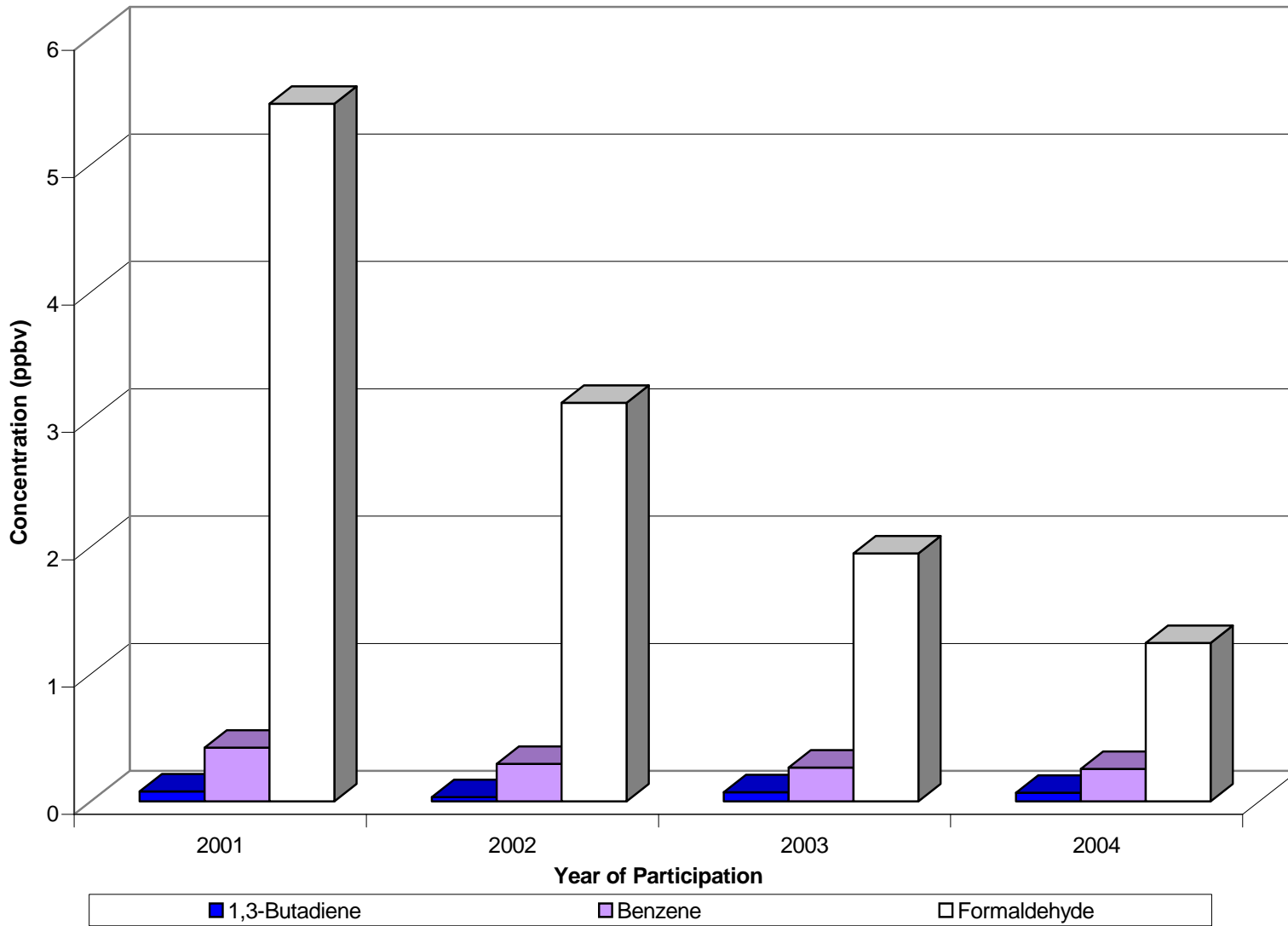


Figure 3-50. Comparison of Yearly Averages for the YFMI Monitoring Site

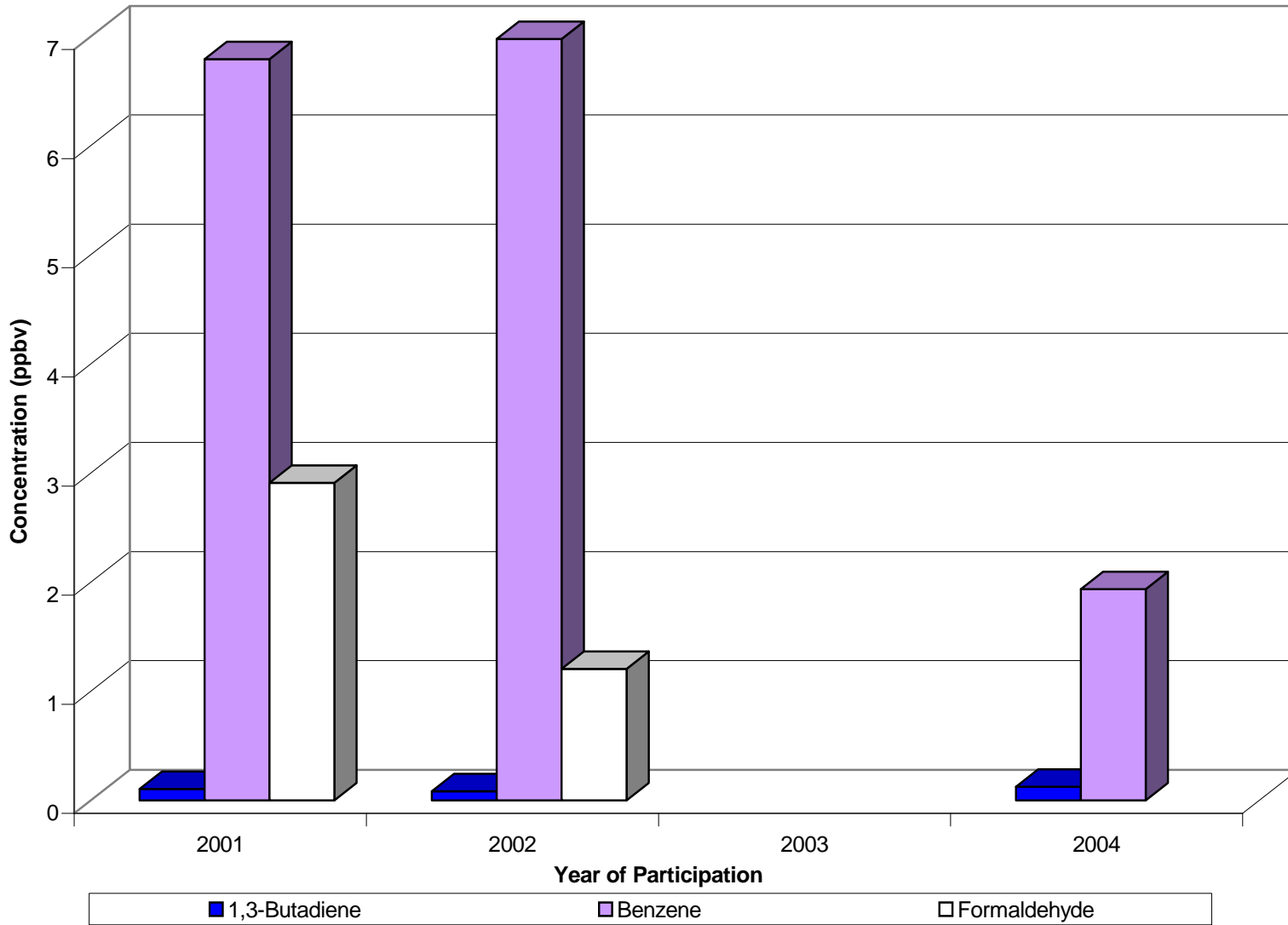


Table 3-1. Target Compound Detection Summaries of the VOC Concentrations

Chemical¹	# of Detects	Min. Value (ppbv)	Max. Value (ppbv)	Average Value (ppbv)	Mode (ppbv)	Median (ppbv)	1st Quartile (ppbv)	3rd Quartile (ppbv)	Standard Deviation (ppbv)	Coefficient of Variation
Hydrocarbons										
Acetylene	1111	0.05	111	1.71	0.44	0.95	0.57	1.61	5.97	3.50
<i>Benzene</i>	1119	0.05	8.77	0.47	0.28	0.33	0.22	0.53	0.59	1.26
<i>1,3-Butadiene</i>	303	0.06	0.69	0.12	0.06	0.10	0.07	0.15	0.08	0.66
Ethylbenzene	1016	0.04	1.86	0.16	0.04	0.11	0.07	0.18	0.15	0.97
<i>n</i> -Octane	317	0.06	16.6	0.23	0.06	0.09	0.07	0.15	1.06	4.69
Propylene	1107	0.07	18.4	0.87	0.29	0.48	0.27	0.86	1.62	1.85
Styrene	673	0.04	4.69	0.15	0.04	0.07	0.05	0.12	0.31	2.02
Toluene	1120	0.05	9.91	0.91	0.23	0.63	0.33	1.09	0.97	1.06
1,2,4-Trimethylbenzene	782	0.06	11.6	0.20	0.09	0.13	0.09	0.21	0.50	2.45
1,3,5-Trimethylbenzene	553	0.04	3.56	0.09	0.04	0.06	0.05	0.09	0.18	2.04
<i>m,p</i> -Xylene	1090	0.05	4.93	0.40	0.11	0.26	0.15	0.48	0.44	1.09
<i>o</i> -Xylene	1023	0.04	1.65	0.18	0.07	0.12	0.07	0.22	0.17	0.96
Halogenated Hydrocarbons										
Bromochloromethane	Not Available									
Bromodichloromethane	20	0.04	8.99	0.97	0.09	0.14	0.09	0.21	2.20	2.26
Bromoform	2	0.06	0.11	0.09		0.09	0.07	0.10	0.03	0.29
Bromomethane	21	0.05	0.34	0.15	0.06	0.12	0.07	0.18	0.09	0.60
<i>Carbon Tetrachloride</i>	1004	0.06	0.76	0.10	0.09	0.09	0.08	0.11	0.04	0.40

Table 3-1. Target Compound Detection Summaries of the VOC Concentrations (Continued)

Chemical ¹	# of Detects	Min. Value (ppbv)	Max. Value (ppbv)	Average Value (ppbv)	Mode (ppbv)	Median (ppbv)	1 st Quartile (ppbv)	3 rd Quartile (ppbv)	Standard Deviation (ppbv)	Coefficient of Variation
Chlorobenzene	6	0.05	0.13	0.09		0.09	0.07	0.10	0.02	0.29
Chloroethane	21	0.10	7.09	0.69	0.14	0.18	0.14	0.42	1.52	2.19
<i>Chloroform</i>	167	0.04	14.36	0.28	0.04	0.06	0.04	0.10	1.52	5.37
Chloromethane	1108	0.05	1.94	0.63	0.52	0.59	0.52	0.69	0.17	0.27
Chloromethylbenzene	No Detects									
Chloroprene	1	Not Available								
Dibromochloromethane	4	0.09	2.37	1.23		1.24	0.61	1.86	0.87	0.70
<i>1,2-Dibromoethane</i>	No Detects									
<i>m</i> -Dichlorobenzene	1	Not Available								
<i>o</i> -Dichlorobenzene	1	Not Available								
<i>p</i>-Dichlorobenzene	70	0.06	0.32	0.11	0.07	0.10	0.07	0.13	0.05	0.47
1,1-Dichloroethane	1	Not Available								
<i>1,2-Dichloroethane</i>	2	0.07	0.09	0.08	Not Available				0.01	0.13
1,1-Dichloroethene	3	0.05	0.33	0.23	Not Available	0.26	0.16	0.32	0.13	0.55
<i>cis</i> -1,2-Dichloroethylene	10	0.07	0.14	0.11	0.12	0.12	0.09	0.12	0.02	0.21
<i>trans</i> -1,2-Dichloroethylene	1	Not Available								
<i>1,2-Dichloropropane</i>	2	0.07	0.09	0.08	0.07	0.08	0.07	0.09	0.01	0.13
<i>cis</i> -1,3-Dichloropropene	1	Not Available								
<i>trans</i> -1,3-Dichloropropene	53	0.05	0.16	0.09	0.10	0.09	0.08	0.10	0.02	0.17

Table 3-1. Target Compound Detection Summaries of the VOC Concentrations (Continued)

Chemical¹	# of Detects	Min. Value (ppbv)	Max. Value (ppbv)	Average Value (ppbv)	Mode (ppbv)	Median (ppbv)	1st Quartile (ppbv)	3rd Quartile (ppbv)	Standard Deviation (ppbv)	Coefficient of Variation
Dichlorodifluoromethane	1120	0.05	1.70	0.64	0.50	0.59	0.52	0.70	0.19	0.29
Dichlorotetrafluoroethane	47	0.03	0.05	0.03	0.03	0.03	0.03	0.03	<0.01	0.15
Hexachloro-1,3-butadiene	No Detects									
<i>Methylene Chloride</i>	564	0.08	3.30	0.21	0.08	0.13	0.09	0.20	0.26	1.27
<i>1,1,2,2-Tetrachloroethane</i>	No Detects									
<i>Tetrachloroethylene</i>	301	0.05	32.4	0.42	0.05	0.09	0.06	0.15	2.03	4.80
1,2,4-Trichlorobenzene	No Detects									
1,1,1-Trichloroethane	79	0.05	1.18	0.14	0.05	0.06	0.05	0.15	0.17	1.27
1,1,2-Trichloroethane	No Detects									
<i>Trichloroethylene</i>	96	0.05	0.86	0.15	0.05	0.09	0.06	0.18	0.14	0.92
Trichlorofluoromethane	1114	0.04	2.82	0.34	0.30	0.30	0.26	0.36	0.18	0.52
Trichlorotrifluoroethane	953	0.04	0.53	0.11	0.10	0.10	0.09	0.11	0.03	0.28
<i>Vinyl Chloride</i>	6	0.06	0.23	0.14		0.16	0.09	0.18	0.06	0.42
Polar Compounds										
Acetonitrile	488	0.13	325	9.33	0.57	1.53	0.66	5.06	27.57	2.95
Acrylonitrile	101	0.08	8.08	0.28	0.18	0.15	0.11	0.22	0.81	2.86
<i>tert</i> -Amyl Methyl Ether	7	0.07	0.20	0.10	0.07	0.09	0.07	0.10	0.04	0.43
Ethyl Acrylate	2	0.06	0.07	0.07		0.07	0.06	0.07	0.01	0.08
Ethyl <i>tert</i> -Butyl Ether	1	Not Available								
Methyl Ethyl Ketone	917	0.15	118.00	1.22	0.39	0.61	0.41	0.93	4.90	4.03
Methyl Isobutyl Ketone	213	0.08	2.77	0.23	0.08	0.15	0.11	0.25	0.28	1.22

Table 3-1. Target Compound Detection Summaries of the VOC Concentrations (Continued)

Chemical¹	# of Detects	Min. Value (ppbv)	Max. Value (ppbv)	Average Value (ppbv)	Mode (ppbv)	Median (ppbv)	1st Quartile (ppbv)	3rd Quartile (ppbv)	Standard Deviation (ppbv)	Coefficient of Variation
Methyl Methacrylate	39	0.11	6.36	0.77	0.21	0.40	0.21	0.69	1.27	1.64
Methyl <i>tert</i> -Butyl Ether	343	0.07	48.60	0.61	0.12	0.26	0.15	0.53	2.67	4.38

¹ = **BOLD** indicates the compound is prevalent for 2004 Program Year.

Italics indicates the chemical is an urban air toxics strategy HAP.

Table 3-2. Target Compound Detection Summaries of the Carbonyl Concentrations

Chemical ¹	# of Detects	Min. Value (ppbv)	Max. Value (ppbv)	Average Value (ppbv)	Mode (ppbv)	Median (ppbv)	1 st Quartile (ppbv)	3 rd Quartile (ppbv)	Standard Deviation (ppbv)	Coefficient of Variation
Carbonyl Compounds										
Acetaldehyde	1200	0.03	61.60	2.03	1.09	1.29	0.82	2.05	4.04	1.99
Acetone	1202	0.02	65.1	1.40	1.04	0.92	0.51	1.51	2.97	2.12
Benzaldehyde	1149	<0.01	4.67	0.07	0.02	0.03	0.02	0.05	0.24	3.27
Butyr/Isobutyraldehyde	1200	0.01	6.09	0.17	0.07	0.10	0.06	0.15	0.41	2.42
Crotonaldehyde	1182	0.01	7.96	0.12	0.040	0.05	0.03	0.11	0.35	3.01
2,5-Dimethylbenzaldehyde	249	<0.01	0.24	0.02	0.01	0.01	0.01	0.03	0.03	1.40
Formaldehyde	1200	0.04	208.50	4.63	1.51	1.92	1.15	3.26	12.92	2.79
Hexaldehyde	1179	<0.01	3.14	0.08	0.02	0.03	0.02	0.05	0.24	3.09
Isovaleraldehyde	438	<0.01	1.04	0.03	0.01	0.01	0.01	0.02	0.07	2.59
Propionaldehyde	1089	0.01	8.56	0.14	0.04	0.09	0.05	0.14	0.38	2.67
Tolualdehydes	1058	<0.01	3.12	0.06	0.02	0.03	0.02	0.04	0.16	2.52
Valeraldehyde	1079	<0.01	1.78	0.06	0.02	0.02	0.01	0.04	0.13	2.36

¹ = **BOLD** indicates the compound is prevalent for 2004 Program Year.

Italics indicates the chemical is an urban air toxics strategy HAP.

Table 3-3. Range of Detectable Concentrations by Site

UATMP Site	Range of Detectable Values (ppbv)	Number of Valid Sampling Days		Number of Detects	Number of Concentrations > 5ppbv
		Carbonyl	VOC		
APMI	0.01-32.40	14	14	390	12
AZFL	0.004-4.02	60	NA	579	0
BTMO	0.005-2.12	4	NA	39	0
BTUT	0.003-36.9	59	60	1562	14
CANC	0.004-7.53	24	NA	251	2
CANJ	0.004-83.00	53	60	1616	40
CHNJ	0.00325-46.5	54	57	1344	16
CUSD	0.004-306.00	58	62	1398	11
DEMI	0.005-208.5	47	50	1414	31
DITN	0.003-20.80	18	17	437	5
EATN	0.004-14.70	12	13	369	6
ELNJ	0.003-17.3	59	60	1714	34
GAFL	0.003-4.94	57	NA	557	0
GPCO	0.004-51.50	57	55	1532	9
GPMS	0.004-325.00	23	25	589	8
GRMS	0.003-134.00	29	31	721	31
HACT	0.032-17.40	25	NA	249	19
HOMI	0.006-50.80	3	2	55	0
INDEM	0.005-171.00	53	NA	588	53
ITCMI	0.03-18.20	NA	60	779	2
JAMS	0.005-12.00	23	25	656	12
KITN	0.003-15.10	19	19	503	5
LDTN	0.002-27.80	31	31	832	21
LOTN	0.002-22.70	23	25	675	11
MAWI	0.009-3.64	14	15	355	0
MCAZ	0.04-11.60	NA	13	276	2
NBIL	0.03-111.10	NA	58	941	22
NBNJ	0.003-140.00	59	60	1605	40
ORFL	0.0035-5.37	52	NA	579	1
PGMS	0.002-46.00	21	27	625	5
PSAZ	0.04-4.77	NA	12	277	0
QVAZ	0.04-0.91	NA	5	56	0
RTPNC	0.003-3.26	9	NA	86	0
S4MO	0.004-35.6	62	65	1766	18
SFSD	0.003-16.60	62	67	1457	6
SKFL	0.005-57.20	28	NA	266	4
SLMO	0.005-3.24	5	NA	47	0
SLND	0.04-118.00	NA	25	372	10

Table 3-3. Range of Detectable Concentrations by Site (Continued)

UATMP Site	Range of Detectable Values (ppbv)	Number of Valid Sampling Days		Number of Detects	Number of Concentrations > 5ppbv
		Carbonyl	VOC		
SPAZ	0.04-8.94	NA	12	260	4
SPIL	0.03-20.60	NA	57	976	5
SYFL	0.0045-5.40	60	NA	632	1
TUMS	0.003-55.5	25	26	633	7
YFMI	0.03-6.35	NA	14	246	1

Table 3-4. Geometric Means by Site

UATMP Site	Geometric Mean (ppbv)			
	Carbonyls	Halogenated Hydrocarbons	Hydrocarbons	Polar
APMI	3.36	5.79	5.06	3.98
AZFL	4.13	NA	NA	NA
BOMA	NA	NA	NA	NA
BTMO	3.05	NA	NA	NA
BTUT	7.34	1.75	4.53	0.85
CANC	2.81	NA	NA	NA
CANJ	5.71	1.95	4.33	2.82
CHNJ	3.66	1.66	1.66	1.45
CUSD	3.67	1.63	1.53	1.81
DEMI	6.94	2.64	5.41	1.09
DITN	3.40	1.62	3.14	2.01
EATN	6.52	1.81	4.75	2.10
ELNJ	7.69	1.76	6.03	2.10
GAFL	3.54	NA	NA	NA
GPCO	5.86	1.91	6.88	0.96
GPMS	2.24	1.69	2.21	4.36
GRMS	4.24	1.68	2.83	37.01
HACT	14.23	NA	NA	NA
HOMI	1.69	2.67	1.21	50.37
INDEM	27.39	NA	NA	NA
ITCMI	NA	1.91	1.88	0.73
JAMS	4.25	1.87	4.48	5.06
KITN	6.60	1.45	2.93	1.35
LDTN	7.47	1.72	2.69	1.97
LOTN	6.07	1.77	3.04	2.16
MAWI	2.58	2.74	3.42	0.35
MCAZ	NA	1.98	8.18	2.31
NBIL	NA	2.47	3.91	0.62
NBNJ	7.92	1.83	3.09	2.21
ORFL	4.65	NA	NA	NA
PGMS	3.57	1.82	3.23	1.54
PSAZ	NA	2.72	10.13	3.16
QVAZ	NA	1.45	0.98	0.65
RTPNC	2.12	NA	NA	NA
S4MO	6.33	2.00	3.99	1.05
SFSD	4.43	1.53	1.64	0.67
SKFL	4.69	NA	NA	NA
SLMO	5.33	NA	NA	NA

Table 3-4. Geometric Means by Site (Continued)

UATMP Site	Geometric Mean (ppbv)			
	Carbonyls	Halogenated Hydrocarbons	Hydrocarbons	Polar
SLND	NA	1.65	1.92	4.21
SPAZ	NA	2.01	13.84	3.22
SPIL	NA	2.22	4.16	0.73
SYFL	3.20	NA	NA	NA
TUMS	3.25	1.77	2.44	3.86
YFMI	NA	2.88	7.32	0.47

Table 3-5a. Nationwide Cancer Compound Toxicity Ranking (Prevalent Compounds Shaded)

Compound	Formula Weight	# Detects	Average Concentration (µg/m³)	Cancer URE¹ (1/(µg/m³))	Cancer Weighted Toxicity	Cancer Risk (Out of 1 million)	% Contribution Weighted Toxicity	Cumulative % Contribution Weighted Toxicity
Acrylonitrile	53.06	101	0.61	6.80 E-05	4.18 E-05	41.8	31.06	31.06
Tetrachloroethylene	165.85	301	2.86	5.90 E-06	1.69 E-05	16.9	12.53	43.60
Benzene	78.11	1119	1.50	7.80 E-06	1.17 E-05	11.7	8.68	52.28
Carbon Tetrachloride	153.82	1004	0.64	1.50 E-05	9.65 E-06	9.65	7.17	59.45
1,2 - Dichloroethane	98.96	2	0.32	2.60 E-05	8.42 E-06	8.42	6.25	65.70
1,3 - Butadiene	54.09	303	0.28	3.00 E-05	8.27 E-06	8.27	6.14	71.85
Acetaldehyde	44.05	1200	3.66	2.20 E-06	8.05 E-06	8.05	5.98	77.83
<i>p</i> -Dichlorobenzene	147.00	70	0.68	1.10 E-05	7.44 E-06	7.44	5.23	83.36
1,2 - Dichloropropane	112.99	2	0.37	1.90 E-05	7.02 E-06	7.02	5.22	88.57
Ethyl Acrylate	100.12	2	0.27	1.40 E-05	3.73 E-06	3.73	2.77	91.34
Vinyl Chloride	62.5	6	0.37	8.80 E-06	3.22 E-06	3.22	2.40	93.74
<i>cis</i> -1,3 - Dichloropropene	110.97	1	0.64	4.00 E-06	2.54 E-06	2.54	1.89	95.63
<i>trans</i> -1,3 - Dichloropropene	110.97	53	0.42	4.00 E-06	1.70 E-06	1.70	1.26	96.89
Trichloroethylene	131.40	96	0.80	2.00 E-06	1.59 E-06	1.59	1.18	98.07
1,1 - Dichloroethane	98.97	1	0.79	1.60 E-06	1.26 E-06	1.26	0.94	99.01
Bromoform	253.75	2	0.88	1.10 E-06	9.70 E-07	0.97	0.72	99.73

Table 3-5a. Nationwide Cancer Compound Toxicity Ranking (Prevalent Compounds Shaded) (Continued)

Compound	Formula Weight	# Detects	Average Concentration (µg/m³)	Cancer URE¹ (1/(µg/m³))	Cancer Weighted Toxicity	Cancer Risk (Out of 1 million)	% Contribution Weighted Toxicity	Cumulative % Contribution Weighted Toxicity
Dichloromethane	84.94	564	0.72	4.70 E-07	3.36 E-07	0.34	0.25	99.98
Formaldehyde	30.03	1200	5.69	5.50 E-09	3.13 E-08	0.03	0.02	100.00
Total Cancer Toxicity					1.35 E-04			

¹ URE = Unit Risk Estimate. The URE is an upper-bound estimate of the excess cancer risk resulting from a lifetime of continuous exposure to an agent at a concentration of 1 µg/m³ in air.

Table 3-5b. Nationwide Noncancer Compound Toxicity Ranking (Prevalent Compounds Shaded)

Compound	Formula Weight	# Detects	Average Concentration (µg/m ³)	Noncancer RfC ¹ (mg/m ³)	Noncancer Weighted Toxicity	Adverse Health Concentrations	% Contribution Weighted Toxicity	Cumulative % Contribution Weighted Toxicity
Formaldehyde	30.03	1201	5.69	0.0098	0.58	102	26.54	26.54
Acetaldehyde	44.05	1201	3.66	0.009	0.41	46	18.60	45.14
Acrylonitrile	53.06	101	0.61	0.002	0.31	3	14.07	59.21
Acetonitrile	45.07	488	17.21	0.06	0.29	32	13.12	72.32
1,3-Butadiene	54.09	303	0.28	0.002	0.14	0	6.31	78.63
Bromomethane	94.94	21	0.56	0.005	0.11	0	5.16	83.79
1,2 - Dichloropropane	112.99	2	0.37	0.004	0.09	0	4.23	88.02
Benzene	78.11	1119	1.50	0.03	0.05	0	2.29	90.30
Xylenes (Total)	318.48	1091	4.23	0.1	0.04	0	1.94	92.24
<i>cis</i> -1,3 - Dichloropropene	110.97	1	0.64	0.02	0.03	0	1.45	93.69
Chloroprene	88.5	1	0.22	0.007	0.03	0	1.42	95.11
<i>trans</i> -1,3 - Dichloropropene	110.97	53	0.42	0.02	0.02	0	0.97	96.08
Carbon Tetrachloride	153.82	1004	0.64	0.04	0.02	0	0.74	96.82
Chloromethane	50.49	1108	1.30	0.09	0.01	0	0.66	97.48
Chloroform	120.39	167	1.39	0.098	0.01	0	0.65	98.13
Tetrachloroethylene	165.85	301	2.86	0.27	0.01	0	0.48	98.61
Toluene	92.13	1120	3.43	0.4	0.01	0	0.39	99.00

Table 3-5b. Nationwide Noncancer Compound Toxicity Ranking (Prevalent Compounds Shaded) (Continued)

Compound	Formula Weight	# Detects	Average Concentration (µg/m ³)	Noncancer RfC ¹ (mg/m ³)	Noncancer Weighted Toxicity	Adverse Health Concentrations	% Contribution Weighted Toxicity	Cumulative % Contribution Weighted Toxicity
1,1 - Dichloroethene	96.95	3	0.91	0.2	<0.01	0	0.21	99.21
Methyl Methacrylate	100.12	39	3.16	0.7	<0.01	0	0.21	99.42
Vinyl Chloride	62.5	6	0.37	0.1	<0.01	0	0.17	99.59
1,1 - Dichloroethane	98.97	1	0.79	0.5	<0.01	0	0.07	99.66
Trichloroethylene	131.4	96	0.80	0.6	<0.01	0	0.06	99.72
<i>p</i> -Dichlorobenzene	147.00	70	0.68	0.8	<0.01	0	0.04	99.76
1,1,1 - Trichloroethane	133.42	79	0.74	1	<0.01	0	0.03	99.79
Methyl tert-Butyl Ether	88.15	343	2.19	3	<0.01	0	0.03	99.83
Methyl Ethyl Ketone	72.11	917	3.59	5	<0.01	0	0.03	99.86
Dichloromethane	84.94	564	0.72	1	<0.01	0	0.03	99.89
Ethylbenzene	106.16	1016	0.67	1	<0.01	0	0.03	99.92
Styrene	104.14	673	0.66	1	<0.01	0	0.03	99.95
Chlorobenzene	112.56	6	0.40	1	<0.01	0	0.02	99.97
Methyl Isobutyl Ketone	100.16	213	0.95	3	<0.01	0	0.01	99.99
Chloroethane	64.52	21	1.82	10	<0.01	0	0.01	99.99

Table 3-5b. Nationwide Noncancer Compound Toxicity Ranking (Prevalent Compounds Shaded) (Continued)

Compound	Formula Weight	# Detects	Average Concentration (µg/m³)	Noncancer RfC¹ (mg/m³)	Noncancer Weighted Toxicity	Adverse Health Concentrations	% Contribution Weighted Toxicity	Cumulative % Contribution Weighted Toxicity
1,2 - Dichloroethane	98.96	2	0.32	2.4	<0.01	0	0.01	100.00
Total Noncancer Toxicity								

¹ RfC = Reference Concentration. The RfC is an estimate of a concentration in air to which a human population might be exposed that is likely to be without appreciable risks of deleterious effects during a lifetime (assumed to be 70 years).

Table 3-6. Summary of Pearson Correlation Coefficients for Selected Meteorological Parameters and Prevalent Compounds

Prevalent Compound ^a	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind speed	v-component of wind speed
Acetaldehyde	0.11	0.10	0.06	0.08	-0.06	0.01	-0.02	0.03
Acetonitrile	0.13	0.11	0.12	0.12	0.04	-0.01	-0.03	0.05
Acrylonitrile	-0.16	-0.13	-0.07	-0.10	0.09	-0.01	-0.19	-0.05
Benzene	-0.09	-0.08	-0.08	-0.09	0.01	0.04	0.02	0.06
Bromomethane	0.12	0.13	0.24	0.22	0.12	0.06	0.05	-0.14
1,3 - Butadiene	-0.10	-0.13	-0.18	-0.16	-0.10	0.19	-0.08	0.00
Carbon Tetrachloride	0.00	0.02	0.10	0.06	0.16	0.01	0.05	0.05
Formaldehyde	0.09	0.08	0.07	0.08	0.01	0.01	0.04	0.10
p - Dichlorobenzene	0.13	0.10	-0.13	-0.03	-0.30	-0.12	0.04	0.08
Tetrachloroethylene	-0.06	-0.07	-0.02	-0.05	0.08	-0.01	0.03	-0.01
Vinyl Chloride	0.90	0.90	0.89	0.89	-0.24	-0.03	0.13	0.73
Xylenes (Total)	0.13	0.12	0.02	0.07	-0.14	0.03	-0.12	0.08

^a Due to the low number of detects, Pearson Correlation coefficients could not be computed for 1,2-Dichloroethane, 1,2-dichloropropane, Ethyl Acrylate, and *cis*-1,3-dichloropropene.

Table 3-7. Summary of Mobile Information by Site

UATMP Site	Estimated No. of County Motor Vehicles Owned	2003 County Population	Estimated Traffic Near Site	County-Level On-Road Emissions (tpy)	County-Level Non-Road Emissions (tpy)	Hydrocarbon Arithmetic Mean (ppbv)	Average Acetylene Concentration (ppbv)
APMI	1,430,965	2,028,778	60,000	9,892	1,902	5.74	1.87
AZFL	936,312	926,146	51,000	4,830	2,072	NA	NA
BOMA	579,762	680,705	27,287	1,141	1,962	NA	NA
BTMO	86,254	57,929	4,360	254	60	NA	NA
BTUT	182,209	255,597	33,310	1,117	429	5.67	1.75
CANC	26,623	27,306	100	164	37	NA	NA
CANJ	399,282	513,909	62,000	1,294	705	5.01	1.36
CHNJ	375,383	483,150	12,623	1,718	1,397	2.04	0.66
CUSD	9,120	7,585	1,940	43	38	1.87	0.67
DEMI	1,430,965	2,028,778	12,791	9,892	1,902	6.85	2.21
DITN	40,593	44,935	4,420	345	67	4.27	0.83
EATN	575,087	569,842	38,450	2,796	1,022	5.44	1.40
ELNJ	411,286	529,360	170,000	1,328	664	8.18	1.50
GAFL	1,020,861	1,073,407	81,400	5,580	2,140	NA	NA
GPCO	127,138	124,676	19,572	557	223	7.59	2.15
GPMS	163,972	189,614	17,000	862	1,393	2.66	0.70
GRMS	19,564	22,809	1,100	130	131	3.38	0.66
HACT	733,923	871,457	10,000	2,833	1,470	NA	NA
HOMI	15,827	15,189	7,000	67	320	1.22	0.51
INDEM	275,061	487,476	42,950	1,518	957	NA	NA
ITCMI	33,504	38,822	100,000	181	606	2.52	0.76
JAMS	177,642	249,087	12,500	1,208	255	5.42	1.66
KITN	156,360	153,050	300	1,180	228	3.70	1.24
LDTN	41,458	41,624	13,360	366	182	2.94	0.83
LOTN	575,087	569,842	3,000	2,796	1,022	3.44	1.14
MAWI	401,588	449,378	23,750	1,762	1,040	3.93	1.35

Table 3-7. Summary of Mobile Information by Site (Continued)

UATMP Site	Estimated No. of County Motor Vehicles Owned	2003 County Population	Estimated Traffic Near Site	County-Level On-Road Emissions (tpy)	County-Level Non-Road Emissions (tpy)	Hydrocarbon Arithmetic Mean (ppbv)	Average Acetylene Concentration (ppbv)
MCAZ	2,870,961	3,389,260	10,108	10,069	5,456	10.15	1.90
NBIL	2,005,291	5,351,552	29,600	8,766	5,441	12.94	9.72
NBNJ	606,794	780,995	63,000	2,361	1,330	4.04	1.01
ORFL	916,248	964,865	59,000	5,584	2,305	NA	NA
PGMS	116,592	133,928	8,600	668	1,113	3.89	0.91
PSAZ	2,870,961	3,389,260	250	10,069	5,456	11.46	3.05
QVAZ	175,693	204,148	200	1,098	223	1.02	0.40
RTPNC	259,865	236,781	12,000	1,263	337	NA	NA
S4MO	244,956	332,223	22,840	1,377	482	4.55	1.55
SFSD	152,815	154,617	4,320	547	198	1.81	0.65
SKFL	936,312	926,146	50,500	4,830	2,072	NA	NA
SLMO	244,956	332,223	15,016	1,377	482	NA	NA
SLND	6,678	6,881	925	52	62	2.17	0.53
SPAZ	2,870,961	3,389,260	50,000	10,069	5,456	14.71	3.23
SPIL	2,005,291	5,351,552	42,000	8,766	5,441	4.96	1.67
SYFL	1,020,861	1,073,407	5,142	5,580	2,140	NA	NA
TUMS	68,191	77,690	4,900	438	179	2.64	0.75
YFMI	1,430,965	2,028,778	500	9,892	1,902	8.81	2.08

Table 3-8. UATMP Sites in MSAs Using Reformulated Gasoline (RFG)

Site	MSA	Fuel Program ¹	Fuel Additive	
			Summer ²	Winter ³
BOMA	Boston-Lawrence-Worcester, MA	RFG Opt-in	MTBE TAME	MTBE TAME Ethanol
CANJ	Philadelphia-Camden-Wilmington, PA- NJ-MD-DE	RFG Mandated	MTBE TAME	MTBE TAME Ethanol
CHNJ	New York-Newark-Edison, NY-NJ-PA	RFG Mandated	MTBE TAME	MTBE TAME Ethanol ETBE
ELNJ	New York-Newark-Edison, NY-NJ-PA	RFG Mandated	MTBE TAME	MTBE TAME Ethanol ETBE
HACT	Hartford-West Hartford-East Hartford, CT	RFG Mandated	MTBE TAME	MTBE TAME Ethanol ETBE
INDEM	Chicago-Naperville-Joliet, IL-IN-WI	RFG Mandated	MTBE Ethanol	
MCAZ	Phoenix-Mesa-Scottsdale, AZ	Winter- oxygenated	n/a ⁴	Ethanol
NBIL	Chicago-Naperville-Joliet, IL-IN-WI	RFG Mandated	MTBE Ethanol	
NBNJ	New York-Newark-Edison, NY-NJ-PA	RFG Mandated	MTBE TAME	MTBE TAME Ethanol ETBE
PSAZ	Phoenix-Mesa-Scottsdale, AZ	Winter- oxygenated	n/a ⁴	Ethanol
QVAZ	Phoenix-Mesa-Scottsdale, AZ	Winter- oxygenated	n/a ⁴	Ethanol

Table 3-8. UATMP Sites in MSAs Using Reformulated Gasoline (RFG) (Continued)

Site	MSA	Fuel Program ¹	Fuel Additive	
			Summer ²	Winter ³
S4MO	St. Louis, MO-IL	RFG Opt-in	MTBE Ethanol	MTBE Ethanol TAME
SLMO	St. Louis, MO-IL	RFG Opt-in	MTBE Ethanol	MTBE Ethanol TAME
SPAZ	Phoenix-Mesa-Scottsdale, AZ	Winter- oxygenated	n/a ⁴	Ethanol
SPIL	Chicago-Naperville-Juliet, IL-IN-WI	RFG Mandated	MTBE Ethanol	

¹ USEPA, 2003b.

² The summer season for RFG is from 6/1 to 9/15.

³ The winter season is the non-summer portion of the year. (There is no autumn or spring seasonal variation.) Winter oxygenate seasons vary by state.

⁴ n/a - Indicates that summer oxygenates are not applicable to the fuel program at this site.

Table 3-9. Regulations Implemented After 2002

MACT Source Category	Promulgation Date	Implementation Date	Applicable Pollutant Types¹	% Emission Reduction	Key
Amino/Phenolic Resins Production	1/20/2000	1/20/2003	C, V	51	A
Secondary Aluminum Production	3/23/2000	3/24/2003	M	60	B
Petroleum Refineries - Catalytic Cracking, Catalytic Reforming, & Sulfur Plant Units	4/11/2002	4/11/2005	C, M, V	87	C
Metal Coil (Surface Coating)	6/10/2002	6/10/2005	V	53	D
Primary Copper Smelting	6/12/2002	6/12/2005	M	23	E
Large Appliance (Surface Coating)	7/23/2002	7/23/2005	V	45	F
Municipal Waste Combustors: Small	1/31/2003	11/6/2005	M	96	G
Paper & Other Webs (Surface Coating)	12/4/2002	12/4/2005	V	80	H
Coke Ovens: Pushing, Quenching, & Battery Stacks	4/14/2003	4/14/2006	V	43	I
Refractory Products Manufacturing	4/16/2003	4/17/2006	V	18.9	J
Reinforced Plastic Composites Production	4/21/2003	4/21/2006	V	43	K
Asphalt Processing and Asphalt Roofing Manufacturing	4/29/2003	5/1/2006	C, V	29	L
Brick and Structural Clay Products Manufacturing	5/16/2003	5/16/2006	M	0.4	M
Integrated Iron & Steel Manufacturing	5/20/2003	5/20/2006	V	20	N
Semiconductor Manufacturing	5/22/2003	5/22/2006	M, V	NA	O
Metal Furniture (Surface Coating)	5/23/2003	5/23/2006	V	70	P
Engine Test Facilities	5/27/2003	5/27/2006	M, V	NA	Q

Table 3-9. Regulations Implemented After 2002 (Continued)

MACT Source Category	Promulgation Date	Implementation Date	Applicable Pollutant Types¹	% Emission Reduction	Key
Printing, Coating & Dyeing Of Fabrics	5/29/2003	5/29/2006	V	60	R
Site Remediation	10/8/2003	10/8/2006	V	50	S
Miscellaneous Organic Chemical Manufacturing	11/10/2003	11/10/2006	V	69	T
Metal Can (Surface Coating)	11/13/2003	11/13/2006	V	70	U
Miscellaneous Coating Manufacturing	12/11/2003	12/11/2006	V	64	V
Miscellaneous Metal Parts & Products (Surface Coating)	1/2/2004	1/2/2007	V	48	W
Organic Liquids Distribution (Non-Gasoline)	2/3/2004	2/3/2007	V	28	X
Stationary Combustion Turbines	3/5/2004	3/5/2007	C, V	90	Y
Plastic Parts & Products (Surface Coating)	4/19/2004	4/19/2007	V	80	Z
Iron and Steel Foundries	4/22/2004	4/22/2007	M, V	36	0
Auto & Light Duty Truck (Surface Coating)	4/26/2004	4/26/2007	V	60	1
Stationary Reciprocating Internal Combustion Engines	6/15/2004	6/15/2007	C	65	2
Plywood and Composite Wood Products	7/30/2004	7/30/2007	C, V	46.5	3
Industrial/Commercial/Institutional Boilers & Process Heaters - coal	9/13/2004	9/13/2007	M	56	4
Industrial/Commercial/Institutional Boilers & Process Heaters - gas	9/13/2004	9/13/2007	M	56	5
Industrial/Commercial/Institutional Boilers & Process Heaters - oil	9/13/2004	9/13/2007	M	56	6

Table 3-9. Regulations Implemented After 2002 (Continued)

MACT Source Category	Promulgation Date	Implementation Date	Applicable Pollutant Types¹	% Emission Reduction	Key
Industrial/Commercial/Institutional Boilers & Process Heaters - wood or waste	9/13/2004	9/13/2007	M	56	7
Utility Boilers: Coal	3/29/2005	1/1/2010	M	20.8	8

¹ C = carbonyl compound; M = metal compound; V = VOC

Table 3-10. Future Regulation Analysis of Emissions for NATTS Sites

NATTS Site	Pollutant Type	Pollutant	10-Mile Point Source Emissions - 2002 (tpy)	% Pollutant Reduction	% Pollutant Type Reduction	% NATTS Reduction	Future Regulation(s) - Key (Table 3-9)
BOMA	Metals	Antimony	0.43	0.37	1.64	1.64	0, 5, 6, 8
		Arsenic	1.03	3.52			
		Beryllium	0.09	1.97			
		Cadmium	0.06	7.80			
		Chromium	0.68	5.20			
		Cobalt	0.54	1.64			
		Lead	3.71	1.00			
		Manganese	0.50	8.86			
		Nickel	11.50	0.28			
		Selenium	0.59	19.33			
BTUT	Carbonyls	Acetaldehyde	3.98	9.32	10.78	9.38	C, E, G, J, K, L, M, P, S, T, V, W, Y, 2, 5
		Formaldehyde	22.65	11.04			
	Metals	Antimony	0.27	21.06	5.49		
		Arsenic	1.07	19.94			
		Beryllium	0.00	0.37			
		Cadmium	0.14	22.35			

Table 3-10. Future Regulation Analysis of Emissions for NATTS Sites (Continued)

NATTS Site	Pollutant Type	Pollutant	10-Mile Point Source Emissions - 2002 (tpy)	% Pollutant Reduction	% Pollutant Type Reduction	% NATTS Reduction	Future Regulation(s) - Key (Table 3-9)
		Chromium	19.61	0.31			
		Cobalt	0.004	0.22			
		Lead	5.19	19.59			
		Manganese	1.17	3.03			
		Mercury	0.07	27.63			
		Nickel	0.40	15.39			
		Selenium	0.40	14.37			
	VOCs	Benzene	17.73	0.35	9.62		
		Chloroform	0.38	62.63			
		Ethylbenzene	8.91	26.00			
		Methyl Ethyl Ketone	22.37	16.11			
		Methyl Isobutyl Ketone	8.29	15.57			
		Methyl Methacrylate	0.20	63.93			
		Methylene Chloride	31.09	0.03			
Styrene	31.11	34.80					

Table 3-10. Future Regulation Analysis of Emissions for NATTS Sites (Continued)

NATTS Site	Pollutant Type	Pollutant	10-Mile Point Source Emissions - 2002 (tpy)	% Pollutant Reduction	% Pollutant Type Reduction	% NATTS Reduction	Future Regulation(s) - Key (Table 3-9)
		Toluene	111.85	1.89			
		Xylenes	44.47	18.81			
DEMI	Carbonyls	Acetaldehyde	5.20	17.70	62.05	3.71	A, C, I, K, L, N, V, X, Y, Z, 2
		Formaldehyde	39.21	67.93			
		1,3-Butadiene	0.11	6.73	2.35		
		Benzene	124.05	16.48			
		Ethylbenzene	179.63	1.38			
		Methyl Ethyl Ketone	92.57	3.74			
		Methyl Isobutyl Ketone	154.01	2.56			
		Styrene	10.59	27.06			
		Toluene	596.52	0.83			
		Xylenes	590.51	1.14			
GPCO	Carbonyls	Acetaldehyde	0.58	19.49	26.47	9.21	R, S, W, Y, Z, 2
		Formaldehyde	11.41	26.83			
	VOCs	Benzene	32.17	0.52	8.44		

Table 3-10. Future Regulation Analysis of Emissions for NATTS Sites (Continued)

NATTS Site	Pollutant Type	Pollutant	10-Mile Point Source Emissions - 2002 (tpy)	% Pollutant Reduction	% Pollutant Type Reduction	% NATTS Reduction	Future Regulation(s) - Key (Table 3-9)
		Methyl Ethyl Ketone	10.28	48.35			
		Methyl Methacrylate	11.96	62.01			
		Styrene	10.57	67.38			
		Toluene	112.05	1.26			
		Xylenes	48.26	3.40			
NBIL	VOCs	1,3-Butadiene	0.004	25.43	14.08	14.08	A, D, H, I, K, L, P, T, U, V, W, X, Y, Z, 1
		Acrylonitrile	2.79	1.72			
		Benzene	93.49	4.88			
		Ethyl Acrylate	1.06	37.16			
		Ethylbenzene	70.30	17.30			
		Methyl Chloride	11.46	59.59			
		Methyl Ethyl Ketone	903.72	14.29			
		Methyl Isobutyl Ketone	346.72	20.88			
		Methyl Methacrylate	1.50	7.61			
		Methyl Tert-Butyl Ether	0.37	38.49			

Table 3-10. Future Regulation Analysis of Emissions for NATTS Sites (Continued)

NATTS Site	Pollutant Type	Pollutant	10-Mile Point Source Emissions - 2002 (tpy)	% Pollutant Reduction	% Pollutant Type Reduction	% NATTS Reduction	Future Regulation(s) - Key (Table 3-9)
		Methylene Chloride	130.87	0.23			
		Styrene	270.23	24.90			
		Tetrachloroethylene	210.44	0.17			
		Toluene	1080.72	16.06			
		Trichloroethylene	363.49	0.52			
		Xylenes	635.93	17.76			
PSAZ	VOCs	Ethylbenzene	12.61	8.28	12.41	12.41	F, K, R, V, Z
		Methyl Ethyl Ketone	33.54	24.00			
		Styrene	159.29	41.02			
		Tetrachloroethylene	36.84	16.99			
		Toluene	352.50	2.69			
		Xylenes	45.92	8.99			
S4MO	Carbonyls	Acetaldehyde	4.42	4.15	3.57	5.46	A, B, D, E, F, I, K, L, M, P, R, S, T, V, W, X, Y, Z, 0, 1, 2, 4, 5, 6, 7, 8
		Formaldehyde	18.07	3.43			
	Metals	Antimony	0.27	2.23	7.54		
		Arsenic	0.77	16.53			

Table 3-10. Future Regulation Analysis of Emissions for NATTS Sites (Continued)

NATTS Site	Pollutant Type	Pollutant	10-Mile Point Source Emissions - 2002 (tpy)	% Pollutant Reduction	% Pollutant Type Reduction	% NATTS Reduction	Future Regulation(s) - Key (Table 3-9)
		Beryllium	0.03	21.83			
		Cadmium	1.08	1.74			
		Chromium	1.18	9.90			
		Cobalt	0.15	20.97			
		Lead	4.60	6.34			
		Manganese	14.06	6.27			
		Mercury	0.30	0.88			
		Nickel	2.10	5.33			
		Selenium	1.93	20.79			
	VOCs	Benzene	191.17	4.38	5.45		
		Ethylbenzene	81.80	7.80			
		Methyl Chloride	2.01	23.15			
		Methyl Ethyl Ketone	152.00	7.25			
		Methyl Isobutyl Ketone	167.24	4.68			
		Methyl Methacrylate	0.46	0.52			

Table 3-10. Future Regulation Analysis of Emissions for NATTS Sites (Continued)

NATTS Site	Pollutant Type	Pollutant	10-Mile Point Source Emissions - 2002 (tpy)	% Pollutant Reduction	% Pollutant Type Reduction	% NATTS Reduction	Future Regulation(s) - Key (Table 3-9)
		Methyl Tert-Butyl Ether	9.18	0.57			
		Methylene Chloride	31.01	8.80			
		Styrene	14.30	24.48			
		Tetrachloroethylene	108.21	0.09			
		Toluene	384.67	8.44			
		Trichloroethylene	158.98	4.40			
		Xylenes	384.22	5.99			
SYFL	Carbonyls	Acetaldehyde	2.02	2.76	4.72	4.72	L,2
		Formaldehyde	2.01	6.69			

Table 3-11. Summary of Additional Analyses

Monitoring Site	Average Metal Compounds Concentrations (ng/m³)	Average SVOC Concentration (ng/m³)	Average SNMOC Concentration (ppbC)
BOMA	23.29	—	—
BTMO	—	—	37.01
BTUT	26.93	—	131.42
CUSD	—	—	58.43
EATN	30.44	—	—
ITCMI	—	27.80	—
LOTN	26.03	—	—
NBIL	—	—	161.92
PGMS	—	—	94.74
S4MO	38.47	—	119.44
SFSD	—	—	35.15
SLMO	—	—	102.74
SLND	—	4.56	—
YFMI	—	52.83	—

Table 3-12. Population and 1,000 Vehicle Miles Traveled (1000VMT) Profiles for Each MSA

MSA	1990 MSA Population	2003 MSA Population	% Change in MSA Population	1990 MSA 1000VMT	2003 MSA 1000VMT	% Change in MSA 1000VMT
Boston, MA	4,133,895	4,439,971	+7.4%	18,738,370	32,582,820	+73.9%
Chicago, IL	8,181,939	9,333,511	+14.1%	45,066,915	60,512,255	+34.3%
Detroit, MI	4,248,699	4,483,853	+5.5%	28,551,395	36,788,715	+28.9%
Durham, NC	344,665	447,066	+14.1%	2,719,712 ^a	3,102,500	+14.1%
Grand Junction, CO	93,145	124,676	+33.9%	476,935 ^a	638,385	+33.9%
Gulfport, MS	207,875	248,965	+19.8%	1,169,825	1,779,010	+52.1%
Hartford, CT	1,123,678	1,177,935	+4.8%	5,072,770	8,038,760	+58.5%
Jackson, MS	446,941	510,060	+14.1%	2,311,910	3,966,090	+71.6%
Kingsport, TN	275,678	299,703	+8.7%	1,160,655 ^a	1,261,805	+8.7
Knoxville, TN	534,910	636,863	+19.1%	2,873,280	4,624,185	+60.9%
Madison, WI	432,323	526,742	+21.8%	1,628,995	2,972,925	+82.5%
Nashville, TN	1,048,216	1,371,302	+30.8%	5,696,555	11,026,285	+93.6%
New York, NY	16,863,671	18,640,775	+10.5%	82,128,650	105,869,710	+28.9%
Ogden, UT	351,799	468,942	+33.3%	1,410,360	3,522,980	+149.8%
Orlando, FL	1,224,844	1,802,986	+47.2%	6,471,450	15,156,625	+134.2%
Pascagoula, MS	131,916	154,335	+17.0%	448,002 ^a	524,140	+17.0%
Philadelphia, PA	5,435,550	5,772,947	+6.2%	24,002,035	37,576,750	+56.6%
Phoenix, AZ	2,238,498	3,593,408	+60.5%	14,473,710	24,942,275	+72.3%
Sioux Falls, SD	153,500	198,377	+29.2%	623,604 ^a	805,920	+29.2%
St. Louis, MO	2,599,893	2,759,440	+6.1%	16,530,120	22,794,250	+37.9%
Tampa, FL	2,067,959	2,531,908	+22.4%	12,304,150	21,258,330	+72.8%

^a 1990 VMT estimate not available; VMT estimated based on ratio of 2003 VMT vs. population ratio.

Table 3-13a. Total Acetaldehyde Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Chicago, IL	2,007	1,399	-30.3%	2.82 ± 0.44	1.06 ± 0.09	-62.40%	2.38 ± 0.34	SH
Detroit, MI	1,179	629	-46.6%	NA	1.84 ± 0.15	NA	2.84 ± 2.31	ND
Durham, NC	146	81	-44.5%	NA	NA	NA	0.44 ± 0.15	NA
Grand Junction, CO	102	21	-79.4%	NA	2.24 ± 0.49	NA	3.22 ± 1.95	ND
Gulfport, MS	100	59	-41.0%	NA	1.64 ± 0.13	NA	1.15 ± 0.44	ND
Hartford, CT	305	203	-33.4%	5.75 ± 0.92	4.04 ± 0.48	-29.70%	2.64 ± 0.61	SL
Jackson, MS	209	91	-56.5%	NA	2.62 ± 0.26	NA	2.45 ± 0.41	ND
Kingsport, TN	590	110	-81.4%	NA	1.87 ± 0.23	NA	0.97 ± 0.10	SL
Knoxville, TN	216	173	-19.9%	NA	5.68 ± 1.62	NA	1.76 ± 0.38	SL
Madison, WI	157	72	-54.1%	NA	0.81 ± 0.10	NA	0.65 ± 0.12	ND
Nashville, TN	511	267	-47.7%	NA	1.75 ± 0.17	NA	0.92 ± 0.10	SL
New York, NY	3,077	1,320	-57.1%	4.08 ± 1.28	2.02 ± 0.14	-50.42%	2.64 ± 0.73	ND
Ogden, UT	147	64	-56.5%	NA	2.50 ± 0.56	NA	2.21 ± 0.59	ND
Orlando, FL	382	270	-29.3%	NA	1.93 ± 0.21	NA	1.23 ± 0.13	SL
Pascagoula, MS	183	57	-68.9%	NA	1.93 ± 0.38	NA	1.06 ± 0.38	SL
Philadelphia, PA	1,236	617	-50.1%	3.59 ± 0.40	1.20 ± 0.20	-66.71%	5.43 ± 2.09	SH
Sioux Falls, SD	71	41	-42.3%	NA	2.58 ± 0.47	NA	1.95 ± 0.54	ND
St. Louis, MO	819	445	-45.6%	2.34 ± 0.75	4.45 ± 0.37	+90.25%	1.90 ± 0.50	SL
Tampa, FL	543	360	-33.6%	NA	2.08 ± 0.12	NA	1.54 ± 0.27	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-13b. Total Benzene Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Chicago, IL	11,835	4,027	-66.0%	9.92 ± 1.81	1.05 ± 0.09	-89.43%	0.68 ± 0.23	SL
Detroit, MI	6,480	4,388	-32.3%	6.91 ± 1.95	2.67 ± 0.61	-61.40%	0.90 ± 0.22	SL
Grand Junction, CO	279	145	-48.0%	NA	3.15 ± 0.68	NA	0.70 ± 0.10	SL
Gulfport, MS	453	375	-17.2%	NA	1.29 ± 0.19	NA	0.27 ± 0.06	SL
Jackson, MS	948	562	-40.7%	NA	2.03 ± 0.20	NA	0.53 ± 0.13	SL
Kingsport, TN	643	371	-42.3%	NA	1.20 ± 0.16	NA	0.35 ± 0.09	SL
Knoxville, TN	1,027	808	-21.3%	NA	1.39 ± 1.08	NA	0.37 ± 0.07	ND
Madison, WI	696	566	-18.7%	NA	0.93 ± 0.12	NA	0.49 ± 0.11	SL
Nashville, TN	1,918	1,392	-27.4%	2.12 ± 0.54	1.49 ± 0.21	-29.54%	0.35 ± 0.04	SL
New York, NY	16,653	7,512	-54.9%	3.24 ± 0.22	1.10 ± 0.06	-66.00%	0.33 ± 0.03	SL
Ogden, UT	622	419	-32.6%	NA	2.18 ± 0.43	NA	0.59 ± 0.08	SL
Pascagoula, MS	466	305	-34.5%	NA	1.43 ± 0.21	NA	0.37 ± 0.07	SL
Philadelphia, PA	5,961	2,577	-56.8%	2.83 ± 0.26	1.20 ± 0.07	-57.58%	0.46 ± 0.08	SL
Phoenix, AZ	3,757	2,407	-35.9%	NA	2.49 ± 0.31	NA	0.84 ± 0.15	SL
Sioux Falls, SD	257	182	-29.2%	NA	1.29 ± 0.43	NA	0.25 ± 0.06	SL
St. Louis, MO	4,358	2,304	-47.1%	6.40 ± 1.93	1.44 ± 0.12	-77.45%	0.43 ± 0.05	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-13c. Total Cadmium Emission (tpy) and Concentration (ng/m³) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Boston, MA	1.0	0.4	-62.1%	NA	2.02 ± 0.24	NA	0.50 ± 0.11	SL
Nashville, TN	6.4	0.4	-93.8%	NA	3.27 ± 0.74	NA	0.21 ± 0.03	SL
Ogden, UT	0.1	0.1	<1.0%	NA	13.63 ± 5.16	NA	0.17 ± 0.04	SL
St. Louis, MO	8.7	2.7	-69.3%	11.34 ± 1.50	4.11 ± 0.51	-63.77%	1.16 ± 0.25	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-13d. Total Ethylbenzene Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Chicago, IL	5,295	2,045	-61.4%	7.45 ± 2.17	0.49 ± 0.08	-93.41%	0.15 ± 0.04	SL
Detroit, MI	3,266	1,827	-44.0%	1.41 ± 0.22	1.00 ± 0.22	-29.16%	0.21 ± 0.03	SL
Grand Junction, CO	81	52	-35.8%	NA	1.26 ± 0.29	NA	0.28 ± 0.04	SL
Gulfport, MS	231	286	23.8%	NA	0.97 ± 0.30	NA	0.09 ± 0.02	SL
Jackson, MS	399	310	-22.3%	NA	1.34 ± 0.19	NA	0.18 ± 0.05	SL
Kingsport, TN	289	150	-48.1%	NA	0.57 ± 0.08	NA	0.12 ± 0.02	SL
Knoxville, TN	479	379	-20.9%	NA	NA	NA	0.10 ± 0.01	NA
Madison, WI	322	242	-24.8%	NA	0.51 ± 0.06	NA	0.12 ± 0.03	SL
Nashville, TN	986	648	-34.3%	1.30 ± 0.44	0.83 ± 0.12	-36.29%	0.13 ± 0.03	SL
New York, NY	8,439	4,205	-50.2%	2.07 ± 0.19	0.76 ± 0.05	-63.56%	0.13 ± 0.01	SL
Ogden, UT	250	204	-18.4%	NA	0.78 ± 0.15	NA	0.17 ± 0.04	SL
Pascagoula, MS	280	160	-42.9%	NA	1.38 ± 0.27	NA	0.19 ± 0.08	SL
Philadelphia, PA	3,387	1,347	-60.2%	1.32 ± 0.16	0.62 ± 0.04	-53.39%	0.14 ± 0.03	SL
Phoenix, AZ	1,490	1,095	-26.5%	NA	2.37 ± 0.32	NA	0.46 ± 0.09	SL
Sioux Falls, SD	142	70	-50.7%	NA	0.62 ± 0.27	NA	0.07 ± 0.01	SL
St. Louis, MO	2,066	1,092	-47.2%	0.91 ± 0.24	0.96 ± 0.12	+5.82%	0.15 ± 0.02	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-13e. Total Formaldehyde Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Chicago, IL	6,782	2,787	-58.9%	4.35 ± 0.52	5.03 ± 0.19	+15.63%	33.57 ± 9.42	SH
Detroit, MI	4,078	1,657	-59.4%	NA	3.74 ± 0.72	NA	8.24 ± 7.58	ND
Durham, NC	595	334	-43.9%	NA	NA	NA	1.17 ± 0.60	NA
Grand Junction, CO	301	66	-78.1%	NA	4.22 ± 0.37	NA	2.30 ± 1.24	SL
Gulfport, MS	294	199	-32.3%	NA	3.09 ± 0.45	NA	0.89 ± 0.45	SL
Hartford, CT	1,108	434	-60.8%	5.02 ± 0.50	9.28 ± 1.82	+85.03%	5.62 ± 1.08	SL
Jackson, MS	639	362	-43.3%	NA	3.71 ± 0.53	NA	0.65 ± 0.14	SL
Kingsport, TN	550	154	-72.0%	NA	2.74 ± 0.41	NA	2.55 ± 0.36	ND
Knoxville, TN	672	294	-56.3%	NA	35.74 ± 15.40	NA	6.49 ± 2.85	SL
Madison, WI	512	192	-62.5%	NA	0.71 ± 0.13	NA	0.98 ± 0.15	ND
Nashville, TN	1,364	558	-59.1%	NA	3.88 ± 0.52	NA	2.90 ± 0.41	SL
New York, NY	10,430	3,988	-61.8%	6.28 ± 2.41	3.61 ± 0.34	-42.50%	3.81 ± 1.06	ND
Ogden, UT	504	200	-60.3%	NA	2.61 ± 0.91	NA	4.10 ± 1.25	ND
Orlando, FL	1,221	915	-25.1%	NA	2.61 ± 0.38	NA	2.66 ± 0.25	ND
Pascagoula, MS	312	175	-43.9%	NA	3.65 ± 0.68	NA	4.54 ± 3.98	ND
Philadelphia, PA	4,348	2,139	-50.8%	5.63 ± 0.32	2.25 ± 0.49	-60.05%	6.71 ± 3.13	SH
Sioux Falls, SD	202	92	-54.5%	NA	4.36 ± 1.68	NA	2.32 ± 0.56	ND
St. Louis, MO	2,658	1,263	-52.5%	3.82 ± 1.16	11.41 ± 1.99	+198.67%	3.96 ± 1.08	SL
Tampa, FL	1,745	1,081	-38.1%	NA	3.43 ± 0.45	NA	1.88 ± 0.54	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-13f. Total Lead Emission (tpy) and Concentration (ng/m³) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Boston, MA	15.1	7.0	-53.5%	45.29 ± 2.63	4.57 ± 0.64	-89.20%	6.42 ± 0.98	SH
Nashville, TN	12.9	2.8	-78.3%	642.27 ± 82.28	276.49 ± 50.93	-56.95%	6.20 ± 1.54	SL
Ogden, UT	1.5	2.3	+53.3%	NA	8.13 ± 2.57	NA	6.63 ± 1.04	SL
St. Louis, MO	223.1	23.7	-89.4%	725.39 ± 89.17	986.29 ± 125.6	+35.97%	11.74 ± 2.40	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-13g. Total Mercury Emission (tpy) and Concentration (ng/m³) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Boston, MA	3.4	0.5	-84.0%	NA	0.92 ± 0.09	NA	0.03 ± 0.02	SL
Nashville, TN	0.7	0.1	-85.7%	NA	1.60 ± 0.31	NA	0.02 ± 0.01	SL
Ogden, UT	0.2	0.1	-50.0%	NA	2.17 ± 0.43	NA	0.02 ± 0.01	SL
St. Louis, MO	2.3	0.7	-70.4%	10.31 ± 0.92	2.56 ± 0.49	-76.56%	0.03 ± 0.01	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-13h. Total Toluene Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Chicago, IL	36,507	14,602	-60.0%	20.79 \pm 4.69	2.23 \pm 0.25	-89.30%	0.72 \pm 0.11	SL
Detroit, MI	25,103	11,907	-52.6%	8.83 \pm 1.40	5.01 \pm 0.67	-43.25%	1.42 \pm 0.32	SL
Grand Junction, CO	509	368	-27.7%	NA	8.25 \pm 2.40	NA	1.48 \pm 0.19	SL
Gulfport, MS	1,304	1,114	-14.6%	NA	4.73 \pm 1.09	NA	0.60 \pm 0.17	SL
Jackson, MS	2,600	1,408	-45.8%	NA	9.65 \pm 8.91	NA	1.10 \pm 0.36	ND
Kingsport, TN	3,829	1,162	-69.7%	NA	2.66 \pm 0.32	NA	0.62 \pm 0.13	SL
Knoxville, TN	3,101	2,332	-24.8%	NA	3.03 \pm 2.64	NA	0.66 \pm 0.15	ND
Madison, WI	2,422	1,692	-30.1%	NA	2.11 \pm 0.33	NA	0.78 \pm 0.23	SL
Nashville, TN	7,929	4,869	-38.6%	8.81 \pm 5.59	4.93 \pm 1.19	-44.03%	1.02 \pm 0.32	SL
New York, NY	56,702	24,487	-56.8%	12.26 \pm 1.03	4.34 \pm 0.29	-64.58%	0.76 \pm 0.12	SL
Ogden, UT	1,643	1,360	-17.2%	NA	5.37 \pm 1.15	NA	1.25 \pm 0.28	SL
Pascagoula, MS	1,565	813	-48.1%	NA	5.45 \pm 1.22	NA	1.03 \pm 0.29	SL
Philadelphia, PA	24,908	7,565	-69.6%	7.85 \pm 1.59	4.08 \pm 0.34	-47.96%	0.99 \pm 0.20	SL
Phoenix, AZ	9,544	6,523	-31.7%	NA	8.67 \pm 1.10	NA	2.52 \pm 0.52	SL
Sioux Falls, SD	857	448	-47.7%	NA	6.02 \pm 5.86	NA	0.34 \pm 0.06	ND
St. Louis, MO	13,682	6,501	-52.5%	6.42 \pm 2.32	3.96 \pm 0.44	-38.29%	0.97 \pm 0.17	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-13i. Total Xylene Emission (tpy) and Concentration ($\mu\text{g}/\text{m}^3$) Comparison

MSA	1990 Emissions	2002 Emissions	% Change in Emissions	1990-1994 Average Concentration	2002-2003 Average Concentration	% Change in Concentration	2004 UATMP MSA Concentration	Trend Comment
Chicago, IL	24,344	10,244	-57.9%	5.46 ± 0.84	0.75 ± 0.11	-86.29%	0.52 ± 0.13	ND
Detroit, MI	15,393	7,751	-49.6%	3.10 ± 0.85	0.81 ± 0.13	-73.69%	0.81 ± 0.14	ND
Grand Junction, CO	325	220	-32.3%	NA	1.88 ± 0.49	NA	1.22 ± 0.17	ND
Gulfport, MS	955	1,279	33.9%	NA	1.14 ± 0.37	NA	0.29 ± 0.08	SL
Jackson, MS	1,624	920	-43.3%	NA	1.85 ± 0.28	NA	0.73 ± 0.19	SL
Kingsport, TN	1,411	696	-50.7%	NA	0.69 ± 0.11	NA	0.49 ± 0.09	ND
Knoxville, TN	1,979	1,496	-24.4%	NA	NA	NA	0.35 ± 0.05	NA
Madison, WI	1,402	1,162	-17.1%	NA	0.59 ± 0.08	NA	0.44 ± 0.14	ND
Nashville, TN	4,783	2,794	-41.6%	NA	1.10 ± 0.22	NA	0.43 ± 0.08	SL
New York, NY	35,141	25,055	-28.7%	2.03 ± 0.16	0.78 ± 0.05	-61.80%	0.48 ± 0.07	SL
Ogden, UT	1,027	972	-5.4%	NA	0.94 ± 0.20	NA	0.73 ± 0.15	ND
Pascagoula, MS	1,261	1,102	-12.6%	NA	2.00 ± 0.42	NA	0.55 ± 0.12	SL
Philadelphia, PA	15,071	5,174	-65.7%	4.04 ± 1.49	0.73 ± 0.05	-81.86%	0.57 ± 0.12	ND
Phoenix, AZ	6,261	4,273	-31.8%	NA	2.67 ± 0.38	NA	1.82 ± 0.36	SL
Sioux Falls, SD	627	335	-46.6%	NA	0.63 ± 0.30	NA	0.20 ± 0.03	SL
St. Louis, MO	9,039	4,638	-48.7%	14.84 ± 6.56	1.21 ± 0.18	-91.88%	0.52 ± 0.08	SL

SH = 2004 UATMP concentration is significantly higher than the 2002-2003 average MSA concentration

SL = 2004 UATMP concentration is significantly lower than the 2002-2003 average MSA concentration

ND = 2004 UATMP concentration is not significantly different than the 2002-2003 average MSA concentration

NA = Not available

BOLD = significant difference between 1990-1994 average MSA concentration and 2002-2003 average MSA concentration

Table 3-14. Summary of Additional Analyses by Site

Site	NATTS Site	Future Regulation Analysis	Emission Tracer Analysis	RFG Analysis	Site-Specific Trends Analysis	MSA-Specific Trends Analysis	Mobile Tracer Analysis
APMI					✓	✓	
AZFL					✓	✓	
BOMA	✓	✓	No Noncancer Exceedances	VOC Not Sampled		✓	
BTMO					✓	Not in MSA	✓
BTUT	✓	✓	✓			✓	✓
CANC						Not in MSA	
CANJ				✓	✓	✓	
CHNJ				✓	✓	✓	
CUSD					✓	Not in MSA	✓
DEMI	✓	✓	✓		✓	✓	
DITN						✓	
EATN					✓	✓	
ELNJ				✓	✓	✓	
GAFL					✓	✓	
GPCO	✓	✓	✓			✓	
GPMS					✓	✓	
GRMS						Not in MSA	
HACT				VOC Not Sampled		✓	
HOMI					✓	Not in MSA	
INDEM				VOC Not Sampled		✓	
ITCMI						Not in MSA	
JAMS					✓	✓	
KITN						✓	
LDTN						✓	
LOTN					✓	✓	
MAWI						✓	
MCAZ				✓		✓	
NBIL	✓	✓	No noncancer Exceedances	✓		✓	✓
NBNJ				✓	✓	✓	

Table 3-14. Summary of Additional Analyses by Site (Continued)

Site	NATTS Site	Future Regulation Analysis	Emission Tracer Analysis	RFG Analysis	Site-Specific Trends Analysis	MSA-Specific Trends Analysis	Mobile Tracer Analysis
ORFL						✓	
PGMS					✓	✓	✓
PSAZ	✓	✓	✓	✓	✓	✓	
QVAZ				✓	✓	✓	
RTPNC						✓	
S4MO	✓	✓	✓	✓	✓	✓	✓
SFSD					✓	✓	✓
SKFL						✓	
SLMO				✓	✓	✓	✓
SLND						Not in MSA	
SPAZ				✓	✓	✓	
SPIL				✓		✓	
SYFL	✓	✓	No Noncancer Exceedances			✓	
TUMS					✓	Not in MSA	
YFMI					✓	✓	

4.0 Sites in Arizona

This section presents meteorological, concentration, and spatial trends for the four UATMP sites in Arizona (MCAZ, PSAZ, QVAZ, and SPAZ). The Arizona sites sampled for VOC only. All four of these sites are located in the Phoenix metropolitan statistical area (MSA). Figures 4-1 through 4-4 are topographical maps showing the monitoring sites in their urban locations. Figures 4-5 and 4-6 identify facilities within 10 miles of the sites that reported to the 2002 NEI. The MCAZ, PSAZ, and SPAZ sites are within a few miles of each other, with numerous sources between them, while the QVAZ site is farther south and has no nearby industrial sources. MCAZ, PSAZ and SPAZ are located near many different types of industries, of which miscellaneous processes are the most numerous.

Hourly meteorological data were retrieved for all of 2004 at a weather station near these sites for calculating correlations of meteorological data with ambient air concentration measurements. The weather station is Phoenix-Sky Harbor International Airport (WBAN 23183).

Table 4-1 highlights the average UATMP concentration (VOC only) at each of these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average u - and v -components of the wind) for the entire year and on days samples were taken. Normally, the Phoenix area is extremely hot and dry, and the high average temperature and low average relative humidity values in Table 4-1 confirm this observation. Wind speeds were also very light for each site, as the city resides in a valley, but the wind generally flows from the south and east. The pressures for this area are some of the lowest compared to other participating sites in this report. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987). These sites sampled only from January to March, which explains the significant differences between 2004 and sample day averages.

4.1 Prevalent Compounds at the Arizona Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 4-2 summarizes the cancer weighting scores and Table 4-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

Table 4-2 shows that the prevalent cancer compounds reflect the nationwide prevalent cancer list, which is in Section 3 of this report. Only acrylonitrile, benzene, and carbon tetrachloride were prevalent across all four sites. Of the prevalent noncancer compounds summarized in Table 4-3, *trans*-1,3-dichloropropene (detected at MCAZ, SPAZ, and QVAZ), chloromethane (detected at MCAZ and QVAZ), carbon tetrachloride (detected at MCAZ, SPAZ, and QVAZ), and toluene (detected at MCAZ and PSAZ) are not listed among the nationwide noncancer prevalent list. The only noncancer compounds prevalent across all four sites were acrylonitrile and benzene.

The following prevalent toxic compounds were not detected at any of the Phoenix MSA sites: 1,2 dichloroethane, 1,2-dichloropropane, bromomethane, *cis*-1,3-dichloropropene, ethyl acrylate, vinyl chloride, and chloroprene. Note, carbonyls were not sampled at the Arizona sites; therefore, acetaldehyde and formaldehyde would not be detected.

4.2 Toxicity Analysis

Although only detected three or fewer times, acrylonitrile contributed most to three of the four sites' total cancer toxicity. Benzene and carbon tetrachloride had the most detects at each of the sites. At all but one site (SPAZ), acrylonitrile also contributed most to the noncancer toxicity.

The acrylonitrile cancer risk at PSAZ was the highest among the four sites at 247.9 in a million, while at QVAZ, MCAZ, and SPAZ, the acrylonitrile cancer risk was 24.10, 22.14, and

11.81 in a million, respectively. Cancer risk from exposure to benzene was 16.54, 25.22, and 28.36 in a million at MCAZ, PSAZ, and SPAZ, respectively. Also at PSAZ and SPAZ, 1,3-butadiene had a cancer risk of 13.65 and 13.33 in a million, respectively.

For the compounds that may lead to adverse noncancer health effects, the average acrylonitrile toxicity at PSAZ was 1.82 (over 1 indicates a significant chance of a noncancer health effect). However, this compound was only measured once, and this acrylonitrile concentration was above its noncancer RfC weighting factor.

4.3 Meteorological and Concentration Averages at the Arizona Sites

VOCs were sampled at each of the AZ sites as indicated in Tables 3-3 and 3-4, and average UATMP concentrations (VOC only) are listed in Table 4-1. The SPAZ site has the highest average UATMP concentrations ($72.40 \pm 13.41 \mu\text{g}/\text{m}^3$). Table 4-4 summarizes calculated Pearson Correlation coefficients for each of the site-specific prevalent compounds and selected meteorological parameters. Identification of the site-specific prevalent compounds is discussed earlier in this section.

The Arizona sites exhibited some of the strongest Pearson correlations of all the UATMP sites. This is likely due to the low number of sample days (January to March 2004). Most of the correlations between the prevalent compounds and the temperature parameters were, at least, moderately strong and positive. Benzene and *p*-dichlorobenzene had the strongest correlations with dewpoint temperature at QVAZ (0.92) and maximum temperature at PSAZ (0.89), respectively. Overall, the v-component of the wind had the fewest number of correlations that could be considered at least moderately strong. It is important to note that these sites only sampled through March, so the overall number of detects for any pollutant is relatively low.

Figures 4-7 through 4-10 show the composite back trajectories for the Arizona sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in these figures, these sites have very few trajectories because they only sampled through March 2004. The back

trajectories tend to originate from the northeast or southwest. Each circle around the sites in Figures 4-7 through 4-10 represents 100 miles; between 69% (MCAZ) and 100% (QVAZ) of the trajectories originating from within 200 miles of the Arizona sites. The 24-hour airshed domain is much smaller compared to other sites. Back trajectories originated less than 300 miles away.

4.4 Spatial Analysis

County-level vehicle registration and population in Maricopa County and Pinal County, AZ, were obtained from the Arizona Department of Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 4-5. Table 4-5 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10 mile population surrounding the monitors and the vehicle registration ratio. Table 4-5 also contains the average daily traffic information, which includes the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at each Arizona site in Table 4-5. The SPAZ site has the largest amount of traffic passing by on a daily basis, while the PSAZ site has the largest estimated vehicle ownership within 10 miles. These two sites also have the highest average daily UATMP concentrations. QVAZ, which has the lowest number of vehicles passing by and estimated vehicle ownership, measured the lowest UATMP concentrations.

A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area (for more information on this study, refer to section 3.4.2.). Figure 3-2 depicts the average concentration ratios observed for the roadside study and compares these ratios to the concentration ratios at each of the monitoring sites. MCAZ and PSAZ most resemble the ratios from the roadside study. The SPAZ site has a larger difference between the benzene-ethylbenzene and xylenes-ethylbenzene ratios than the roadside study. At QVAZ, the benzene-ethylbenzene ratio is larger than the xylenes-ethylbenzene ratio, whereas the opposite is true for the roadside study.

4.5 RFG Analysis

The Phoenix-Mesa-Scottsdale, AZ, MSA participates in a winter oxygenated reformulated fuel program (EPA, 2001). Originally, the Phoenix MSA opted into the Federal RFG program in 1997. In 1998, EPA approved their opt out petition, as the state was imposing a more stringent RFG program in the Phoenix MSA. During the winter season in the Phoenix MSA (November 15 - March 31), the oxygen content in gasoline must be at least 3.5%, boosting the octane quality, increasing combustion, and reducing exhaust emissions. The oxygenate used as the RFG additive in the Phoenix MSA is ethanol. Figures 4-11 through 4-14 are the VOC profiles at the Arizona sites.

At MCAZ (Figure 4-11), the total VOC concentrations were varied, with the highest concentration occurring on March 10, 2004. On that day, the VOC non-HAP contribution was much higher than on other sampling days. The non-BTEX mobile concentrations were typically low or non-existent. The sampling at MCAZ ran from January 4 - March 15, thus missing three-quarters of the year. Therefore, any reduction in total VOCs or the BTEX compounds during the winter season cannot be determined using 2004 data alone.

At PSAZ (Figure 4-12), the total VOC concentrations were also varied, with the highest concentration occurring on March 10, 2004. (This was also the highest concentration at MCAZ.) On that day, all categories of VOC were slightly higher than on other sampling days. The non-BTEX HAP concentrations were typically low. The sampling at PSAZ ran from January 4 - March 15, thus missing a majority of the year. Any reduction in total VOCs or the BTEX compounds during the winter season cannot be determined using 2004 data alone.

The sampling at QVAZ ran from January 10 - March 10, thus missing most of the year. According to Figure 4-13, the total VOC concentrations were low compared to other Arizona sites, with the highest concentration occurring on January 22, 2004. On that day, the BTEX HAP contribution was much higher than on other sampling days. The stationary source HAP concentrations are typically low. Any reduction in total VOCs or the BTEX compounds during the winter season cannot be determined using 2004 data alone.

At SPAZ (Figure 4-14), the total VOC concentrations were also varied, with the highest concentration occurring on March 10, 2004 (like MCAZ and PSAZ). On that day, the BTEX HAP contribution was much higher than other sampling days. Typically, the non-BTEX mobile HAP concentrations were low. The sampling at SPAZ ran from January 4 - March 15, thus missing most of the year. Any reduction in total VOCs or the BTEX compounds during the winter season cannot be determined using 2004 data alone. It is interesting to note that the highest concentration at each of the sites in Maricopa County occurred on the same day, March 10th.

4.6 NATTS Site Analysis

One of the Phoenix sites, PSAZ, is an EPA-designated NATTS site. A description of the NATTS program is provided in Section 3.6. A regulation analysis and an emission tracer analysis for each of the NATTS sites was conducted. Details on each type of analysis are also provided in Section 3.6.

4.6.1 Regulation Analysis

Table 3-10 summarizes the reduction of emissions that is expected from the promulgation of regulations applicable to facilities located within 10 miles of the monitoring site. This analysis includes only regulations implemented after 2002 or later (regulations implemented prior to 2003 would already be in effect at the time of the 2002 National Emissions Inventory and no further reduction would be expected). As indicated in Table 3-10, five future regulations would be applicable to the facilities located within 10 miles of PSAZ. Since PSAZ sampled only VOC, only VOC reductions are considered. Based on analysis, the regulations shown are expected to achieve reductions in emissions of the following UATMP VOC: ethylbenzene (8%), methyl ethyl ketone (24%), styrene (41%), tetrachloroethylene (17%), toluene (3%), and total xylenes (9%). A 12% reduction of VOC is expected as a result of these regulations, as shown in Table 3-10. These reductions are expected to occur over the next few years as the last compliance date for the applicable regulations is April 2007.

4.6.2 Emission Tracer Analysis

The highest acrylonitrile noncancer toxicity score was further examined here. Figure 4-11 is the pollution rose for acrylonitrile at PSAZ. The highest concentration of acrylonitrile occurred on February 27, 2004 and winds on that day point to possible emission sources south of the monitor. This was also the only time acrylonitrile was detected. Figure 4-12 is a back trajectory map for this date, which shows air originating to the southwest of the monitor. Acrylonitrile stationary emission sources near this site and in the general direction of the back trajectory are also plotted in Figure 4-12. According to the 2002 NEI, there are a few acrylonitrile sources located southwest of the monitoring site. Air sampled at PSAZ on this date likely passed nearby these sources earlier in the day.

4.7 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

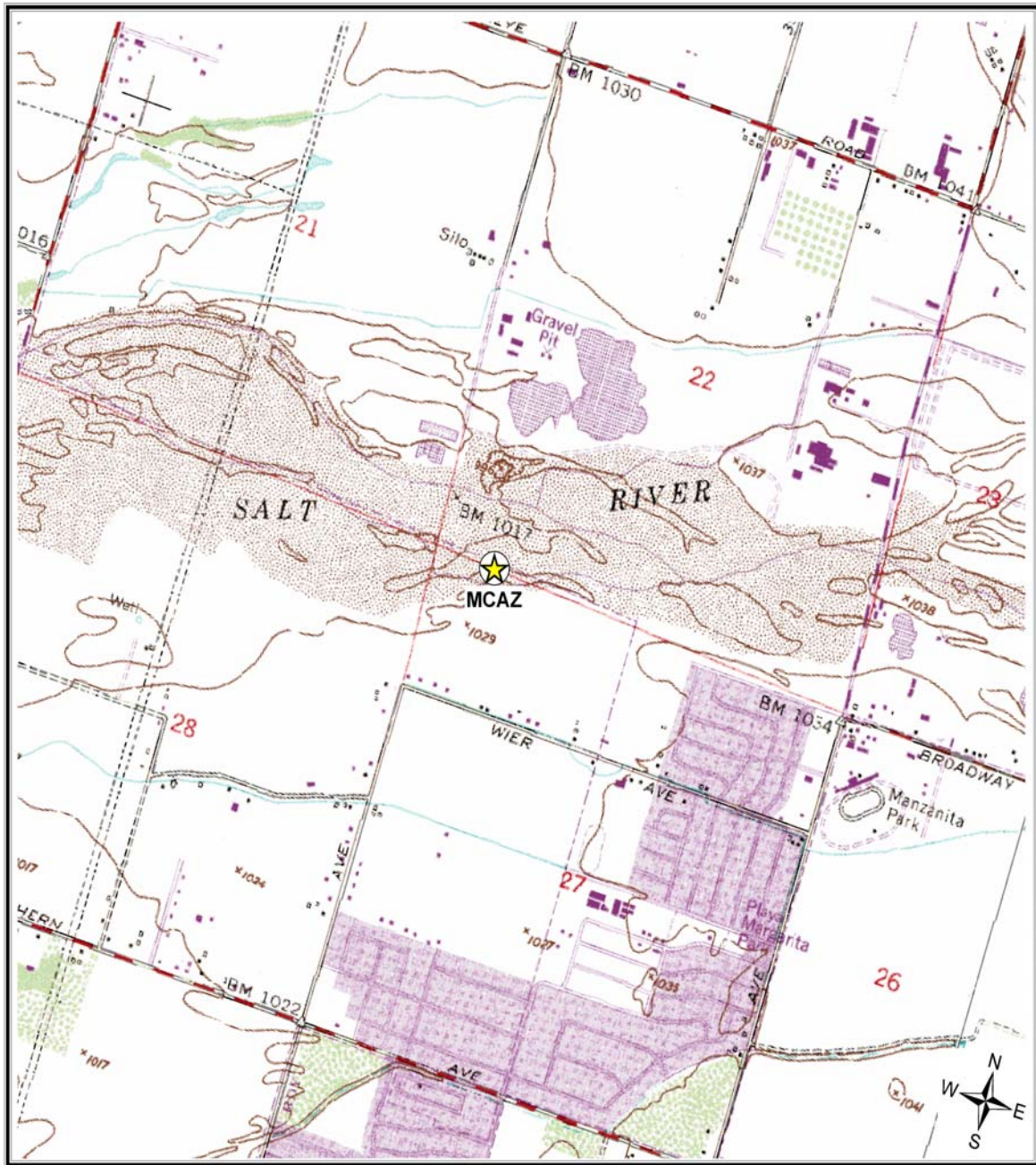
4.7.1 Site-Specific Trends Analyses

PSAZ, QVAZ, and SPAZ have been participants in the UATMP since 2001, while MCAZ has only participated since 2003. Benzene concentrations have varied only a little over the last four years at PSAZ, while 1,3-butadiene has been slightly decreasing. Benzene concentrations at QVAZ have remained fairly steady, except for an increase in 2003. 1,3-Butadiene concentrations at QVAZ also increased significantly in 2003, but this compound was not even detected in 2004. At SPAZ, benzene concentrations are up in 2004 from 2003 levels, but both are less than concentrations in previous years. Levels of 1,3-butadiene at SPAZ have been slightly decreasing since 2002. Please refer to Figures 3-43, 3-44, and 3-48.

4.7.2 MSA-Specific Trends Analyses

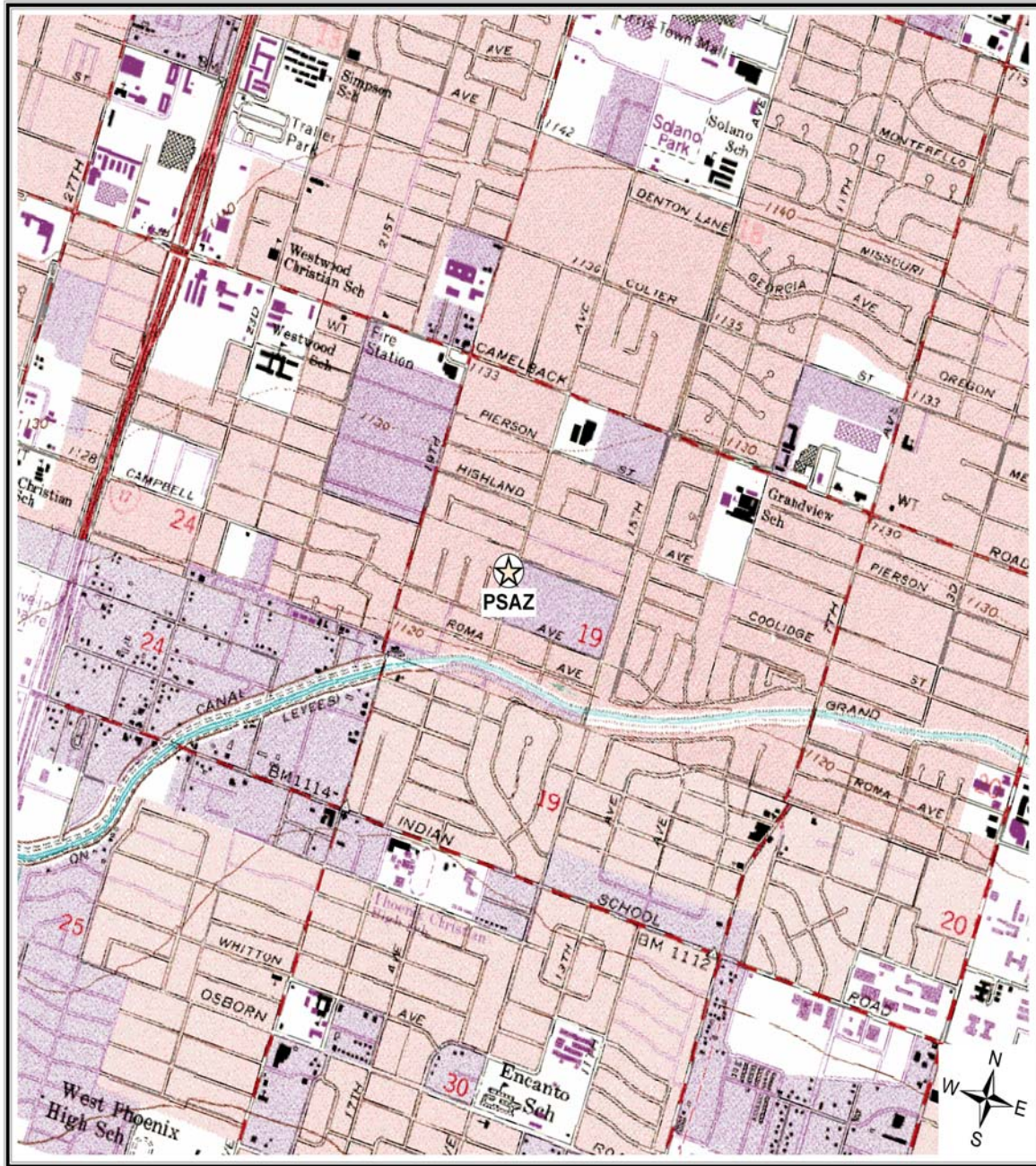
All four Arizona sites reside in the Phoenix-Mesa-Scottsdale, AZ MSA. The Phoenix, AZ MSA has experienced a 60.5% increase in population and a 72.3% increase in vehicle miles traveled (VMT) from 1990 to 2003. VOC emissions have decreased between 27% and 36% between 1990 and 2002. The 2004 VOC concentrations has decreased significantly from the 2002-2003 time period, according to the UATMP sites that represent this MSA. Trends for these and other compounds of interest can be found in Table 3-13. This MSA participates in the winter oxygenated program and participated in the reformulated gasoline program from 1992-1998.

Figure 4-1. Phoenix, Arizona Site 1 (MCAZ) Monitoring Site



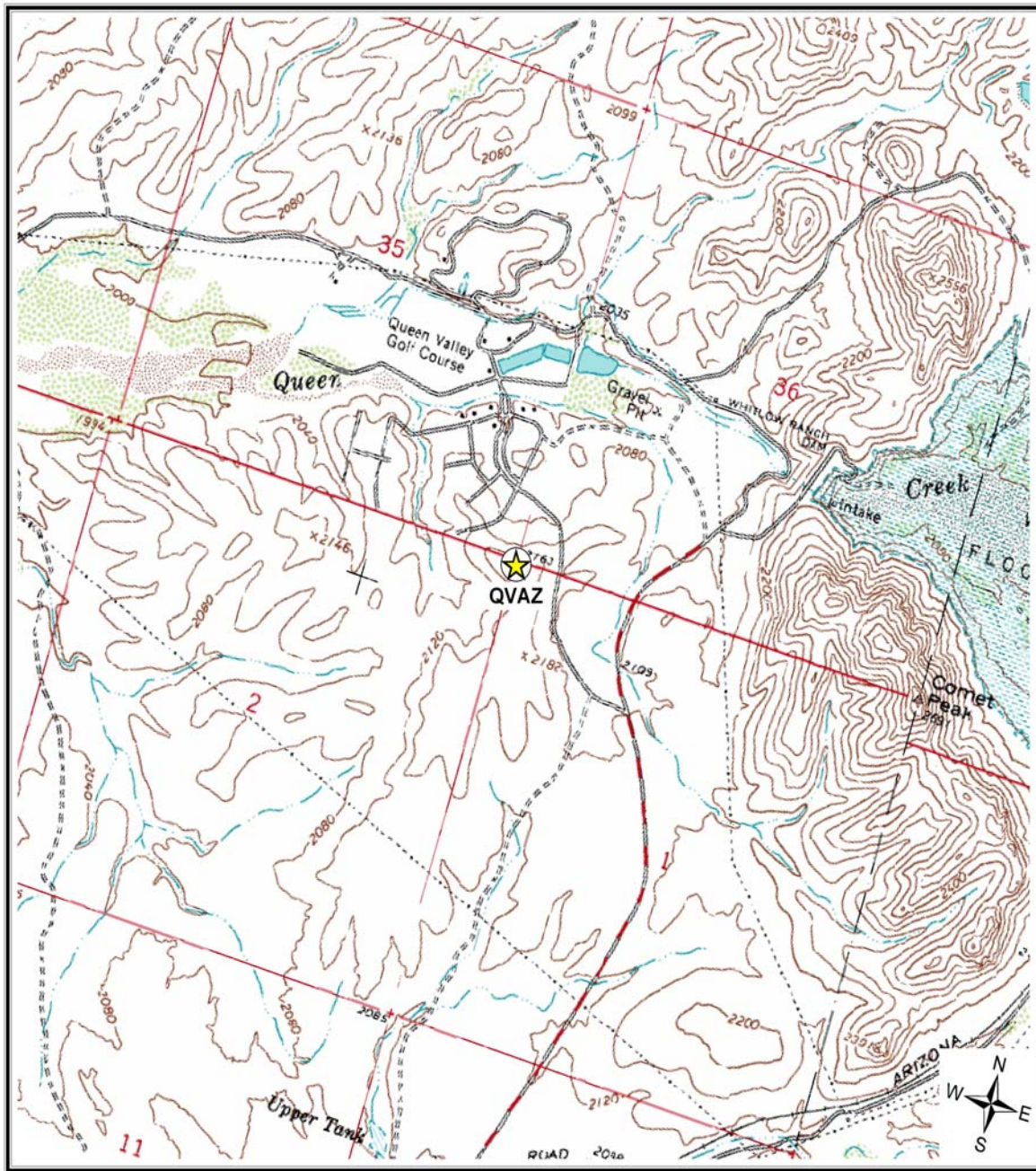
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 4-2. Phoenix, Arizona Site 2 (PSAZ) Monitoring Site



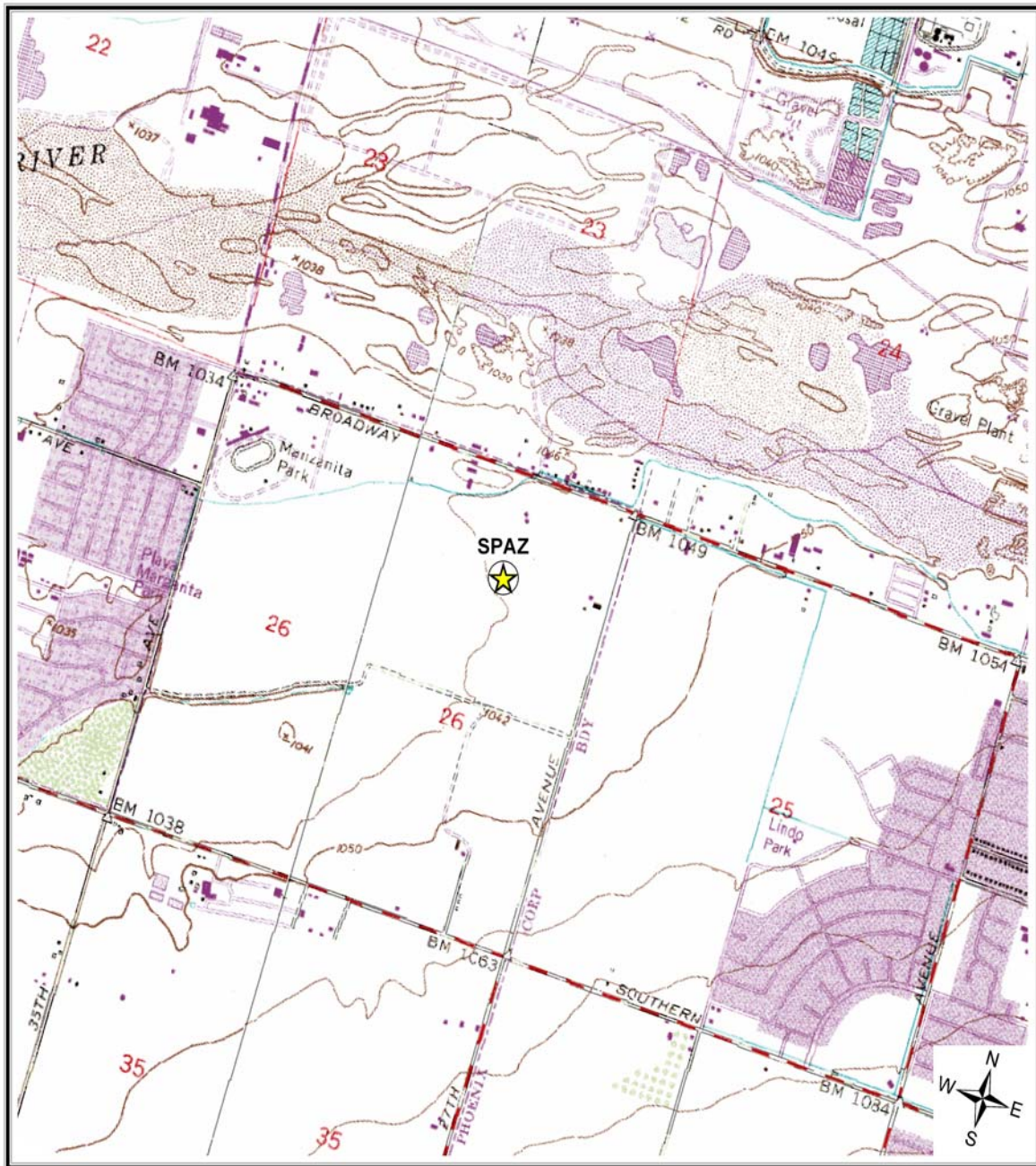
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 4-3. Phoenix, Arizona Site 3 (QVAZ) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 4-4. Phoenix, Arizona Site 4 (SPAZ) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 4-5. Facilities Located Within 10 Miles of MCAZ, PSAZ, and SPAZ

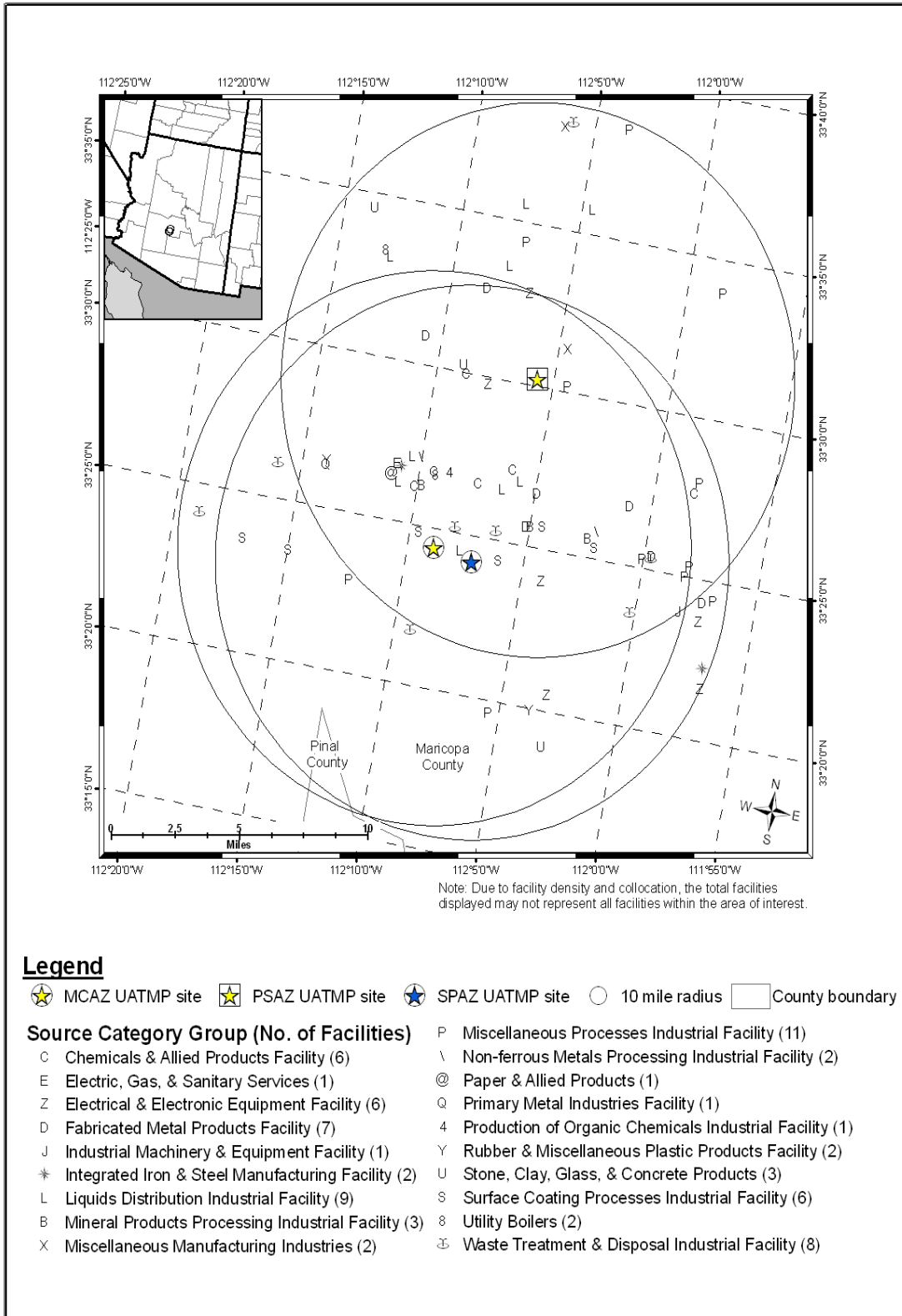


Figure 4-6. Facilities Located Within 10 Miles of QVAZ

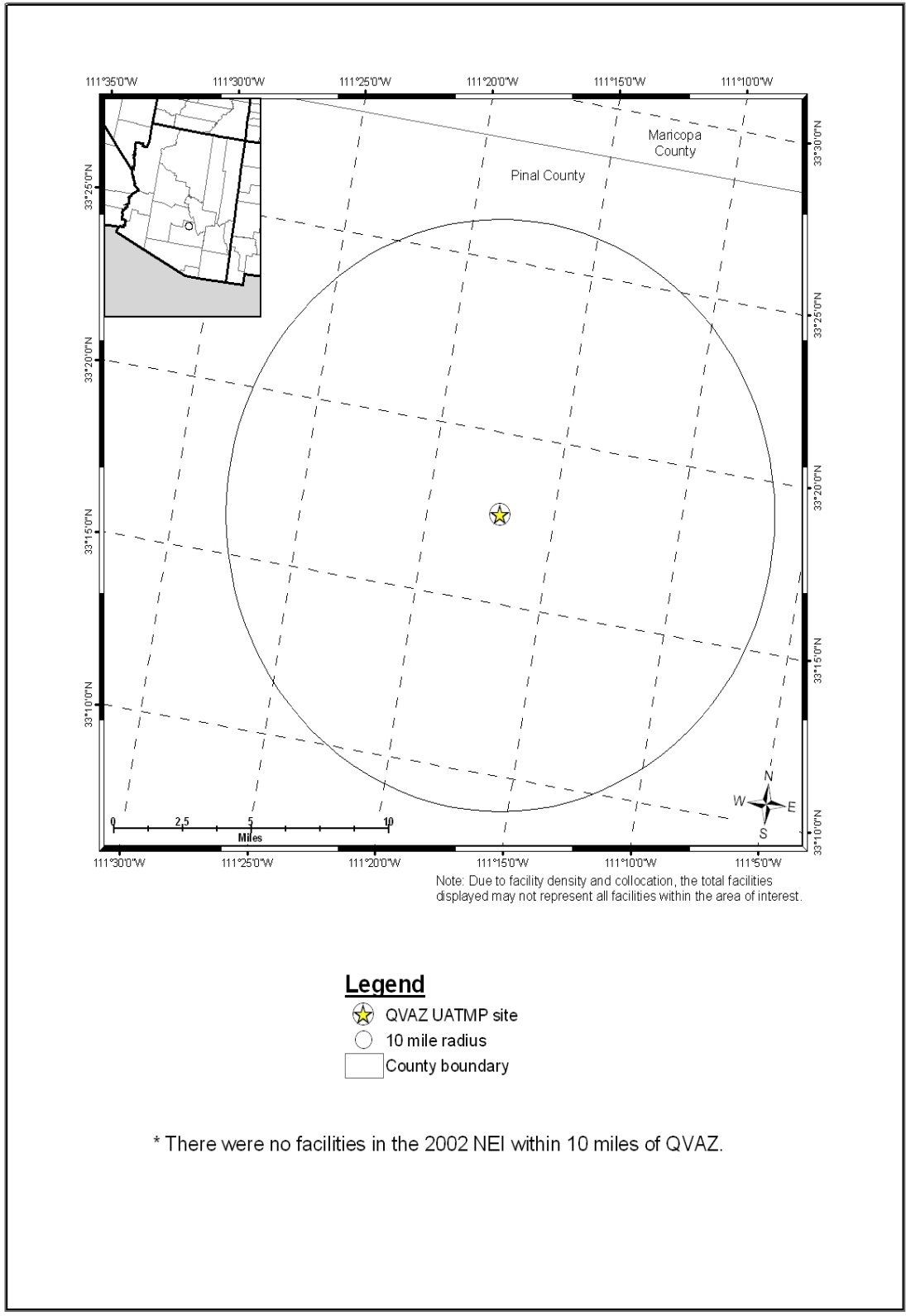


Figure 4-7. Composite Back Trajectory Map for MCAZ

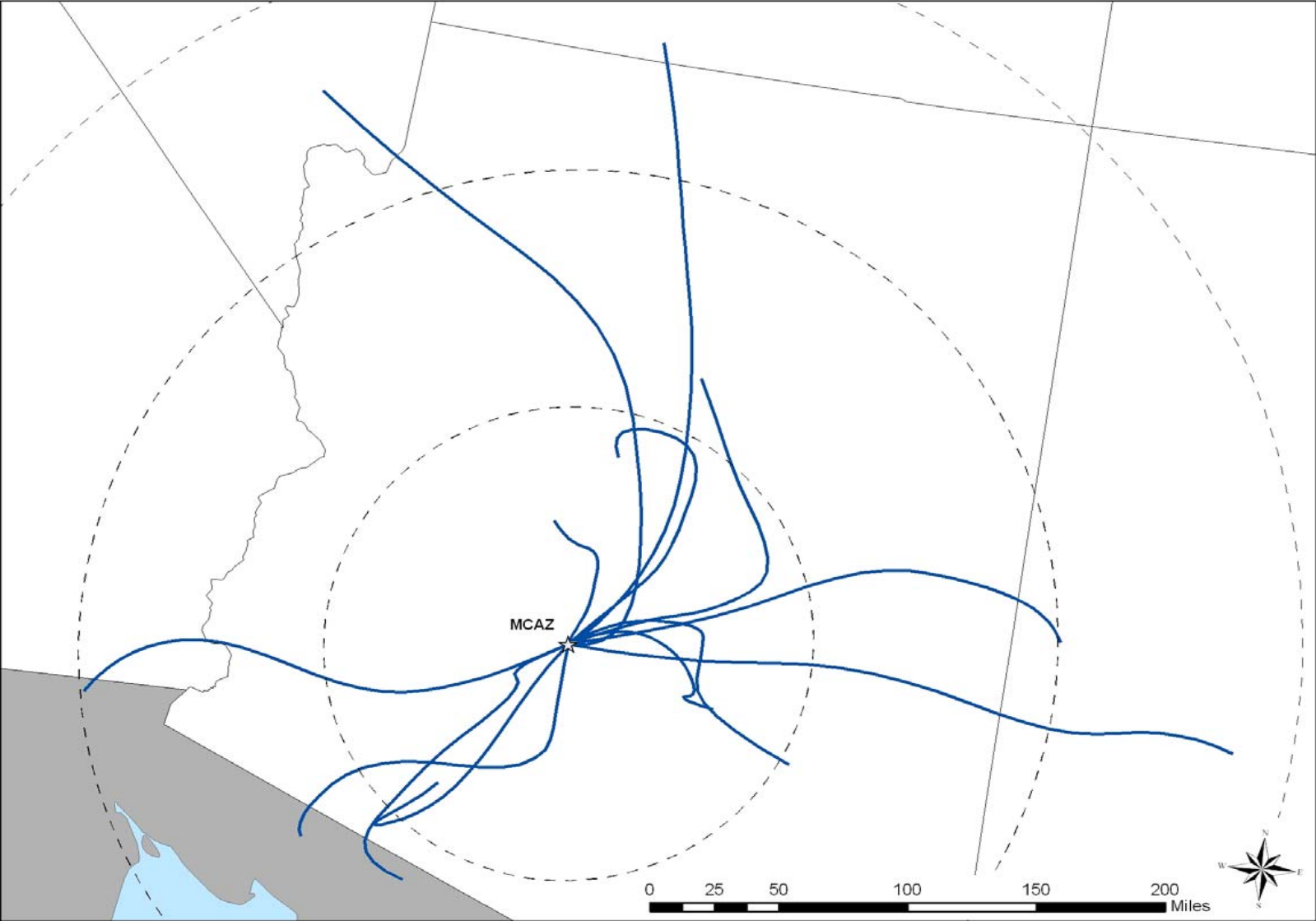


Figure 4-8. Composite Back Trajectory Map for PSAZ

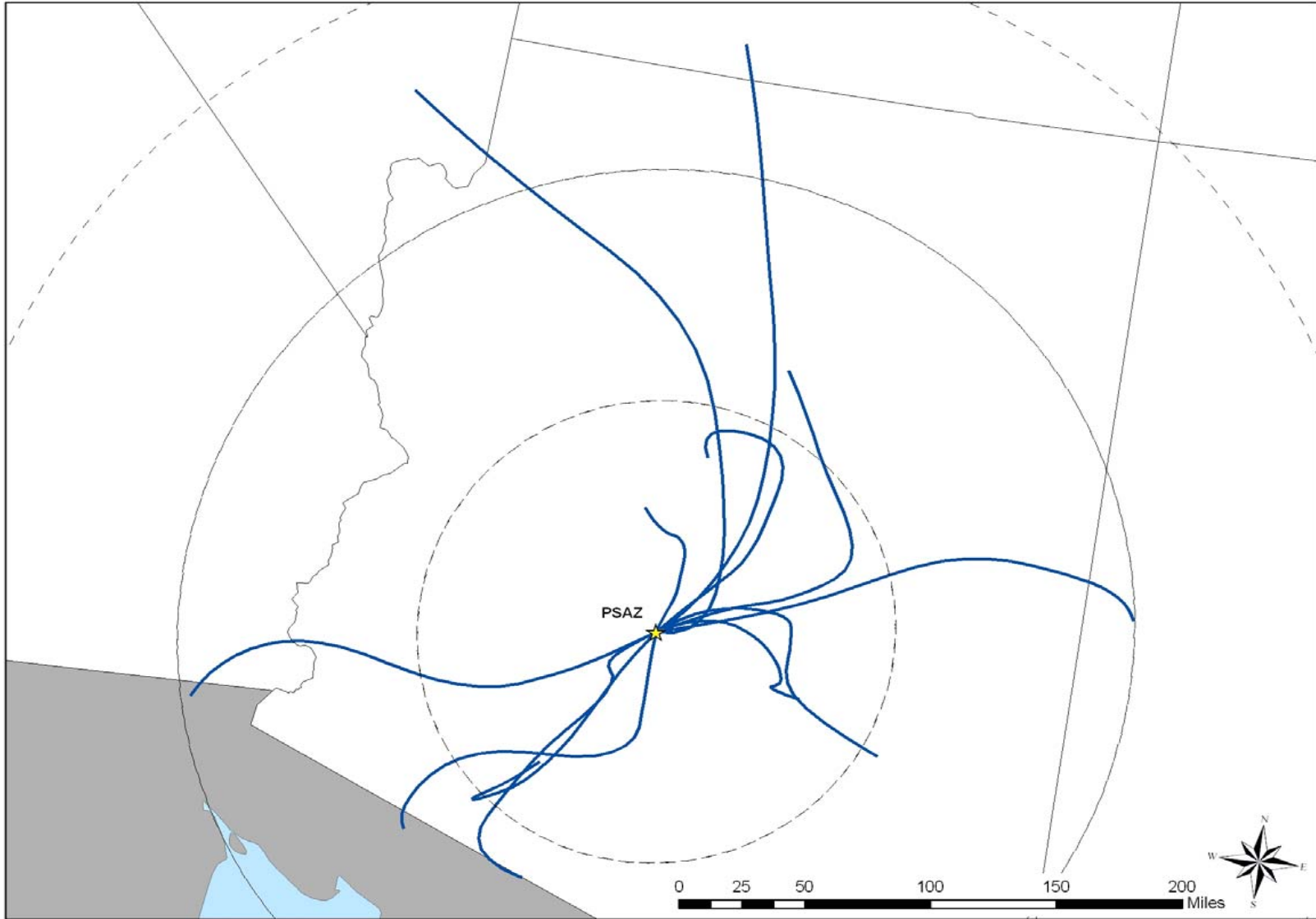


Figure 4-9. Composite Back Trajectory Map for QVAZ

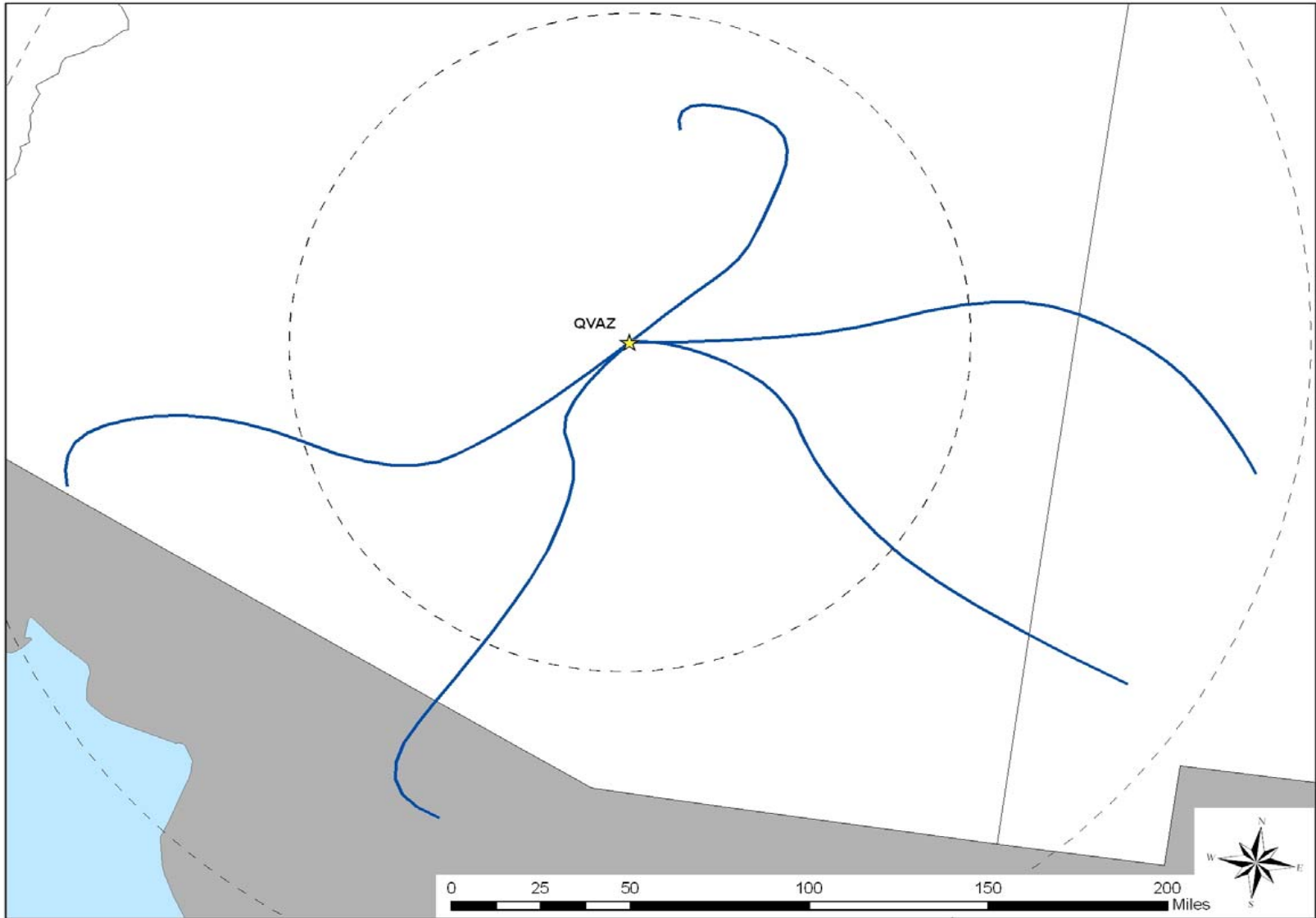


Figure 4-10. Composite Back Trajectory Map for SPAZ

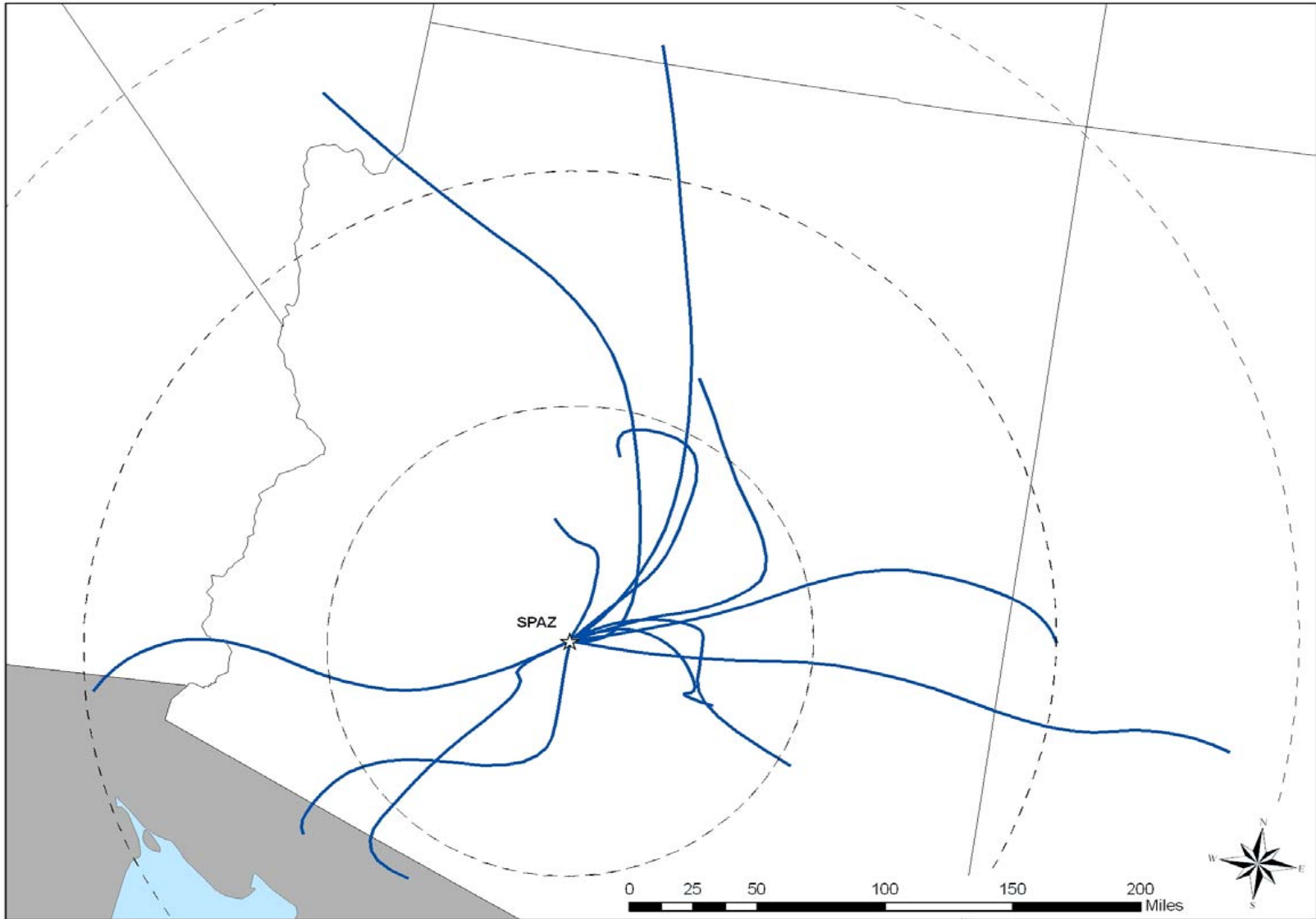


Figure 4-11. 2004 Total VOC Profile for MCAZ

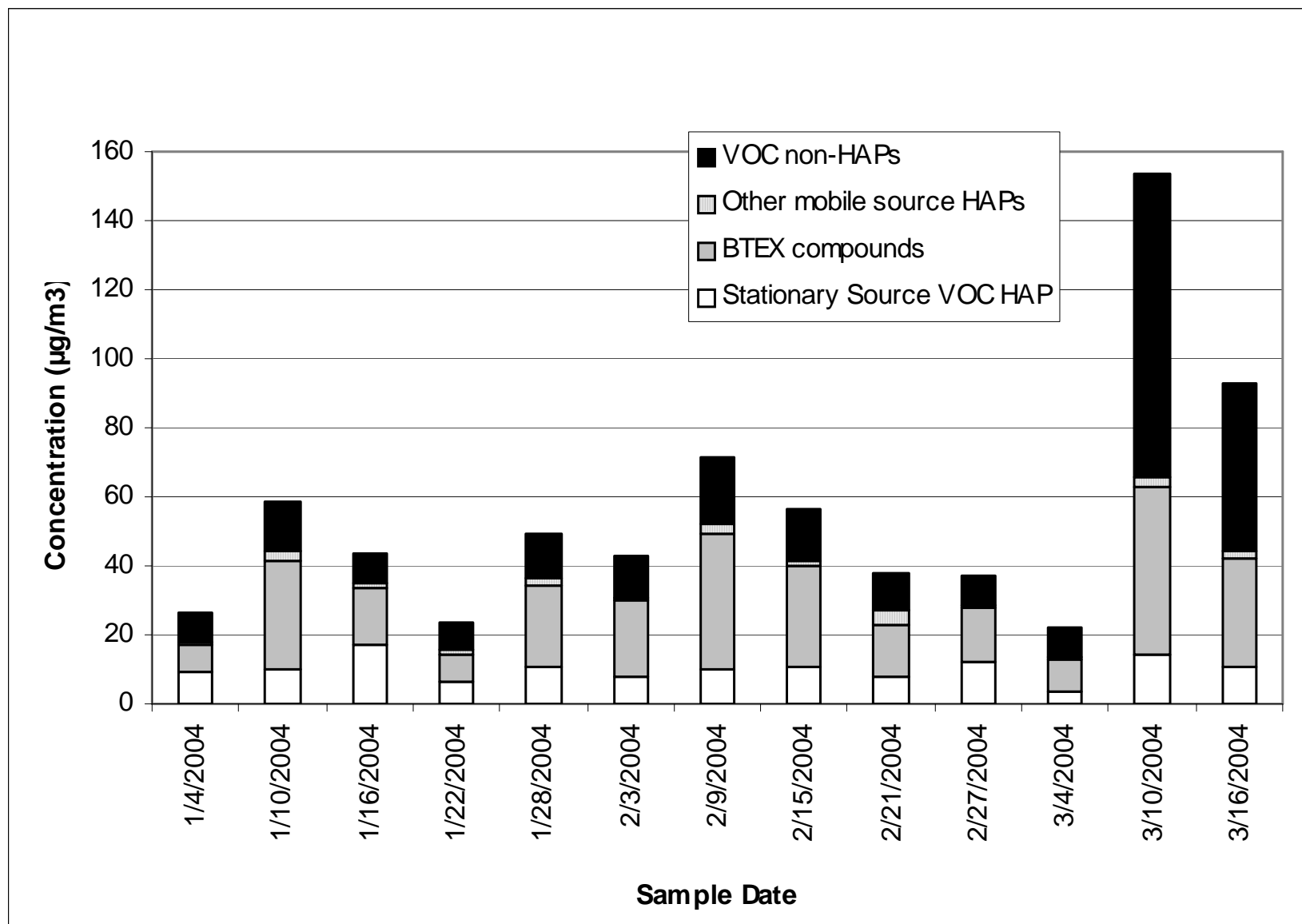


Figure 4-12. 2004 Total VOC Profile for PSAZ

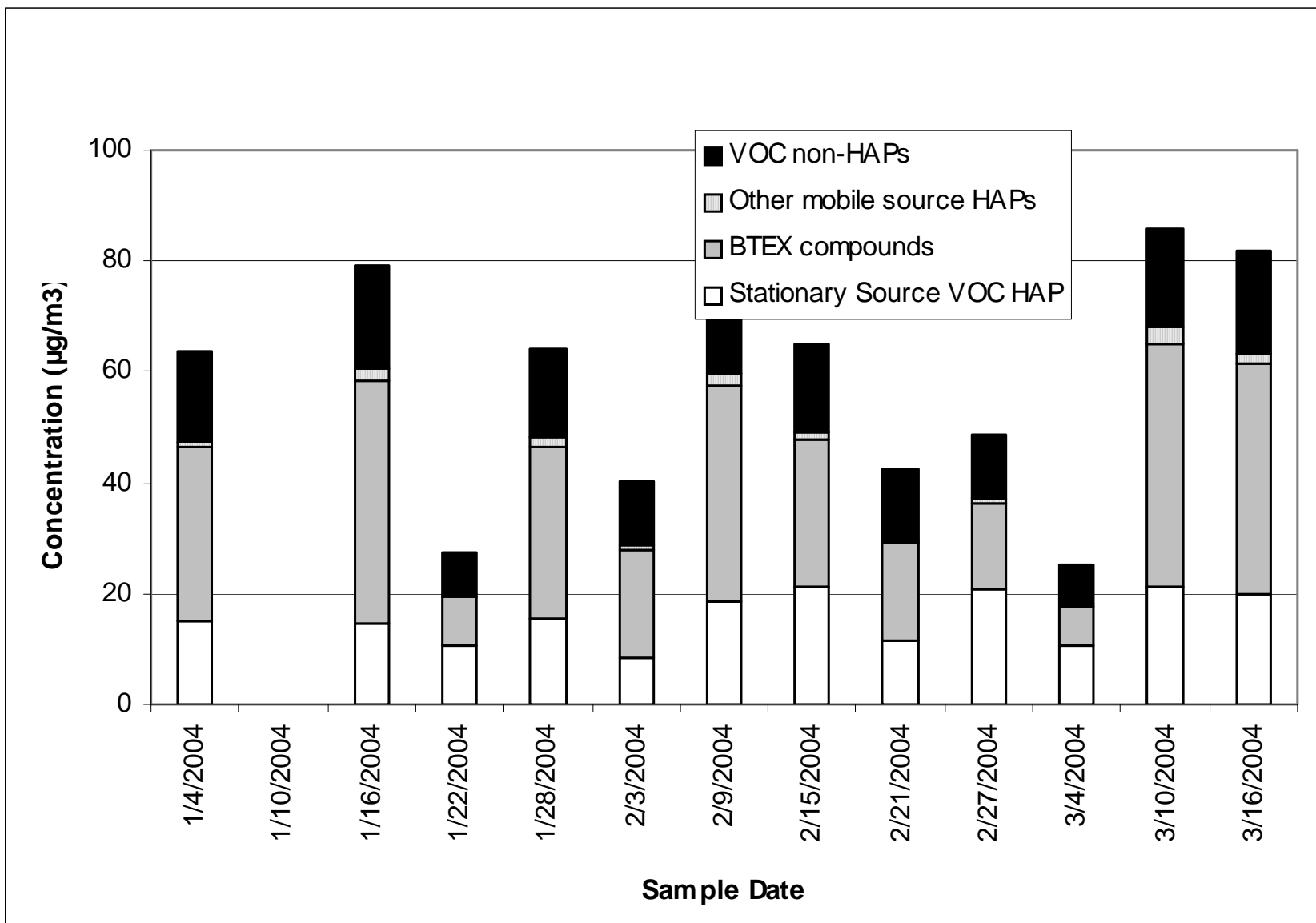
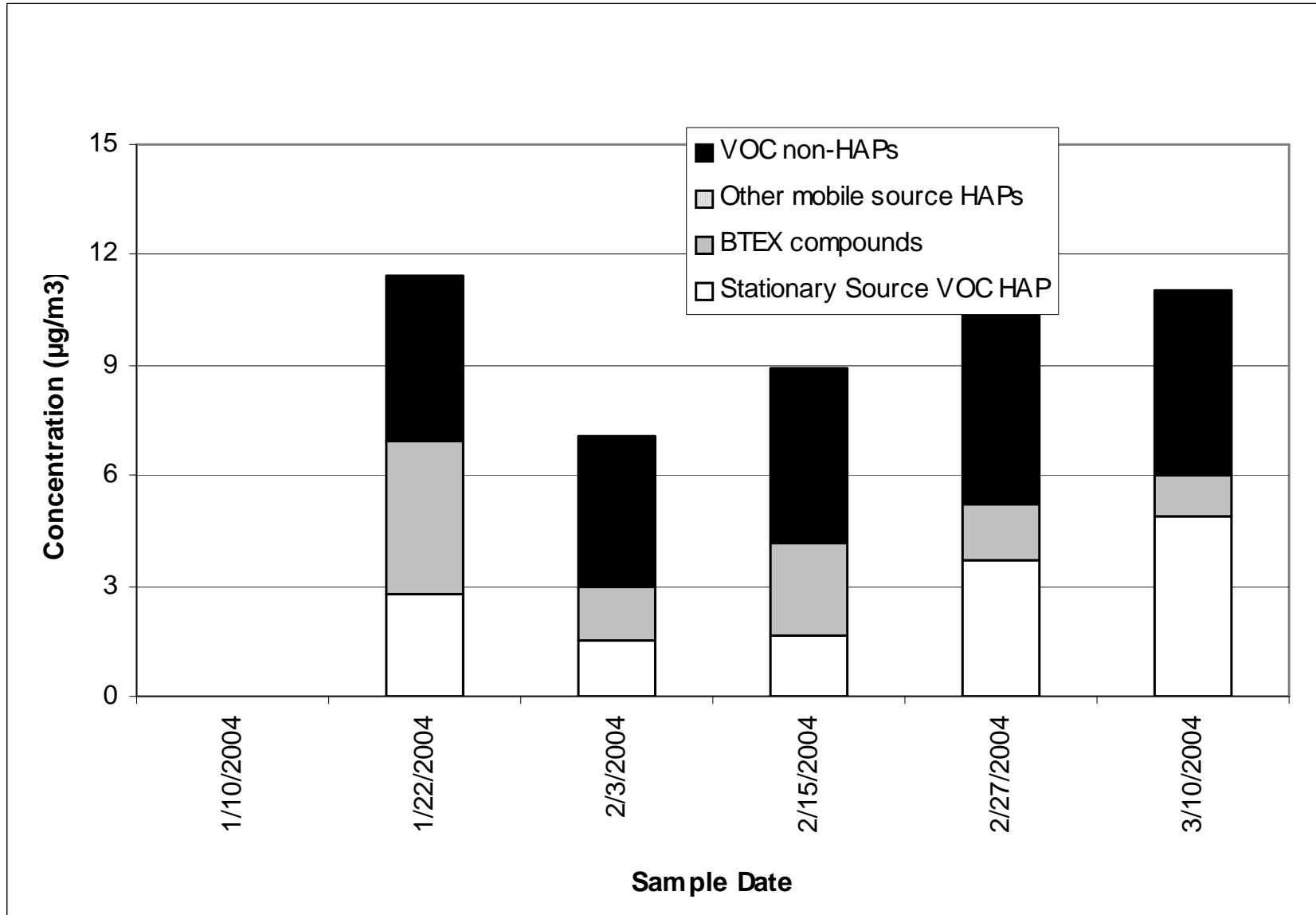


Figure 4-13. 2004 Total VOC Profile at QVAZ



4-21

Figure 4-14. 2004 Total VOC Profile at SPAZ

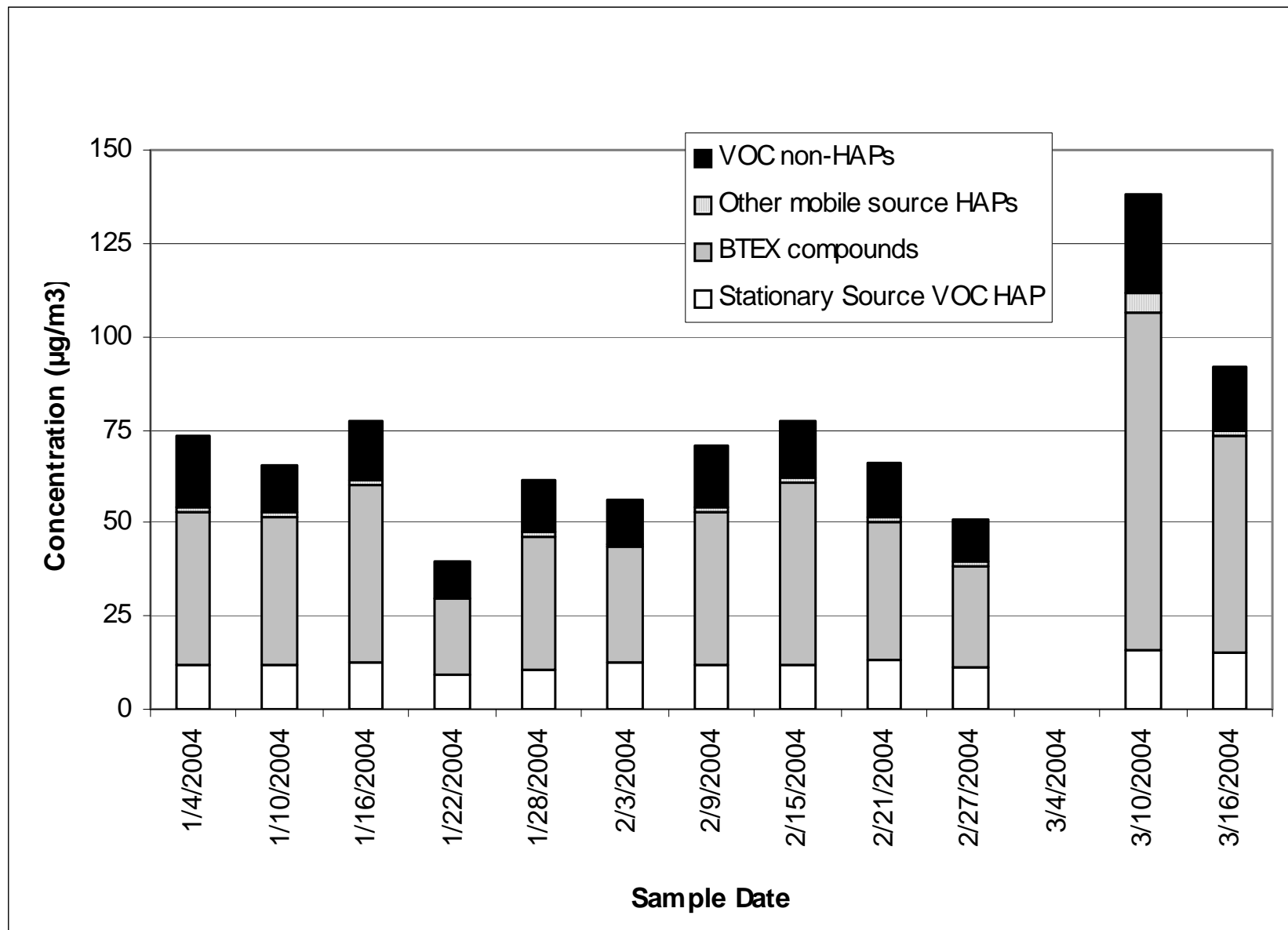


Figure 4-15. Acrylonitrile Pollution Rose for PSAZ

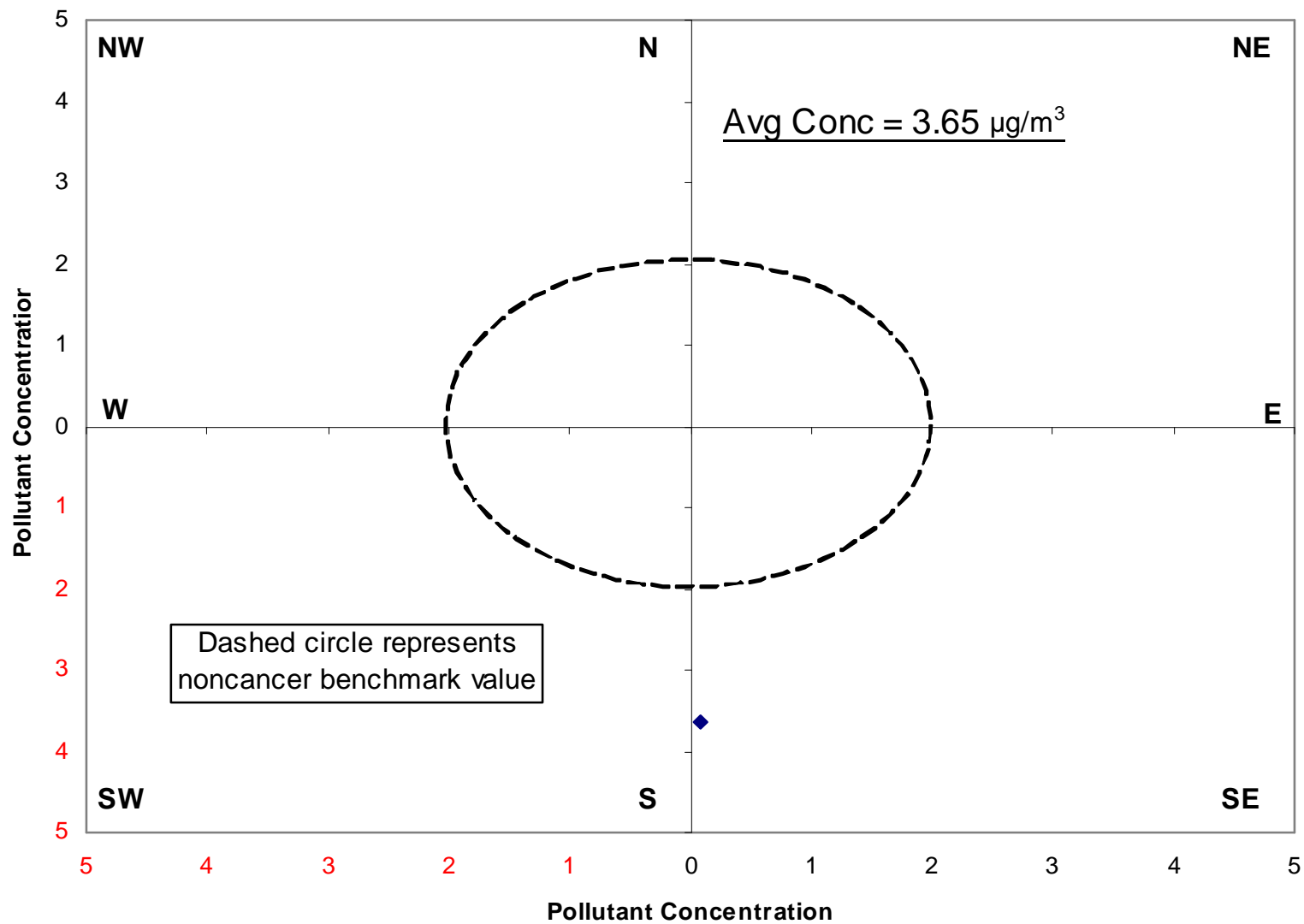


Figure 4-16. Acrylonitrile Sources Along the February 27, 2004 Back Trajectory at PSAZ

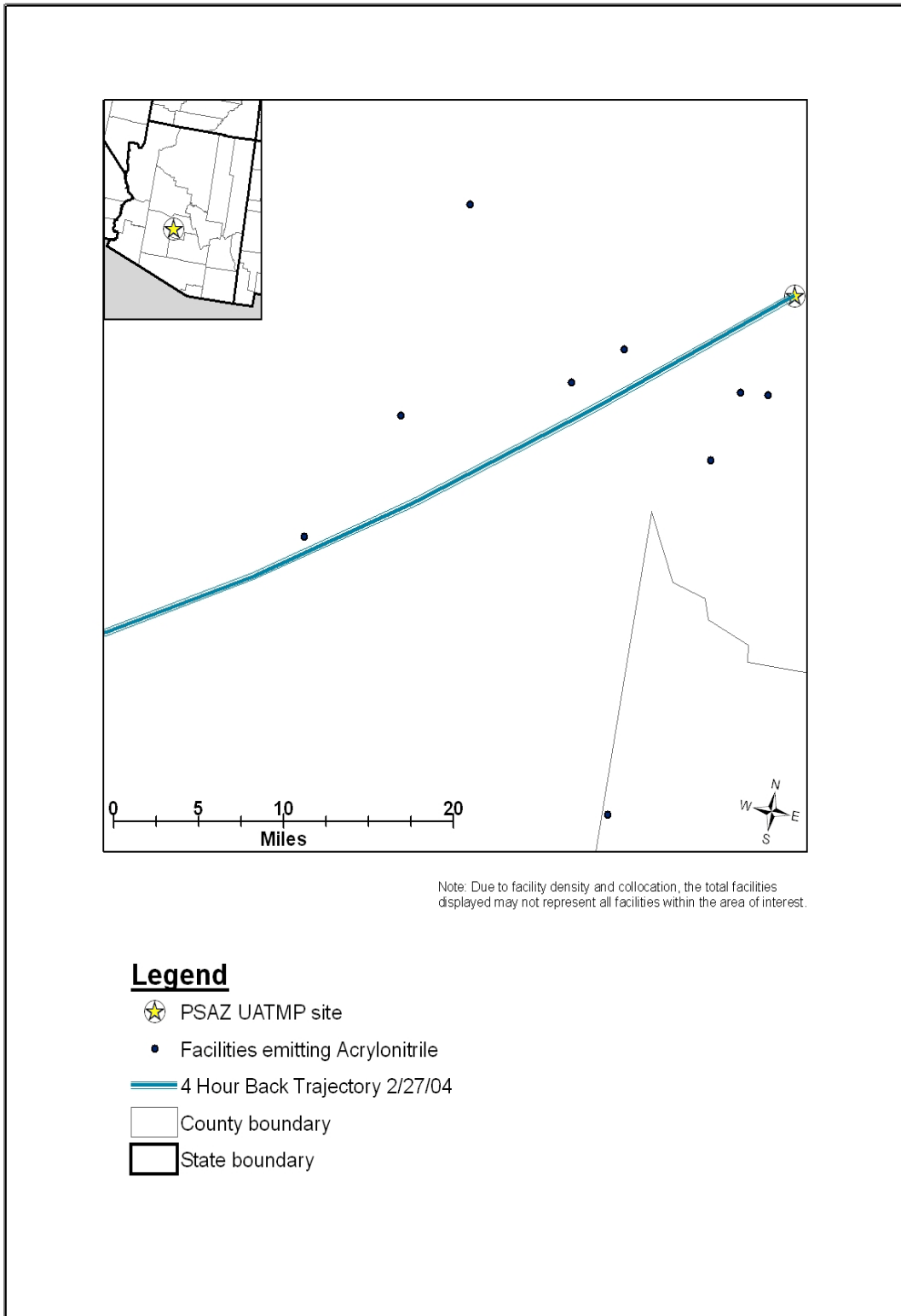


Table 4-1. Average Concentration and Meteorological Parameters for Sites in Arizona

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
MCAZ	All 2004	/ / / / / / / /	85.58 (± 1.68)	75.17 (± 1.60)	37.99 (± 1.20)	55.70 (± 0.89)	32.71 (± 1.87)	1012.07 (± 0.50)	-0.40 (± 0.31)	0.80 (± 0.19)
	sample day	55.04 (± 18.61)	68.46 (± 6.07)	58.88 (± 4.81)	32.75 (± 5.63)	46.95 (± 3.23)	43.03 (± 9.80)	1014.01 (± 2.39)	-2.15 (± 1.76)	0.33 (± 0.92)
PSAZ	All 2004	/ / / / / / / /	85.58 (± 1.68)	75.17 (± 1.60)	37.99 (± 1.20)	55.70 (± 0.89)	32.71 (± 1.87)	1012.07 (± 0.50)	-0.40 (± 0.31)	0.80 (± 0.19)
	sample day	58.56 (± 11.50)	67.58 (± 6.33)	58.20 (± 5.02)	33.57 (± 5.86)	46.90 (± 3.50)	45.00 (± 9.83)	1013.79 (± 2.55)	-1.69 (± 1.57)	0.64 (± 0.78)
QVAZ	All 2004	/ / / / / / / /	85.58 (± 1.68)	75.17 (± 1.60)	37.99 (± 1.20)	55.70 (± 0.89)	32.71 (± 1.87)	1012.07 (± 0.50)	-0.40 (± 0.31)	0.80 (± 0.19)
	sample day	9.91 (± 1.49)	68.80 (± 9.89)	59.68 (± 7.42)	34.09 (± 9.61)	47.94 (± 4.99)	44.30 (± 14.87)	1013.34 (± 4.45)	-2.84 (± 1.86)	0.24 (± 1.73)
SPAZ	All 2004	/ / / / / / / /	85.58 (± 1.68)	75.17 (± 1.60)	37.99 (± 1.20)	55.70 (± 0.89)	32.71 (± 1.87)	1012.07 (± 0.50)	-0.40 (± 0.31)	0.80 (± 0.19)
	sample day	72.40 (± 13.41)	69.50 (± 6.23)	59.41 (± 5.10)	31.50 (± 5.54)	46.70 (± 3.47)	39.62 (± 8.02)	1014.33 (± 2.51)	-1.78 (± 1.75)	0.25 (± 0.98)

Table 4-2. Summary of the Toxic Cancer Compounds at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
West Broadway in Phoenix, Arizona - MCAZ						
Acrylonitrile	2.21 E-05	31.69	31.69	0.33	1	22.14
Benzene	1.65 E-05	23.68	55.37	2.12	13	16.54
1,3-Butadiene	9.41 E-06	13.47	68.84	0.31	11	9.41
Carbon Tetrachloride	8.66 E-06	12.39	81.24	0.58	13	8.66
<i>p</i> -Dichlorobenzene	5.95 E-06	8.52	89.76	0.54	2	5.95
Tetrachloroethylene	4.17 E-06	5.97	95.72	0.71	11	4.17
<i>trans</i> -1,3-Dichloropropene	1.50 E-06	2.15	97.87	0.38	3	1.50
Trichloroethylene	1.18 E-06	1.69	99.57	0.59	1	1.18
Dichloromethane	3.03 E-07	0.43	100.00	0.64	11	0.30
Supersite in Phoenix, Arizona - PSAZ						
Acrylonitrile	2.48 E-04	78.86	78.86	3.65	1	247.92
Benzene	2.52 E-05	8.02	86.88	3.23	12	25.22
1,3-Butadiene	1.36 E-05	4.34	91.22	0.45	12	13.65
<i>p</i> -Dichlorobenzene	9.08 E-06	2.89	94.11	0.83	10	9.08
Carbon Tetrachloride	8.67 E-06	2.76	96.87	0.58	12	8.67
Tetrachloroethylene	8.01 E-06	2.55	99.42	1.36	11	8.01
<i>trans</i> -1,3-Dichloropropene	1.33 E-06	0.42	99.84	0.33	3	1.33
Trichloromethane	4.97 E-07	0.16	100.00	1.06	12	0.50

Table 4-2. Summary of the Toxic Cancer Compounds at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Cancer Risk (Out of 1 Million)
Queen Valley in Phoenix, Arizona - QVAZ						
Acrylonitrile	2.41 E-05	63.52	63.52	0.35	3	24.10
Carbon Tetrachloride	8.87 E-06	23.38	86.89	0.59	5	8.87
Benzene	3.34 E-06	8.80	95.69	0.43	5	3.34
<i>trans</i> -1,3-Dichloropropene	1.63 E-06	4.31	100.00	0.41	1	1.63
South Phoenix, Arizona - SPAZ						
Benzene	2.84 E-05	36.93	36.93	3.64	12	28.36
1,3-Butadiene	1.33 E-05	17.36	54.29	0.44	11	13.33
Acrylonitrile	1.18 E-05	15.37	69.66	0.17	2	11.81
<i>p</i> -Dichlorobenzene	9.26 E-06	12.06	81.72	0.84	10	9.26
Carbon Tetrachloride	8.41 E-06	10.96	92.68	0.56	12	8.41
Tetrachloroethylene	3.69 E-06	4.81	97.48	0.63	9	3.69
<i>trans</i> -1,3-Dichloroepropene	1.59 E-06	2.07	99.55	0.40	4	1.59
Dichloromethane	3.44 E-07	0.45	100.00	0.73	10	0.34

Table 4-3. Summary of the Toxic Noncancer Compounds at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
West Broadway in Phoenix, Arizona - MCAZ						
Acrylonitrile	1.63 E-01	27.66	27.66	0.33	1	0
1,3-Butadiene	1.57 E-01	26.64	54.30	0.31	11	0
Xylenes	1.11 E-01	18.88	73.18	11.11	13	0
Benzene	7.26 E-02	10.40	84.60	2.177	13	0
Toluene	2.03 E-02	3.45	88.64	8.12	13	0
<i>trans</i> -1,3-Dichloropropene	1.88 E-02	3.19	91.83	0.38	3	0
Carbon Tetrachloride	1.44 E-02	2.45	94.28	0.58	13	0
Chloromethane	1.32 E-02	2.24	96.52	1.19	13	0
Acetonitrile	8.64 E-03	1.47	97.98	0.52	6	0
Chloroform	2.82 E-03	0.48	98.46	0.28	7	0
Tetrachloroethylene	2.62 E-03	0.44	98.91	0.71	11	0
Ethylbenzene	1.53 E-03	0.26	99.17	1.53	13	0
Methyl Ethyl Ketone	1.22 E-03	0.21	99.37	6.08	13	0
Trichloroethylene	9.85 E-04	0.17	99.54	0.59	1	0
Styrene	8.34 E-04	0.14	99.68	0.83	13	0
<i>p</i> -Dichlorobenzene	6.76 E-04	0.11	99.80	0.54	2	0
Dichloromethane	6.44 E-04	0.11	99.91	0.64	11	0
Methyl- <i>tert</i> -Butyl Ether	2.81 E-04	0.05	99.96	0.84	12	0
Methyl Isobutyl Ketone	2.61 E-04	0.04	100.00	0.78	8	0

Table 4-3. Summary of the Toxic Noncancer Compounds at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Supersite in Phoenix, Arizona - PSAZ						
Acrylonitrile	1.82 E+00	75.58	75.58	3.65	1	1
1,3-Butadiene	2.27 E-01	9.43	85.01	0.45	12	0
Xylenes	1.24 E-01	5.14	90.15	12.40	12	0
Benzene	1.08 E-01	4.47	94.62	3.23	12	0
Acetonitrile	4.20 E-02	1.74	96.36	2.52	10	0
Toluene	2.45 E-02	1.01	97.38	9.78	12	0
<i>trans</i> -1,3-Dichloropropene	1.66 E-02	0.69	98.07	0.33	3	0
Chloromethane	1.53 E-02	0.63	98.70	1.37	12	0
Carbon Tetrachloride	1.45 E-02	0.60	99.30	0.58	12	0
Tetrachloroethylene	5.03 E-03	0.21	99.51	1.36	11	0
Chloroform	4.00 E-03	0.17	99.67	0.39	7	0
1,1,1-Trichloroethane	2.00 E-03	0.08	99.76	2.00	12	0
Ethylbenzene	1.75 E-03	0.07	99.83	1.75	12	0
Methyl Ethyl Ketone	1.11 E-03	0.05	99.87	5.53	12	0
Dichloromethane	1.06 E-03	0.04	99.92	1.06	12	0
<i>p</i> -Dichlorobenzene	1.03 E-03	0.04	99.96	0.83	10	0
Styrene	5.58 E-04	0.02	99.98	0.56	12	0
Methyl Isobutyl Ketone	1.96 E-04	0.01	99.99	0.59	9	0
Methyl <i>tert</i> -Butyl Ether	1.80 E-04	0.01	100.00	0.54	7	0

Table 4-3. Summary of the Toxic Noncancer Compounds at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Queen Valley in Phoenix, Arizona - QVAZ						
Acrylonitrile	1.77 E-01	68.99	68.99	0.35	3	0
trans-1,3-Dichloropropene	2.04 E-02	7.95	76.94	0.41	1	0
Carbon Tetrachloride	1.48 E-02	5.75	82.69	0.59	5	0
Benzene	1.43 E-02	5.55	88.24	0.43	5	0
Chloromethane	1.23 E-02	4.80	93.05	1.11	5	0
Acetonitrile	8.14 E-03	3.17	96.22	0.49	2	0
Xylenes	6.30 E-03	2.45	98.67	0.63	4	0
Toluene	2.88 E-03	1.12	99.79	1.15	5	0
Methyl Ethyl Ketone	3.63 E-04	0.14	99.93	1.81	2	0
Ethylbenzene	1.74 E-04	0.07	100.00	0.17	2	0
South Phoenix, Arizona - SPAZ						
Xylenes	2.23 E-01	28.62	28.62	22.26	12	0
1,3-Butadiene	2.22 E-01	28.58	57.20	0.44	11	0
Benzene	1.21 E-01	15.58	72.78	3.64	12	0
Acrylonitrile	8.68 E-02	11.16	83.94	0.17	2	0
Toluene	3.54 E-02	4.55	88.49	14.16	12	0
Acetonitrile	3.00 E-02	3.86	92.35	1.80	8	0
trans-1,3,-Dichloropropene	1.99 E-02	2.55	94.90	0.40	4	0
Carbon Tetrachloride	1.40 E-02	1.80	96.71	0.56	12	0

Table 4-3. Summary of the Toxic Noncancer Compounds at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Chloromethane	1.35 E-02	1.74	98.44	1.22	12	0
Ethylbenzene	3.01 E-03	0.39	98.83	3.01	12	0
Chloroform	2.51 E-03	0.32	99.15	0.25	6	0
Tetrachloroethylene	2.32 E-03	0.30	99.45	0.63	9	0
Methyl Ethyl Ketone	1.38 E-03	0.18	99.63	6.88	12	0
<i>p</i> -Dichlorobenzene	1.05 E-03	0.14	99.76	0.84	10	0
Dichloromethane	7.31 E-04	0.09	99.86	0.73	10	0
Styrene	6.32 E-04	0.08	99.94	0.63	12	0
Methyl Isobutyl Ketone	2.57 E-04	0.03	99.97	0.77	7	0
Methyl <i>tert</i> -Butyl Ether	2.22 E-04	0.03	100.00	0.67	9	0

Table 4-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Monitoring Sites 1, 2, 3 and 4 in Phoenix, Arizona

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
West Broadway in Phoenix, Arizona - MCAZ								
1,3-Butadiene	0.09	-0.05	-0.48	-0.28	-0.44	-0.01	0.24	0.31
Acrylonitrile	NA							
Benzene	0.58	0.43	-0.53	-0.04	-0.74	0.04	-0.04	-0.11
Carbon Tetrachloride	0.33	0.38	0.47	0.55	0.20	-0.26	-0.25	-0.16
Chloromethane	0.54	0.45	-0.18	0.19	-0.49	0.13	-0.06	-0.36
<i>p</i> -Dichlorobenzene	NA							
Tetrachloroethylene	0.60	0.60	0.12	0.45	-0.38	-0.50	-0.03	0.02
Toluene	0.69	0.58	-0.34	0.17	-0.67	-0.12	-0.12	-0.12
<i>trans</i> -1,3,-Dichloropropene	NA							
Xylenes	0.74	0.64	-0.31	0.22	-0.69	-0.19	-0.06	-0.06
Supersite in Phoenix, Arizona - PSAZ								
1,3-Butadiene	0.25	0.02	-0.68	-0.41	-0.70	0.30	0.61	0.02
Acetonitrile	-0.31	-0.44	-0.65	-0.64	-0.31	0.37	0.23	0.21
Acrylonitrile	NA							
Benzene	0.59	0.39	-0.50	-0.07	-0.78	0.07	0.54	0.05
Carbon Tetrachloride	0.05	0.10	0.21	0.20	0.08	-0.38	0.21	0.37
<i>p</i> -Dichlorobenzene	0.89	0.78	0.11	0.55	-0.63	-0.12	-0.38	-0.60
Xylenes	0.56	0.39	-0.40	-0.02	-0.71	-0.01	0.55	0.09
Queen Valley in Phoenix, Arizona - QVAZ								
Acetonitrile	NA							
Acrylonitrile	NA							
Benzene	0.22	-0.06	-0.92	-0.59	-0.77	0.47	0.37	0.01
Carbon Tetrachloride	-0.13	0.00	0.40	0.29	0.39	0.25	0.38	0.14
Chloromethane	-0.25	-0.07	0.53	0.32	0.54	0.12	0.30	0.19
<i>trans</i> -1,3-Dichloropropene	NA							

Table 4-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Monitoring Sites 1, 2, 3, and 4 in Phoenix, Arizona (Continued)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
South Phoenix, Arizona - SPAZ								
1,3-Butadiene	0.36	0.20	-0.43	-0.13	-0.59	0.03	0.12	-0.08
Acetonitrile	-0.03	-0.24	-0.72	-0.55	-0.50	0.39	0.12	0.05
Acrylonitrile	NA							
Benzene	0.60	0.52	-0.13	0.24	-0.56	0.31	0.23	0.19
Carbon Tetrachloride	0.19	0.20	0.22	0.26	0.06	-0.17	0.33	0.23
<i>p</i> -Dichlorobenzene	0.83	0.84	0.49	0.77	-0.32	-0.49	-0.18	-0.19
Tetrachloroethylene	0.30	0.35	0.30	0.36	-0.01	-0.40	-0.29	-0.24
Toluene	0.78	0.73	0.10	0.51	-0.49	-0.50	0.04	0.15
<i>trans</i> -1,3-Dichloropropene	0.47	0.30	-0.67	-0.11	-0.80	0.38	-0.48	-0.29
Xylenes	0.75	0.65	-0.09	0.36	-0.61	-0.32	0.11	0.08

Table 4-5. Motor Vehicle Information vs. Daily Concentration for Arizona Monitoring Sites

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Population: Registration)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
MCAZ	3,389,260	2,870,961	0.85	851,952	724,168	10,108	55.04 \pm 18.61
PSAZ	3,389,260	2,870,961	0.85	1,409,602	1,198,162	250	58.56 \pm 11.50
QVAZ	204,148	175,693	0.86	61,848	53,189	200	9.91 \pm 1.49
SPAZ	3,389,260	2,870,961	0.85	851,962	724,168	50,000	72.40 \pm 13.44

5.0 Site in Colorado

This section presents meteorological, concentration, and spatial trends for one UATMP site in Colorado (GPCO), located in Grand Junction. Figure 5-1 is a topographical map showing the monitoring site in its urban locations. Figure 5-2 identifies facilities within 10 miles of this site as reported in the 2002 NEI. The Grand Junction site is surrounded by numerous sources. A large number of sources near GPCO fall into the liquids distribution source category.

Hourly meteorological data were retrieved for all of 2004 at a weather station near this site for calculating correlations of meteorological data with ambient air concentration measurements. The weather station is Walker Field Airport (WBAN 23066).

Table 5-1 highlights the average UATMP concentration at the site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*- components of the wind) for the entire year and on days samples were taken. Grand Junction is located in a mountain valley on the west side of the Rockies. This location can help protect the area from dramatic weather changes. The area tends to be rather dry and winds tend to flow out of the east-southeast on average, due to the valley breeze effect. Valley breezes occur as the sun heats up the side of a mountain. The warm air rises, creating a current that will move up the valley walls. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

5.1 Prevalent Compounds at the Colorado Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site (including metals). Table 5-2 summarizes the cancer weighting scores, and Table 5-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for this site. Due to sampling error, the acetonitrile values can not be reported accurately.

Table 5-2 shows that the prevalent cancer compounds reflect the nationwide prevalent cancer compound list, which is in Section 3 of this report. Of the detected compounds, *trans*-1,3-dichloropropene, dichloromethane, and formaldehyde were not listed among the nationwide prevalent cancer compounds. The prevalent noncancer compounds summarized in Table 5-3, were all listed among the nationwide noncancer prevalent list.

The following prevalent toxic compounds were not detected at the Grand Junction site: 1,2-dichloroethane; 1,2-dichloropropane; *cis*-1,3-dichloropropene; vinyl chloride; ethyl acrylate; and *p*-dichloroethane.

5.2 Toxicity Analysis

Acrylonitrile contributed to nearly 40% of the cancer toxicity, although it was detected the least of the prevalent cancer compounds. Together, acrylonitrile, benzene, and acetaldehyde contribute to nearly 75% of the total toxicity. The risk associated with cancer for these three compounds is 31.14, 17.54, and 12.76 in a million, respectively.

For the compounds that may lead to adverse noncancer health effects, the average acetonitrile toxicity at GPCO was 0.819 (over 1 indicates a significant chance of a noncancer health effect). Acetaldehyde and formaldehyde both had two measured concentrations above the noncancer RfC weighting factor.

5.3 Meteorological and Concentration Averages at the Colorado Sites

Carbonyl compounds and VOC were sampled at this site and Table 5-1 shows the average UATMP concentration at GPCO. Table 5-4 presents the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 5.1 of this report. Moderately strong to strong negative correlations were computed between 1,3-butadiene, benzene, and xylenes and the temperature parameters, the wet bulb temperature, and the *v*-component of the wind; moderately strong to strong positive correlations between these compounds and relative humidity and sea level pressure were also computed. Pearson

correlations could not be computed for bromomethane due to the low number of detects (fewer than 4).

Figure 5-3 shows the composite back trajectory for the GPCO site for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in Figure 5-3, the back trajectories originated predominantly from the south, southwest, and northwest of the site. Each circle around the site in Figure 5-3 represents 100 miles; 80% of the trajectories originated within 300 miles, and 97% within 400 miles from the GPCO site. The 24-hour airshed domain is somewhat smaller than other sites. Back trajectories originated over 400 miles away.

5.4 Spatial Analysis

County-level vehicle registration and population in Mesa County, CO were obtained from the Colorado Department of Revenue and the U.S. Census Bureau, and are summarized in Table 5-5. Table 5-5 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitor and the vehicle registration ratio. Table 5-5 also contains the average daily traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the Colorado site in Table 5-5.

A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area (for more information on this study, refer to Section 3.4.2.). Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The ratios for the Grand Junction site generally resemble those of the roadside study.

5.5 NATTS Site Analysis

The Grand Junction site is an EPA-designated NATTS site. A description of the NATTS program is provided in Section 3.6. A regulation analysis and an emission tracer analysis for each of the NATTS sites was conducted. Details on each type of analysis are also provided in Section 3.6.

5.5.1 Regulation Analysis

Table 3-10 summarizes the reduction of emissions that is expected from the promulgation of regulations applicable to facilities located within 10 miles of the monitoring site. This analysis includes only regulations implemented after 2002 (regulations implemented prior to 2003 would already be in effect at the time of the 2002 National Emissions Inventory and no further reduction would be expected). As indicated in Table 3-10, six future regulations would be applicable to the facilities located within 10 miles of GPCO. Based on analysis, the regulations shown are expected to achieve reductions in emissions of the following UATMP pollutants: acetaldehyde (19%), formaldehyde (27%), benzene (1%), methyl ethyl ketone (48%), methyl methacrylate (62%), styrene (67%), toluene (1%), and total xylenes (48%). Carbonyl compounds are expected to see the greatest reduction of the three compound types shown in Table 3-10. These reductions are expected to occur over the next few years as the last compliance date for the applicable regulations is June 2007.

5.5.2 Emission Tracer Analysis

The highest acetaldehyde and formaldehyde noncancer toxicity scores were further examined. Figures 5-4 through 5-5 are the pollution roses for acetaldehyde and formaldehyde at GPCO. The highest concentration of acetaldehyde and formaldehyde occurred on September 6, 2004 and winds on that day point to possible emission sources southeast of the monitor. Figures 5-6 and 5-7 are back trajectory maps for this date, which shows air originating to the south and west of the monitor. Acetaldehyde and formaldehyde stationary emission sources near this site and in the general direction of the back trajectory are also plotted in Figures 5-6 and 5-7. According to the 2002 NEI, there are very few, if any acetaldehyde and formaldehyde sources located south and west of the monitoring site.

5.6 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

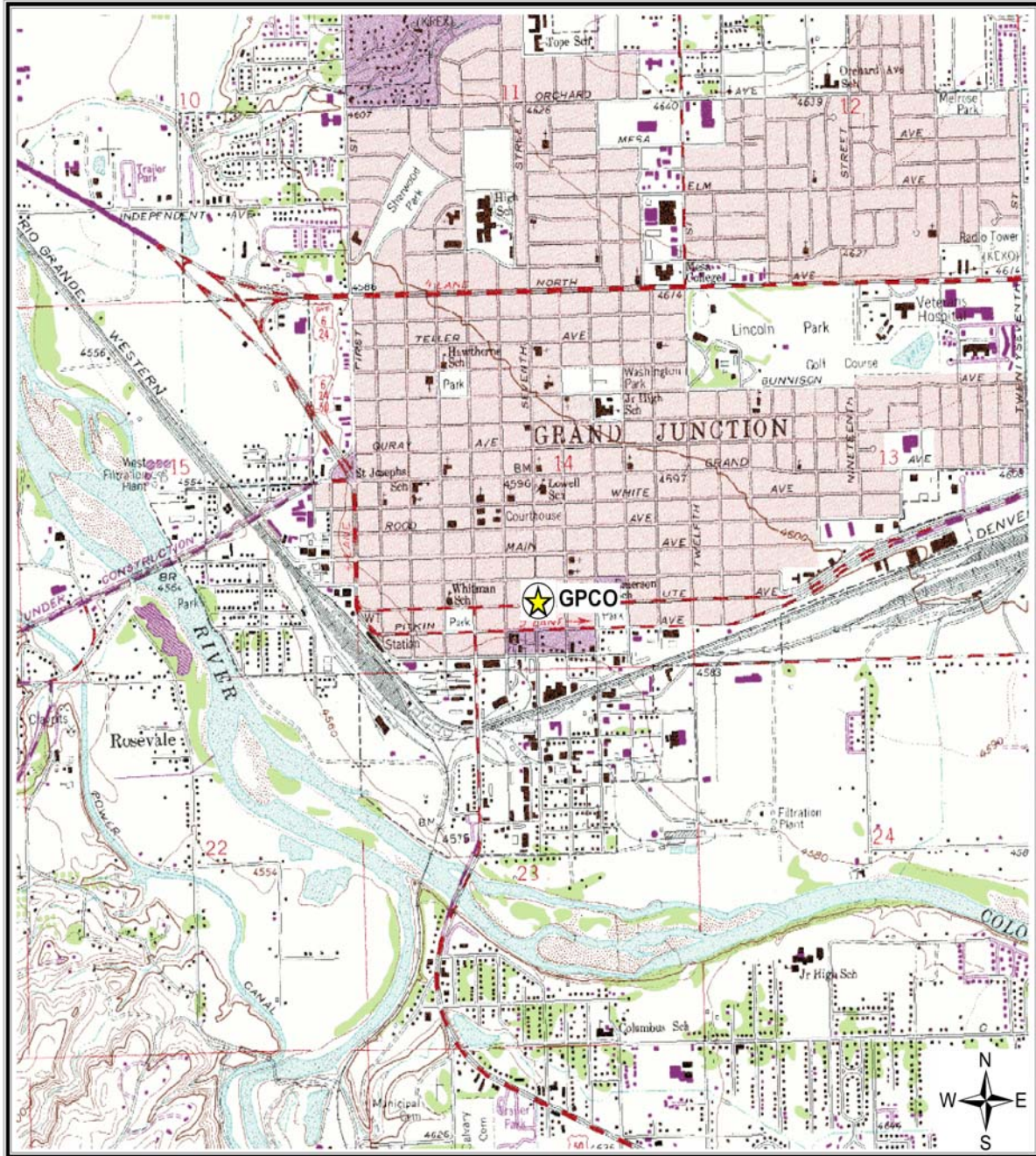
5.6.1 Site-Specific Trends Analyses

GPCO is new to the UATMP this year. Therefore, a site-specific trends analysis was not conducted.

5.6.2 MSA-Specific Trends Analyses

GPCO resides in the Grand Junction, CO MSA. The Grand Junction, CO MSA has experienced a 33.9% increase in population and an estimated vehicle miles traveled (VMT) from 1990 to 2003. VOC and carbonyl compounds emissions have decreased between 28% and 79% from 1990 and 2002, respectively. Concentrations for these compounds seem to be on the decrease or holding steady, based on UATMP sites representing this MSA (GPCO). Trends for these and other compounds of interest can be found in Table 3-13. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

Figure 5-1. Grand Junction, Colorado (GPCO) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000

Figure 5-2. Facilities Located Within 10 Miles of GPCO

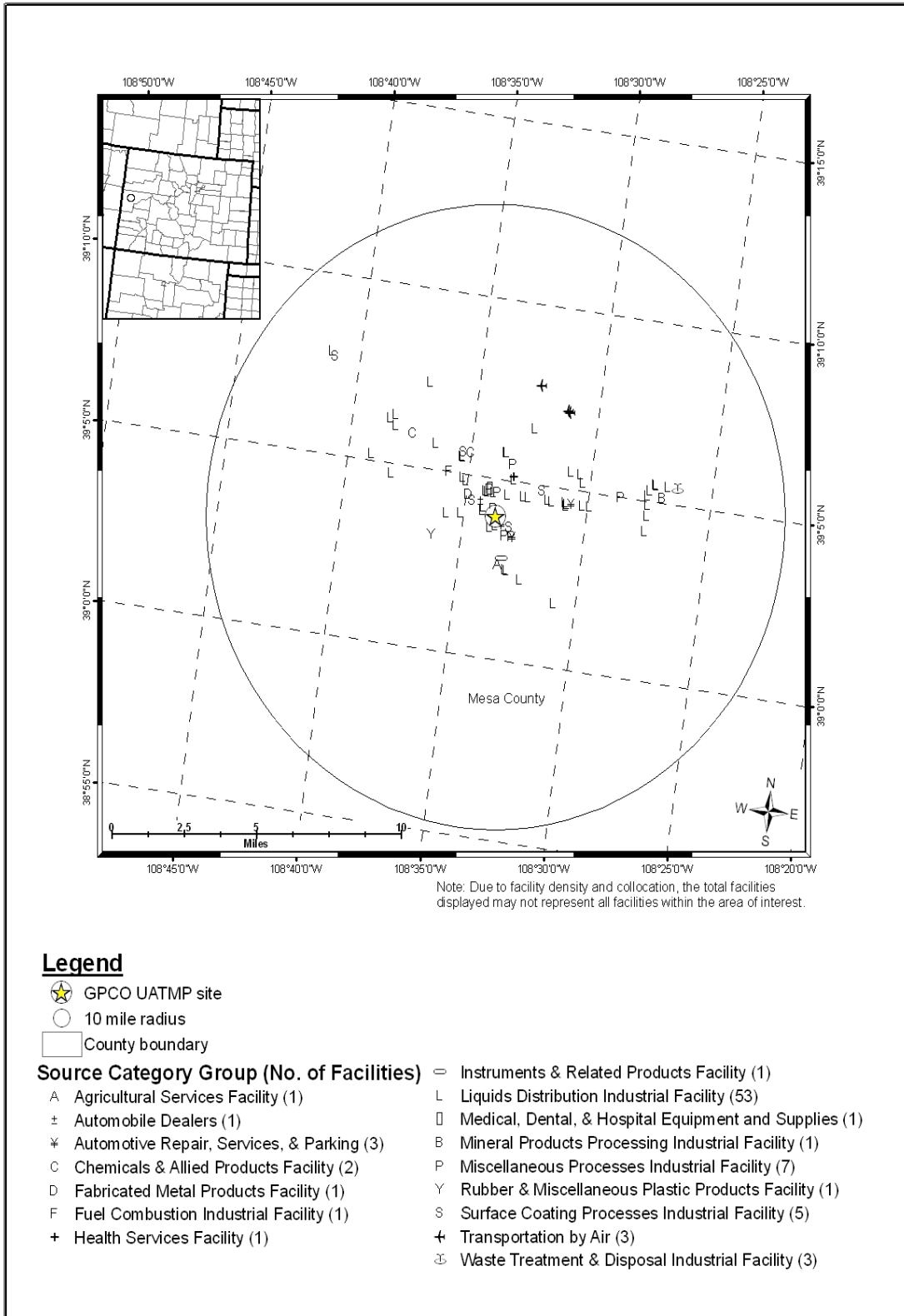


Figure 5-3. Composite Back Trajectory Map for GPCO

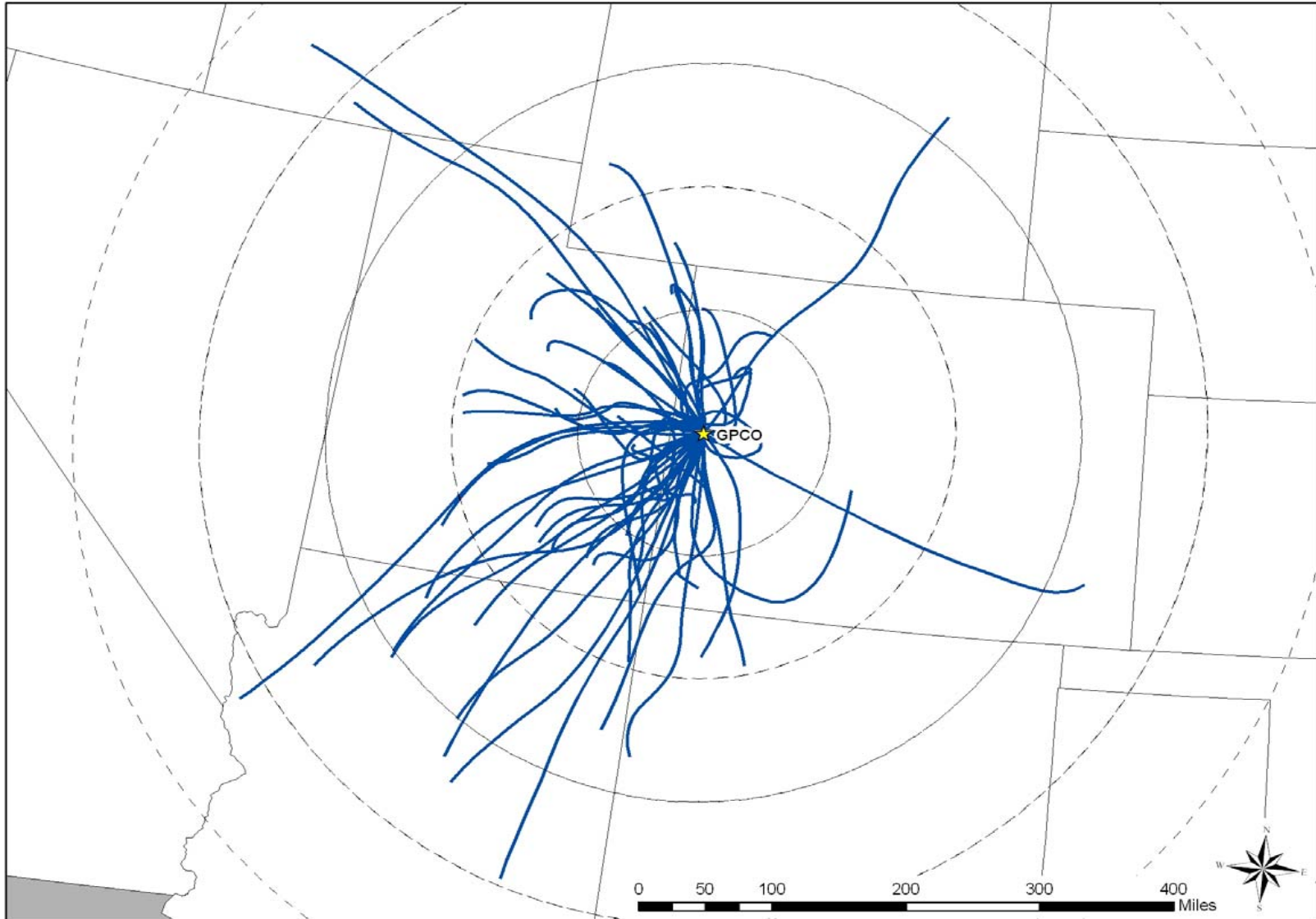


Figure 5-4. Acetaldehyde Pollutant Rose at GPCO

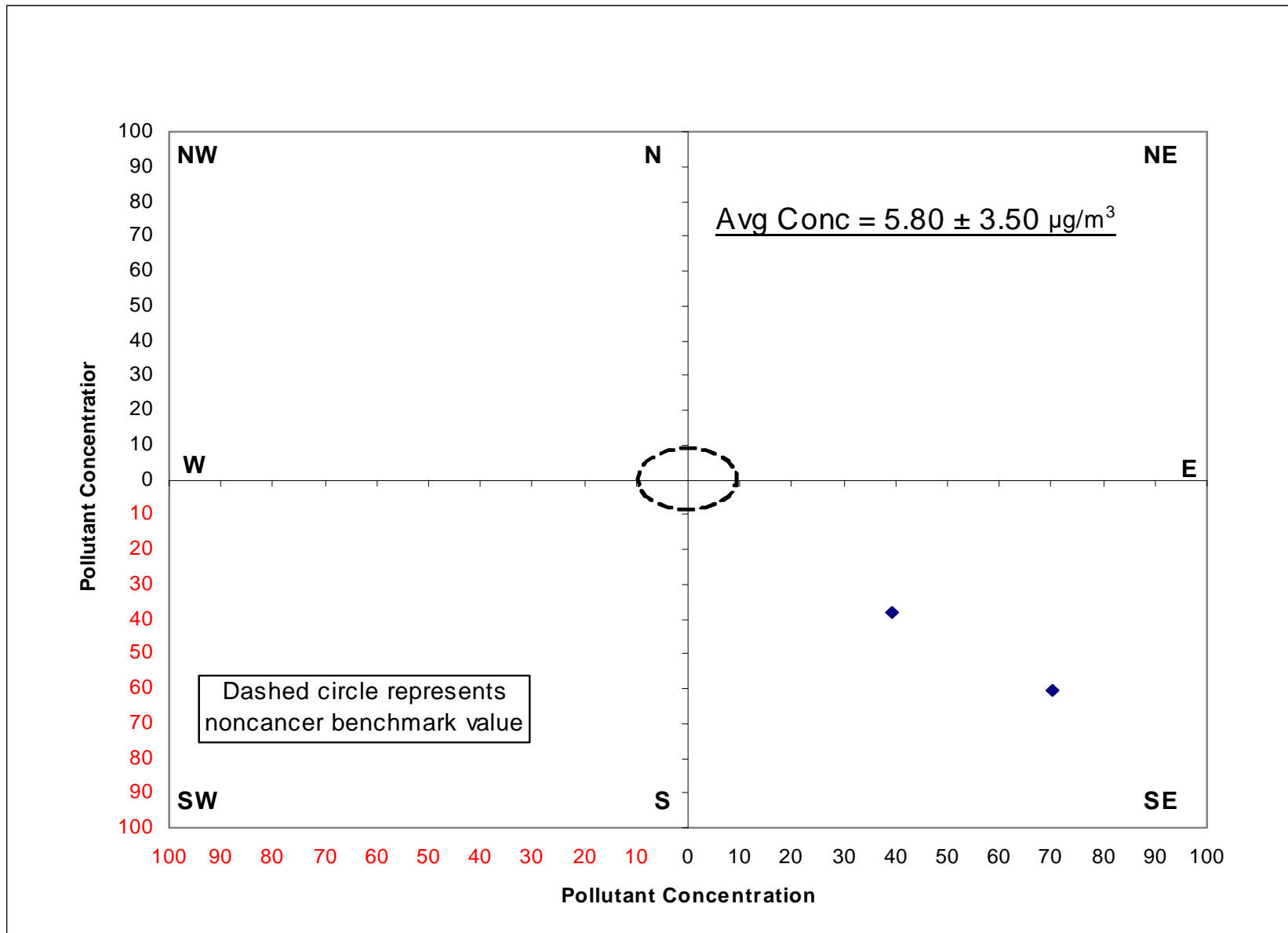


Figure 5-5. Formaldehyde Pollutant Rose at GPCO

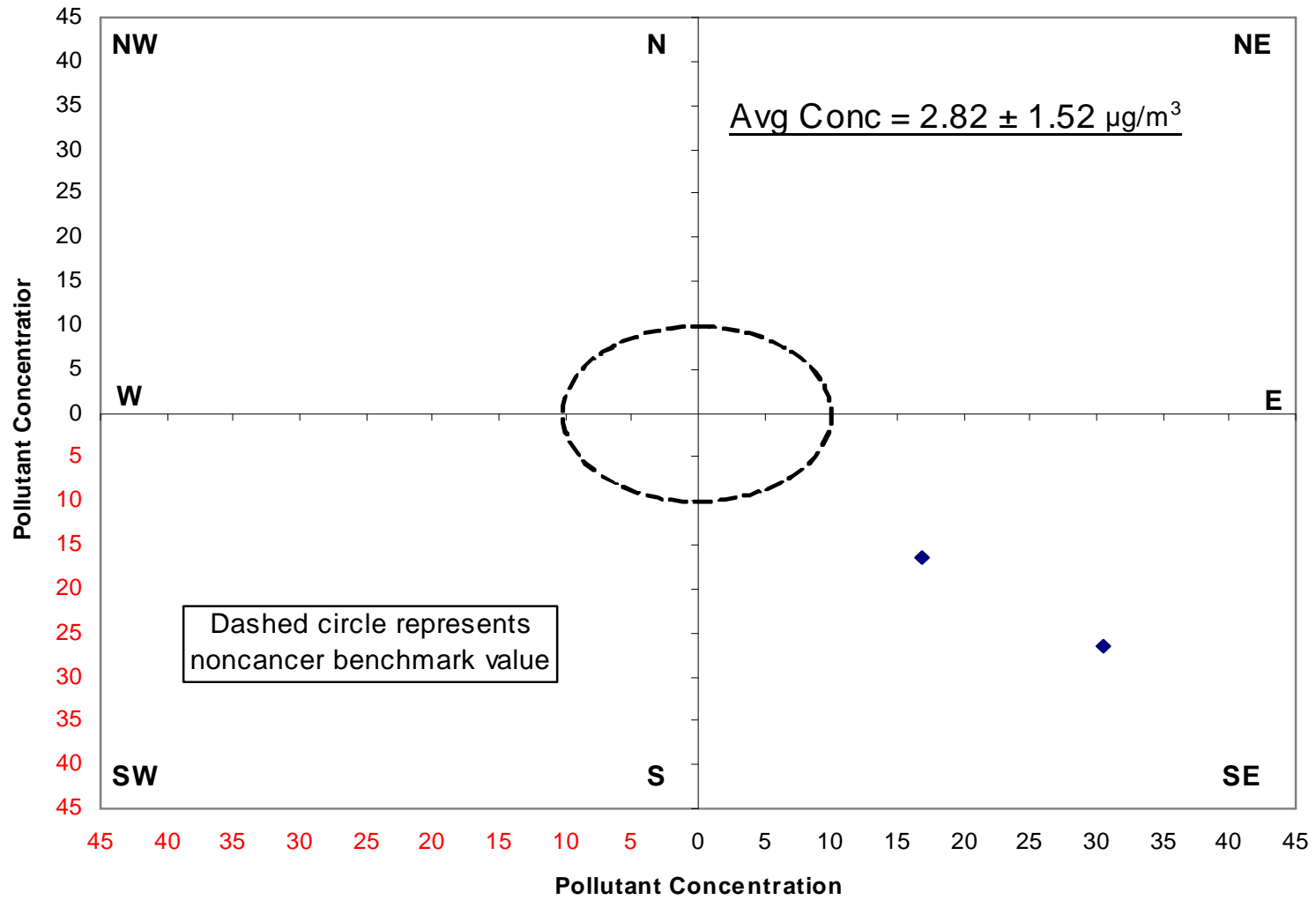


Figure 5-6. Acetaldehyde Sources Along the September 6, 2004 Back Trajectory at GPCO

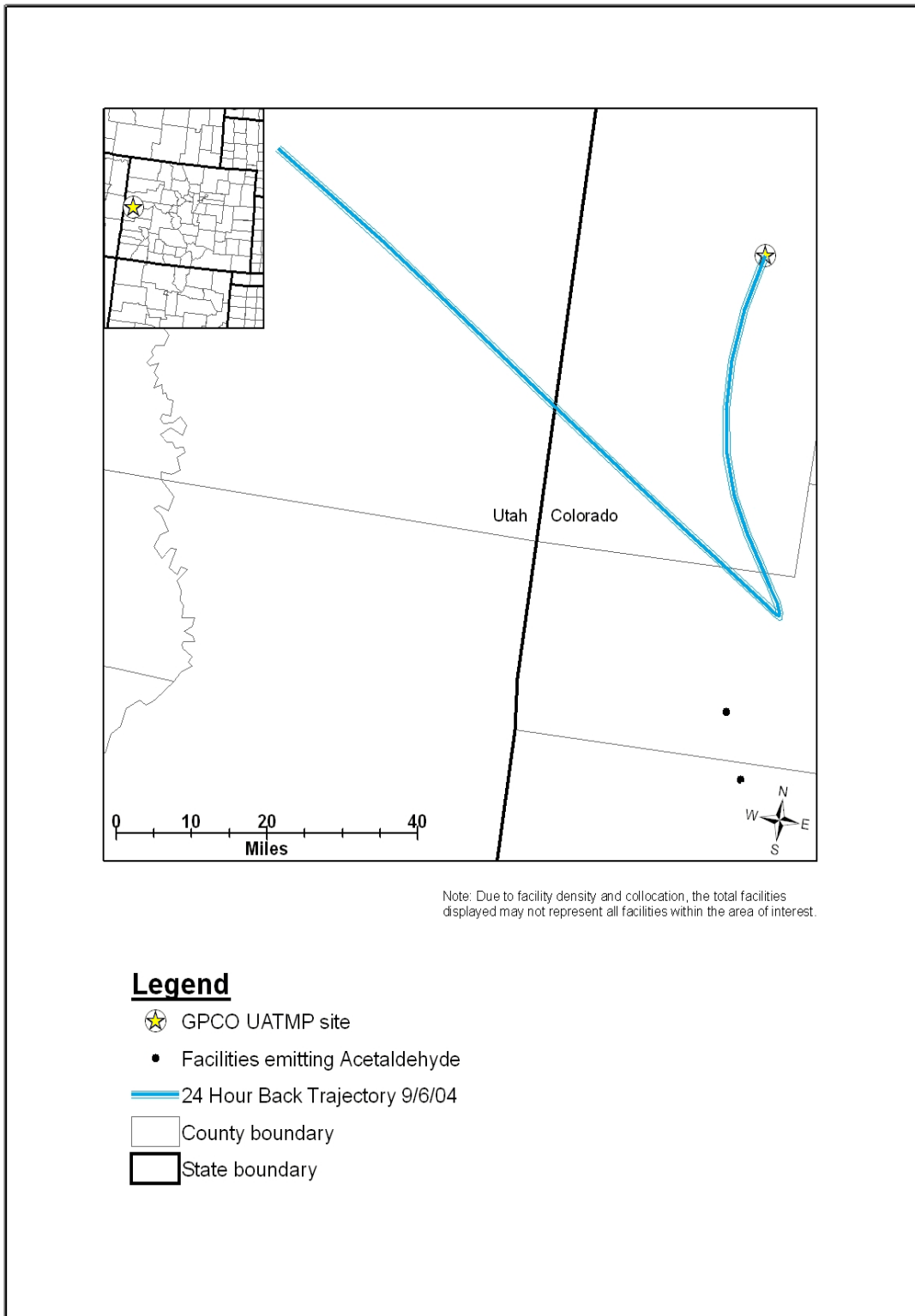


Figure 5-7. Formaldehyde Sources Along the September 6, 2004 Back Trajectory at GPCO

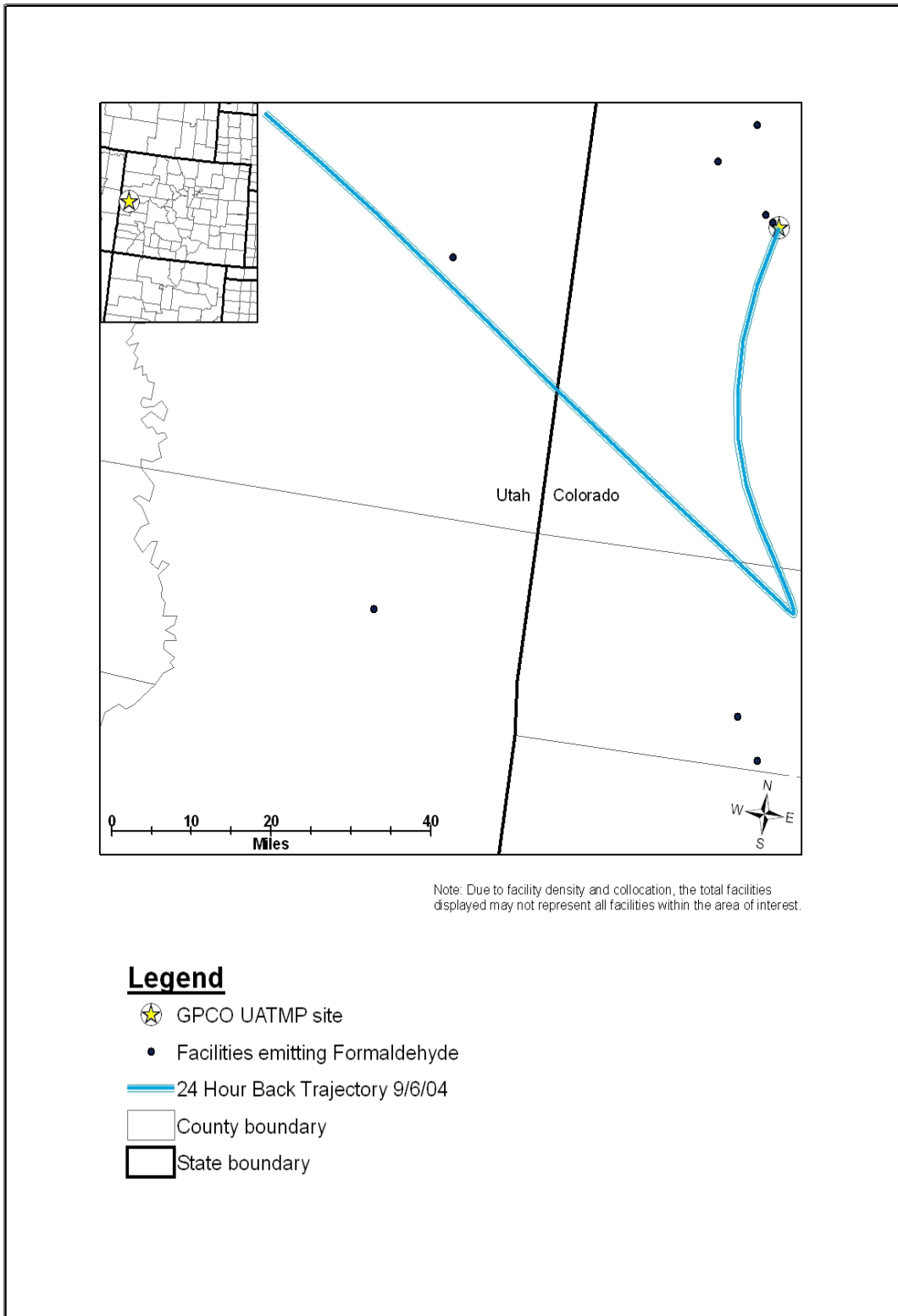


Table 5-1. Average Concentration and Meteorological Parameters for the Site in Colorado

Site Name	Type	Average UATMP Concentration (µg/m ³)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
GPCO	All 2004	/ / / / / / / /	63.98 (±2.30)	52.48 (±2.06)	28.99 (±1.07)	41.00 (±1.32)	50.42 (±2.49)	1015.46 (±0.84)	-1.33 (±0.26)	0.38 (±0.27)
	sample day	52.87 (±10.47)	67.31 (±5.50)	55.68 (±4.76)	29.94 (±2.45)	43.05 (±2.85)	47.42 (±6.17)	1013.83 (±1.88)	-1.45 (±0.60)	0.36 (±0.52)

Table 5-2. Summary of the Toxic Cancer Compounds at the Colorado Monitoring Site - GPCO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	3.11 E-05	37.56	37.56	0.46	5	31.14
Benzene	1.75 E-05	21.16	58.73	2.25	55	17.54
Acetaldehyde	1.28 E-05	15.39	74.12	5.80	57	12.76
Carbon Tetrachloride	8.60 E-06	10.38	84.50	0.57	47	8.60
1-3-Butadiene	7.78 E-06	9.39	93.89	0.26	41	7.78
Tetrachloroethylene	2.94 E-06	3.54	97.43	0.50	23	2.94
<i>trans</i> -1,3-Dichloropropene	1.82 E-06	2.19	99.62	0.45	40	0.30
Dichloromethane	2.97 E-07	0.36	99.98	0.63	1	1.82
Formaldehyde	1.55 E-08	0.02	100.00	2.82	57	0.02

Table 5-3. Summary of the Toxic Noncancer Compounds at the Colorado Monitoring Site - GPCO

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Acetaldehyde	6.44 E-01	40.06	40.06	5.80	57	2
Formaldehyde	2.88 E-01	17.91	57.98	2.82	57	2
Acrylonitrile	2.29 E-01	14.24	72.21	0.46	5	0
1,3-Butadiene	1.30 E-01	8.07	80.28	0.26	41	0
Xylenes	9.00 E-02	5.60	85.88	9.00	55	0
Benzene	7.50 E-02	4.66	90.54	2.25	55	0
Bromomethane	7.38 E-02	4.59	95.12	0.37	2	0
<i>trans</i> -1,3-Dichloropropene	2.27 E-02	1.41	96.54	0.45	1	0
Chloromethane	1.44 E-02	0.89	97.43	1.29	54	0
Carbon Tetrachloride	1.43 E-02	0.89	98.32	0.57	47	0
Toluene	1.40 E-02	0.87	99.19	5.58	55	0
Methyl Methacrylate	3.11 E-03	0.19	99.38	2.18	30	0
Chloroform	3.01 E-03	0.19	99.57	0.30	1	0
Styrene	2.25 E-03	0.14	99.71	2.25	53	0
Tetrachloroethylene	1.84 E-03	0.11	99.82	0.50	23	0
Ethylbenzene	1.19 E-03	0.07	99.90	1.19	55	0
Dichloromethane	6.32 E-04	0.04	99.94	0.63	40	0
Methyl Ethyl Ketone	5.74 E-04	0.04	99.97	2.87	50	0
Methyl Isobutyl Ketone	2.26 E-04	0.01	99.99	0.68	12	0
Methyl tert-Butyl Ether	1.80 E-04	0.01	100.00	0.54	1	0
Chloroethane	3.69 E-05	0.00	100.00	0.37	1	0

Table 5-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at Site in Grand Junction, Colorado (GPCO)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
1,3-Butadiene	-0.51	-0.54	-0.17	-0.54	0.46	0.52	-0.09	-0.30
Acetaldehyde	0.17	0.11	0.07	0.11	-0.07	0.14	-0.06	0.15
Acrylonitrile	0.63	0.68	-0.76	0.36	-0.58	-0.67	-0.18	0.99
Benzene	-0.45	-0.48	0.00	-0.40	0.54	0.51	-0.06	-0.33
Bromomethane	NA							
Carbon Tetrachloride	-0.15	-0.10	0.13	-0.07	0.20	-0.06	-0.03	0.09
Formaldehyde	0.08	0.03	0.05	0.04	0.01	0.19	-0.09	0.13
Tetrachloroethylene	0.06	0.01	0.11	0.04	0.02	0.28	-0.05	0.03
Xylenes	-0.33	-0.35	0.08	-0.27	0.43	0.22	0.04	-0.37

Table 5-5. Motor Vehicle Information vs. Daily Concentration for the Colorado Monitoring Site

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Population: Registration)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
GPCO	124,676	127,138	1.02	106,900	109,038	19,572	52.87 (± 10.47)

6.0 Site in Connecticut

This section presents meteorological, concentration, and spatial trends for the UATMP site in Connecticut (HACT), located in Hartford. Figure 6-1 is a topographical map showing the monitoring site in its urban location. This site is located under the I-84 overpass to I-91, in downtown Hartford. Figure 6-2 identifies facilities within 10 miles of this site that reported to the 2002 NEI. The Hartford site is surrounded by numerous sources. Many sources near HACT fall into three categories: surface coating, waste treatment and disposal, and fuel combustion.

Hourly meteorological data were retrieved for all of 2004 at the weather station nearest this site for calculating correlations of meteorological data with ambient air concentration measurements. The weather station is Hartford-Brainard Airport (WBAN 14752). Similar to last year, the HACT site sampled for carbonyl compounds only. Table 6-1 highlights the average UATMP concentration (carbonyl compounds only) at the HACT site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*- components of the wind) for the entire year and on days samples were taken. Hartford's New England location ensures fairly variable weather from day to day because most frontal systems trek across the region. However, the city's proximity to the Atlantic Ocean has a major influence on its climate, as summers will be somewhat cooler and winters will be slightly warmer. This information can be verified in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

6.1 Prevalent Compounds at the Connecticut Site

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at this site. The only carbonyl compounds with toxicity weighting factors are acetaldehyde and formaldehyde. Table 6-2 summarizes the cancer weighting scores, and Table 6-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for this site.

Tables 6-2 and 6-3 show that acetaldehyde and formaldehyde were both detected at HACT. Acetaldehyde was the only prevalent cancer compound, while both acetaldehyde and formaldehyde were prevalent non-cancer compounds at the HACT site. Both of the toxic carbonyl compounds were detected at the HACT site.

6.2 Toxicity Analysis

The acetaldehyde cancer toxicity score was over 99% of the total cancer score, while formaldehyde's toxicity was over 57% of the total noncancer toxicity. The acetaldehyde cancer risk was the highest among the toxic carbonyl compounds at 10.45 in a million. For the compounds that may lead to adverse noncancer health effects, the average formaldehyde toxicity was 0.705 (over 1 indicates a significant chance of a noncancer health effect). Of the twenty-five measured formaldehyde concentrations, 5 were above the formaldehyde noncancer RfC weighting factor. Two of the twenty-five acetaldehyde detections were above the acetaldehyde noncancer RfC weighting factor.

6.3 Meteorological and Concentration Averages at the Connecticut Site

Only carbonyl compounds were sampled at this site, as indicated in Tables 3-3 and 3-4. Therefore, only carbonyl compounds factor into the average UATMP concentration. The average UATMP concentration was 31.92 (\pm 5.35) $\mu\text{g}/\text{m}^3$. Sampling began in January and ended in late May. This can explain some of the differences between the 2004 averages and the sample day averages as shown in Table 6-1.

Table 6-4 presents the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters at HACT. Identification of the site-specific prevalent compounds is discussed in Section 6.1 of this report. The meteorological parameters had mostly poor correlations with formaldehyde, with the exception of the *v*-component of the wind (0.39). This observation was also true in 2003 as well. With the exception of the moisture parameters, the correlations tended to be poor with acetaldehyde as well. The moisture parameter correlations with acetaldehyde were all moderate and negative, indicating that as the moisture content increases, acetaldehyde concentrations decrease.

Figure 6-3 shows the composite back trajectory for the HACT site for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in Figure 6-3, the back trajectories originated predominantly from the southwest, northwest, and north of the site. Each circle around the site in Figure 6-3 represents 100 miles; 56% of the trajectories originated within 400 miles, and 96% within 800 miles from the HACT site. The 24-hour airshed domain is rather large. Back trajectories originated over 800 miles away.

6.4 Spatial Analysis

County-level vehicle registration and population in Hartford County, CT, were obtained from the Connecticut Department of Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 6-5. Table 6-5 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the computed vehicle registration ratio. Table 6-5 also contains the average daily traffic information, which reflects the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the HACT site in Table 6-5.

6.5 RFG Analysis

Because VOCs were not sampled at HACT, an RFG analysis was not performed. However, the Hartford MSA is a federal RFG mandated area (EPA, 1994), and must use gasoline additives to reduce VOC emissions. During the summer period, MTBE and TAME are used; in the winter, MTBE, TAME, ETBE, and ethanol are used. A summer 2002 survey of 6 service stations showed an oxygen content of 2.12% by weight and a benzene content of 0.600% by volume. MTBE and TAME averaged 9.27% and 2.74% by weight, respectively (EPA, 2003b). A winter survey of 4 service stations showed an oxygen content of 2.01% by weight and a benzene content of 0.718% by volume. MTBE, TAME, ETBE, and ethanol averaged 8.85%, 1.53%, - 0.02%, and 0.45%, respectively (EPA, 2003b).

6.6 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

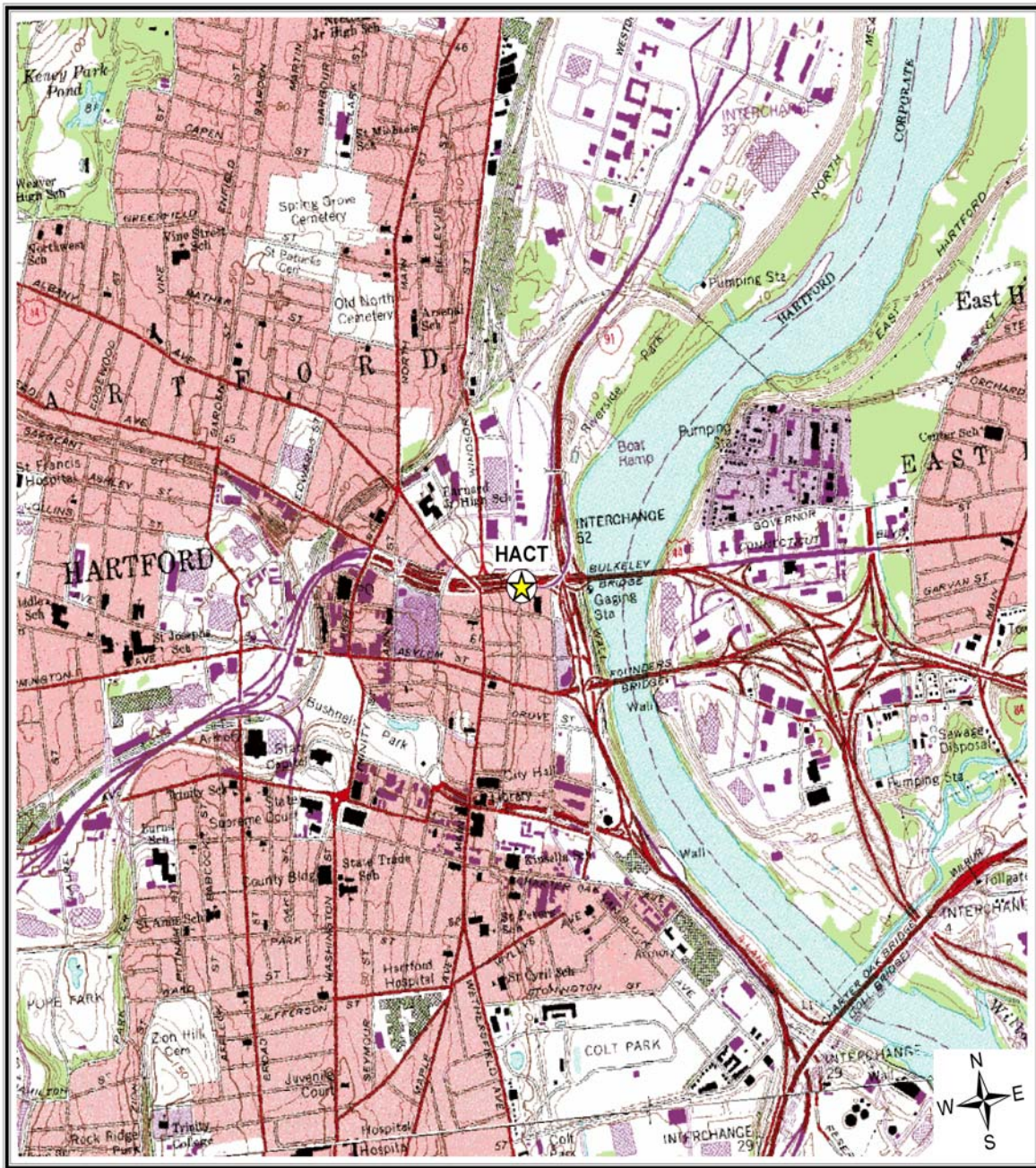
6.6.1 Site-Specific Trends Analyses

HACT has been a participant in the UATMP since 2003. Therefore, no site-specific trends analysis has been conducted.

6.6.2 MSA-Specific Trends Analyses

HACT resides in the Hartford-West Hartford-East Hartford, CT MSA. The Hartford, CT MSA has experienced a 4.8% increase in population and a 58.5% increase in vehicle miles traveled (VMT) from 1990 to 2003 (29%). Acetaldehyde and formaldehyde emissions have decreased approximately 33% and 61% respectively, between 1990 and 2002. Acetaldehyde concentrations decreased significantly between 1990 and 2003. Acetaldehyde concentrations at UATMP sites that represent this MSA (HACT) seem to continue this downward trend. Formaldehyde concentrations increased over 85% between 1990 and 2003. Research has shown that formaldehyde concentrations tend to increase when fuels containing ethanol are combusted. Ethanol is used in the winter time. Figure 3-23 shows formaldehyde concentrations at HACT only being present in the winter and spring, showing the affect of reformulated gasoline. The UATMP MSA concentration for 2004 shows a decreasing trend. Trends for these and other compounds of interest can be found in Table 3-13. This MSA participated in the winter oxygenated program from 1992 to 1995 and the reformulated gasoline program throughout the duration of the time period.

Figure 6-1. Hartford, Connecticut (HACT) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000

Figure 6-2. Facilities Located Within 10 Miles of HACT

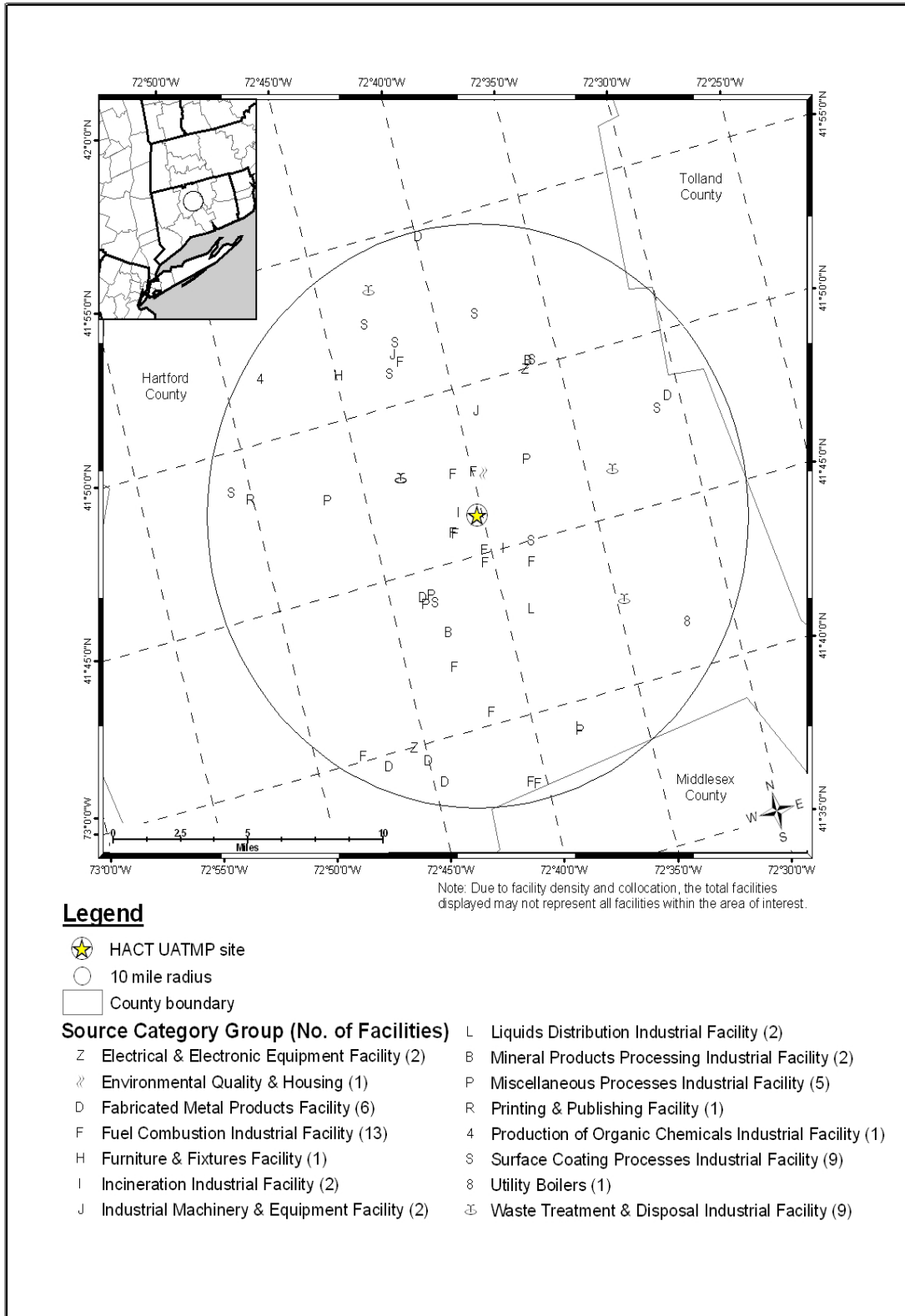


Figure 6-3. Composite Back Trajectory Map for HACT

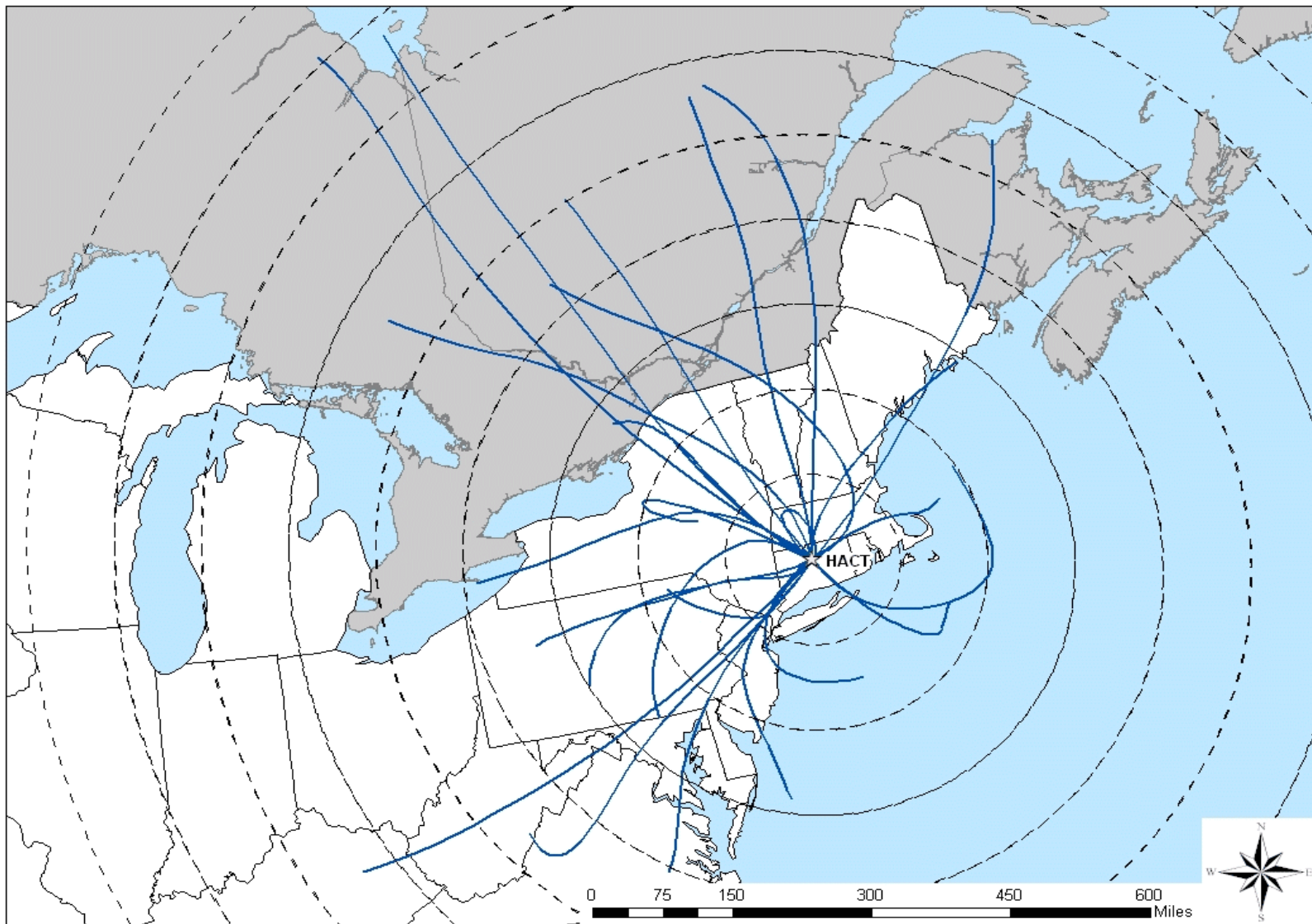


Table 6-1. Average Concentration and Meteorological Parameters for the HACT Site in Connecticut

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
HACT	All 2004	/ / / / / / / /	60.10 (± 1.97)	51.51 (± 1.85)	35.79 (± 2.10)	46.30 (± 1.76)	67.32 (± 1.51)	1017.15 (± 0.78)	1.25 (± 0.29)	-0.72 (± 0.47)
	sample day	31.92 (± 5.35)	49.00 (± 7.08)	40.86 (± 6.71)	27.85 (± 8.00)	36.20 (± 6.37)	64.09 (± 7.52)	1015.73 (± 3.51)	0.97 (± 1.28)	-2.38 (± 2.15)

Table 6-2. Summary of the Toxic Cancer Compounds at the Hartford, Connecticut Monitoring Site - HACT

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	1.04 E-05	99.64	99.64	4.75	25	10.45
Formaldehyde	3.80 E-08	0.36	100.00	6.91	25	0.04

Table 6-3. Summary of the Toxic Noncancer Compounds at the Hartford, Connecticut Monitoring Site - HACT

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Formaldehyde	7.05 E-01	57.18	57.18	6.91	25	5
Acetaldehyde	5.28 E-01	42.82	100.00	4.75	25	2

Table 6-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Hartford, Connecticut Site (HACT)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
Acetaldehyde	-0.18	-0.22	-0.31	-0.25	-0.30	-0.01	0.19	0.15
Formaldehyde	0.05	0.02	-0.06	0.00	-0.18	-0.01	0.16	0.39

Table 6-5. Motor Vehicle Information vs. Daily Concentration for the Connecticut Monitoring Site

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Population: Registration)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
HACT	871,457	733,923	0.84	583,236	489,918	10,000	31.92 (± 5.35)

7.0 Sites in Florida

This section presents meteorological, concentration, and spatial trends for the four UATMP sites in and near the Tampa/St. Petersburg, FL area (AZFL, GAFL, SKFL, SYFL) and one site near Orlando, FL, area (ORFL). In the Tampa/St. Petersburg area, two of these sites are located in Hillsborough County and two are in Pinellas County. Figures 7-1 through 7-5 are topographical maps showing the monitoring sites in their urban locations. Figures 7-6 and 7-7 identify facilities within 10 miles of the sites and that reported to the 2002 NEI. SKFL and AZFL are located on the Peninsula, with the bulk of the facilities to the north, and closest to SKFL. GAFL is located near the Gandy Bridge on Highway 92. Few facilities are within a few miles of GAFL, most are farther to the west or northeast and east of this site. SYFL is farther inland in Plant City. Most of the facilities within 10 miles are to the west or northeast of this site. A wide range of industries have facilities near these sites, of which surface coating processes are the most numerous. Several facilities surround ORFL, most of which are involved in waste treatment and disposal.

Hourly meteorological data were retrieved for all of 2004 at five weather stations near these sites for calculating correlations of meteorological data with ambient air concentration measurements. The five weather stations are Tampa International Airport, St. Petersburg/Whitted Airport, St. Petersburg/Clearwater International Airport, Winter Haven's Gilbert Airport, and Orlando Executive Airport (WBAN 12842, 92806, 12873, 12876, and 12841, respectively).

As in the past, the Florida sites sampled for carbonyl compounds only. Table 7-1 highlights the average UATMP concentration (carbonyl compounds only) at each of the sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average u - and v -components of the wind) for the entire year and on days samples were taken. Florida's climate is subtropical, with very mild winters and warm, humid summers, as Table 7-1 confirms. The annual average maximum temperature is around 80°F for all locations and average relative humidity is between 72 and 79 percent.

Although land and sea breezes affect each of the locations, wind generally blows from a southeasterly direction due to high pressure offshore. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

7.1 Prevalent Compounds at the Florida Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at these sites. Acetaldehyde and formaldehyde are the only carbonyl compounds with toxicity weighting factors. Table 7-2 summarizes the cancer weighting scores, while Table 7-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for this site.

As shown in Tables 7-2 and 7-3, acetaldehyde was the only prevalent cancer compound at each of the Florida sites, while both acetaldehyde and formaldehyde were prevalent for noncancer compounds. Both of the toxic carbonyl compounds were detected at the Florida sites, similar to nationwide cancer and non-cancer prevalent carbonyl compounds.

7.2 Toxicity Analysis

The number of detects of acetaldehyde was equal to the number of detects for formaldehyde at all of the sites, with the exception of SYFL (acetaldehyde had one less). Acetaldehyde's cancer toxicity contribution was greater than 99% at all of the sites. The acetaldehyde cancer risk at SKFL was the highest among the five sites at 10.74 in a million, while the remaining sites ranged from 3.44 (SYFL) to 7.37 (AZFL). Acetaldehyde and formaldehyde's contribution to noncancer toxicity was more equal. Only one site, SKFL, detected concentrations of either compound above the adverse noncancer threshold.

7.3 Meteorological and Concentration Averages at the Florida Sites

Only carbonyl compounds were measured at the five sites, as indicated in Tables 3-3 and 3-4. Table 7-1 lists the averages for selected meteorological parameters from January 2004 to

December 2004, and for days on which sampling occurred, as well as the average UATMP concentration at each of the sites. SKFL measured the highest average UATMP concentration ($13.34 \pm 10.98 \mu\text{g}/\text{m}^3$) while SYFL measured the lowest ($6.23 \pm 0.60 \mu\text{g}/\text{m}^3$).

Table 7-4 summarizes calculated Pearson Correlation coefficients for the prevalent carbonyl compounds (acetaldehyde and formaldehyde) and selected meteorological parameters by site. Identification of the site-specific prevalent compounds is discussed in Section 7.1. Generally, correlations between formaldehyde and the meteorological parameter tend to be higher than those of acetaldehyde, although most of the correlations tend to be in the weak to moderate range.

Correlations between both compounds and the temperature parameters (average maximum and average) were all positive, indicating that higher temperatures correspond with higher concentrations. The strongest correlations occurred at ORFL between formaldehyde and average maximum temperature (0.66) and average temperature (0.61).

Correlations between the prevalent compounds and the moisture parameters (dew point temperature, wet bulb temperature, and relative humidity) were relatively weak. Again, formaldehyde at ORFL exhibit moderately strong correlations, 0.48 with the wet bulb temperature, and 0.40 with the dewpoint temperature. Relative humidity did not exhibit this same trend.

AZFL exhibited the strongest correlations with the wind parameters, although GAFL and ORFL both had some correlations in the moderate range. Both compounds exhibited moderately strong negative correlations at AZFL with the *u*-component of the wind (-0.53 with acetaldehyde and -0.44 with formaldehyde), indicating that as winds increase from the east or west, concentrations of the prevalent compounds decrease. The strongest correlation with sea-level pressure also occurred at AZFL (0.29 with acetaldehyde).

Figures 7-8 through 7-12 show the composite back trajectories for the Florida sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in these figures, the back trajectories originate from almost every direction (with the exception of SKFL, which sampled during only a portion of the year, and therefore has fewer trajectories). Relatively few trajectories originate from the north and north-northeast of most of the sites. Each circle around the sites in Figure 7-8 through 7-12 represents 100 miles; between 57% and 68% of the trajectories originated within 300 miles; and 96% to 98% within 600 miles from the Florida sites. The 24-hour airshed domain is large, with some back trajectories originating over 600 miles away.

7.4 Spatial Analysis

County-level vehicle registration and population information were obtained from the Florida Department of Highway Safety and Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 7-5. Table 7-5 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the estimated population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 7-5 also contains the average daily traffic information, which reflects the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the Florida sites in Table 7-5. The GAFL site has the largest amount of traffic passing by on a daily basis, while the SYFL site has the lowest. The ORFL site has the highest estimated 10-mile vehicle ownership, while the SYFL site has the lowest.

7.5 NATTS Site Analysis

One of the Tampa sites, SYFL, is an EPA-designated NATTS site. A description of the NATTS program is provided in Section 3.6. A regulation analysis and an emission tracer analysis for each of the NATTS sites was conducted. Details on each type of analysis are also provided in Section 3.6.

7.5.1 Regulation Analysis

Table 3-10 summarizes the reduction of emissions that is expected from the promulgation of regulations applicable to facilities located within 10 miles of the monitoring site. This analysis includes only regulations implemented after 2002 or later (regulations implemented prior to 2003 would already be in effect at the time of the 2002 National Emissions Inventory and no further reduction would be expected). As indicated in Table 3-10, two future regulations would be applicable to the facilities located within 10 miles of SYFL. Since SFYL sampled only carbonyl compounds, only carbonyl reductions are considered. Based on analysis, the regulations shown are expected to achieve a 3% reduction in acetaldehyde and a 7% reduction in formaldehyde. A 5% reduction of total carbonyl is expected as a result of these regulations, as shown in Table 3-10. These reductions are expected to occur over the next few years as the last compliance date for the applicable regulations is June 2007.

7.5.2 Emission Tracer Analysis

No prevalent noncancer compounds exceeded their noncancer adverse health threshold, therefore, no emission tracer analysis was conducted for SYFL.

7.6 Trends Analysis

For sites that participated prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on this analysis can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was conducted. Details on this analysis are discussed in Section 3.9.

7.6.1 Site-Specific Trends Analysis

AZFL and GAFL have been participants in the UATMP since 2001. A comparison of AZFL's annual average formaldehyde concentrations show that formaldehyde concentrations have been steadily decreasing over the last four years. GAFL exhibits a downward trend as well, although there was a formaldehyde concentration spike in 2002. Please refer to Figures 3-28 and 3-36.

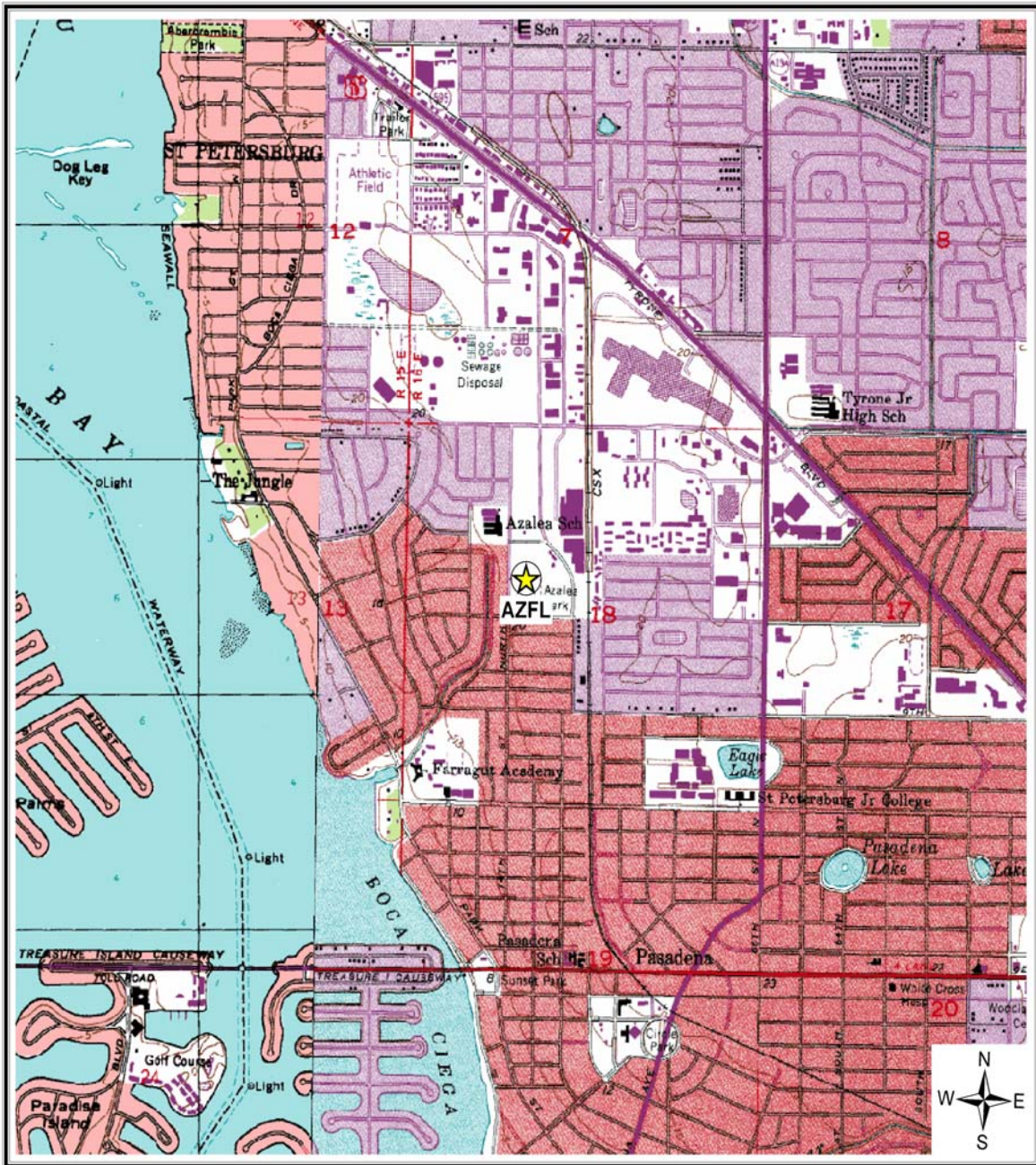
7.6.2 MSA-Specific Trends Analysis

For UATMP sites residing in MSAs assigned by the U.S. Census Bureau, an MSA-specific trends analysis was performed. All five Florida sites reside in MSAs, four in the Tampa-St. Petersburg-Clearwater, FL MSA, and one in the Orlando, FL MSA.

The Orlando, FL MSA experienced a 47.2% increase in population and a 134.2% increase in vehicle miles traveled (VMT) from 1990 to 2003. Acetaldehyde and formaldehyde emissions decreased approximately 29% and 25% (respectively) between 1990 and 2002. The 2004 acetaldehyde concentrations for the UATMP site representing the Orlando MSA (ORFL) decreased significantly from the 2002-2003 time period, while formaldehyde concentrations changed little. Trends for these and other compounds of interest can be found in Table 3-13. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

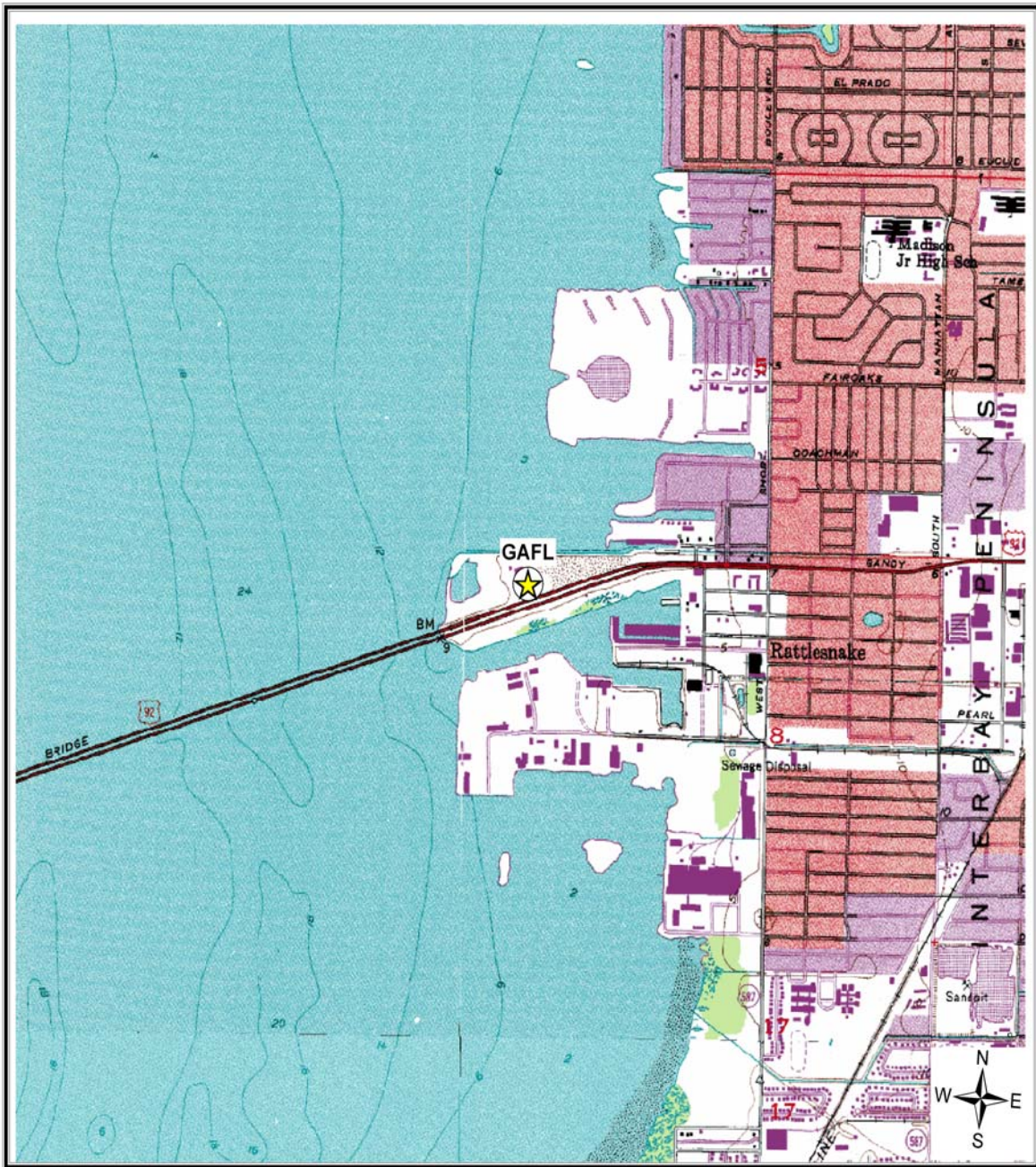
The Tampa Bay MSA experienced a 22.4% rise in population and a 72.8% rise in VMT between 1990 and 2003. Both emissions and measured concentrations of acetaldehyde have decreased recently. Formaldehyde trends show a similar decrease in emissions and measured concentrations. Trends for these and other compounds of interest can be found in Table 3-13. This MSA does not participate in either the winter oxygenated or reformulated gasoline program.

Figure 7-1. St. Petersburg, Florida (AZFL) Monitoring Site



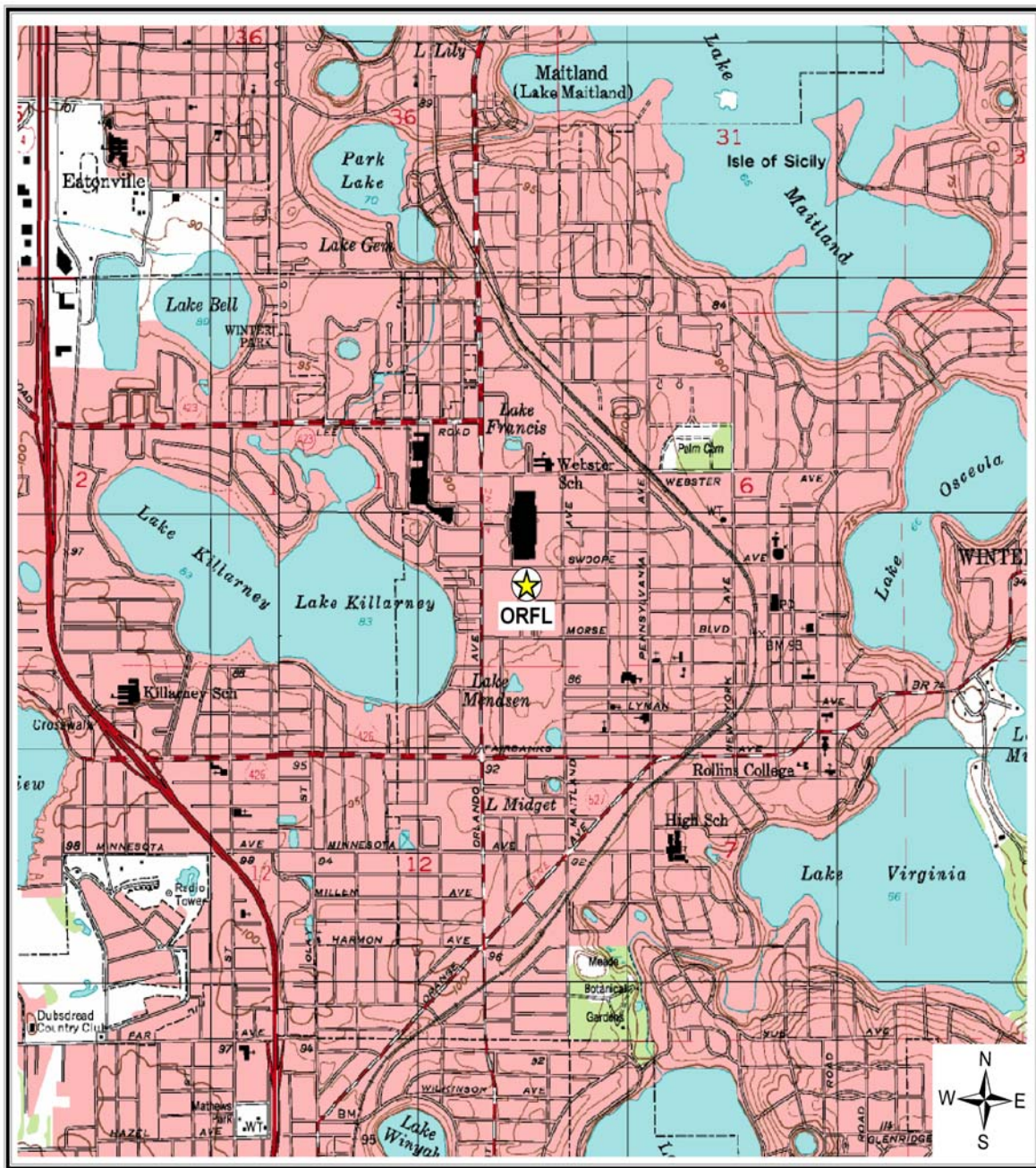
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-2. Tampa, Florida (GAFL) Monitoring Site



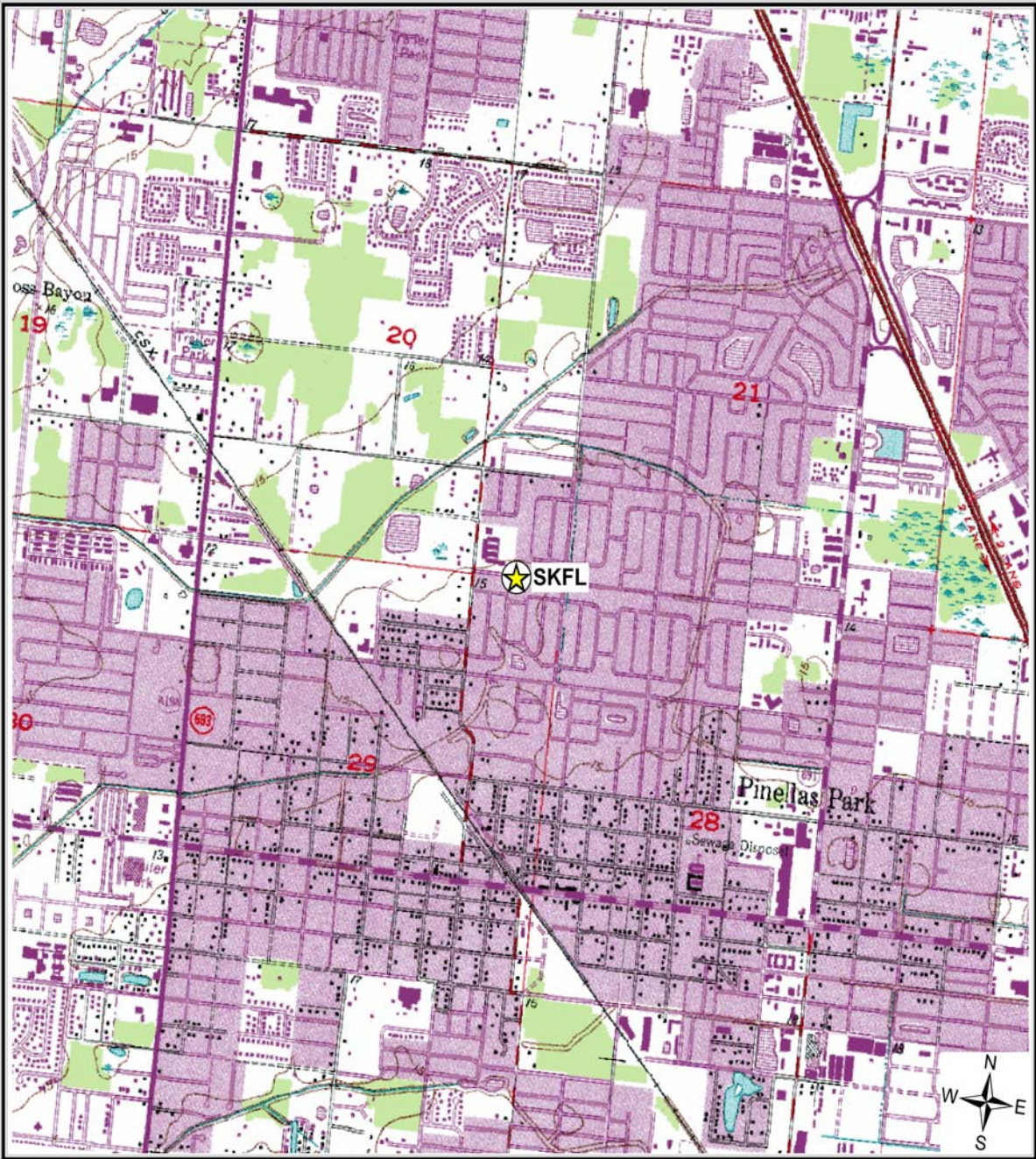
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 7-3. Winter Park, Florida (ORFL) Monitoring Site



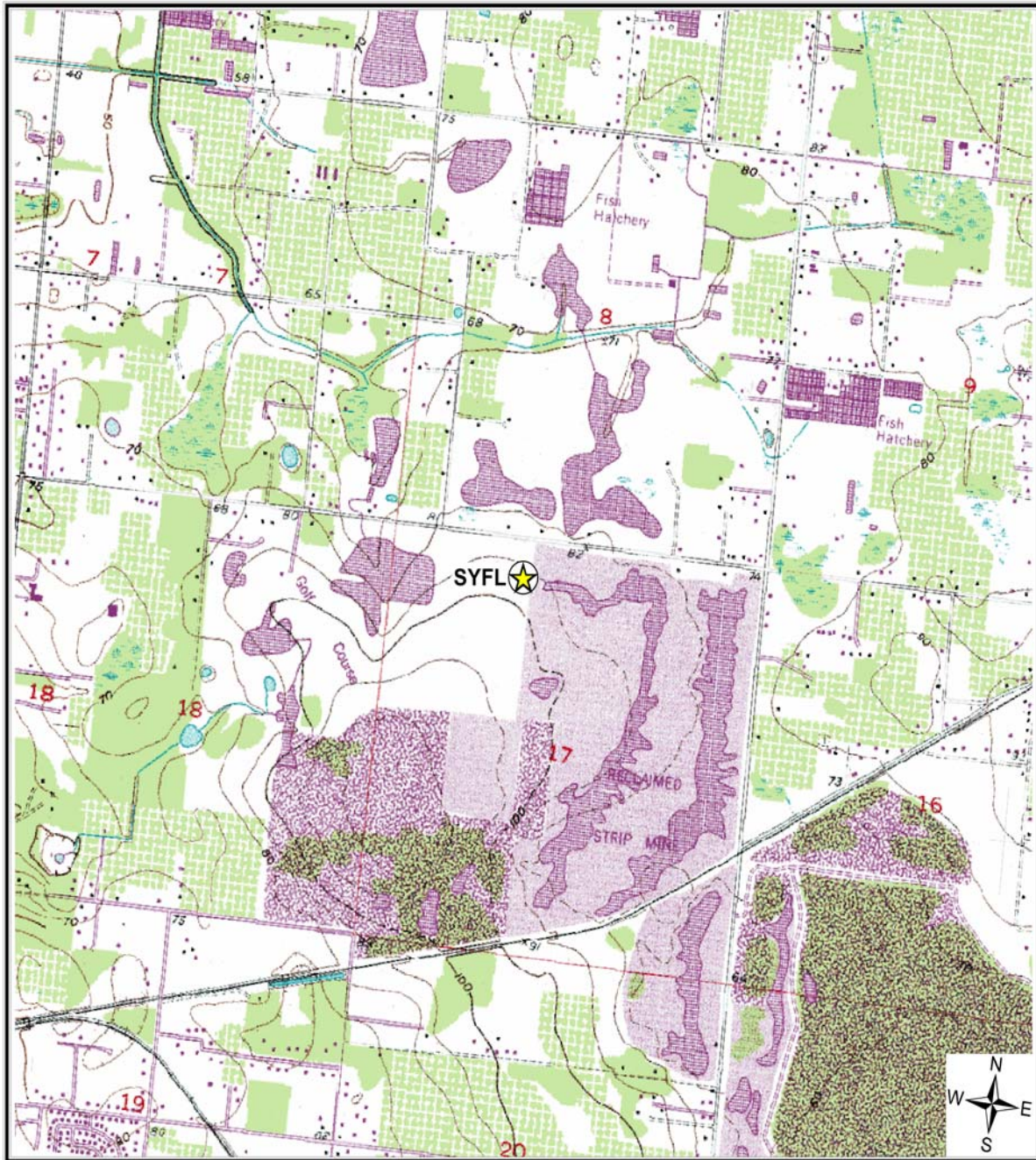
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 7-4. Pinellas Park, Florida (SKFL) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 7-5. Plant City, Florida (SYFL) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 7-6. Facilities Located Within 10 Miles of AZFL, GAFL, SKFL, and SYFL

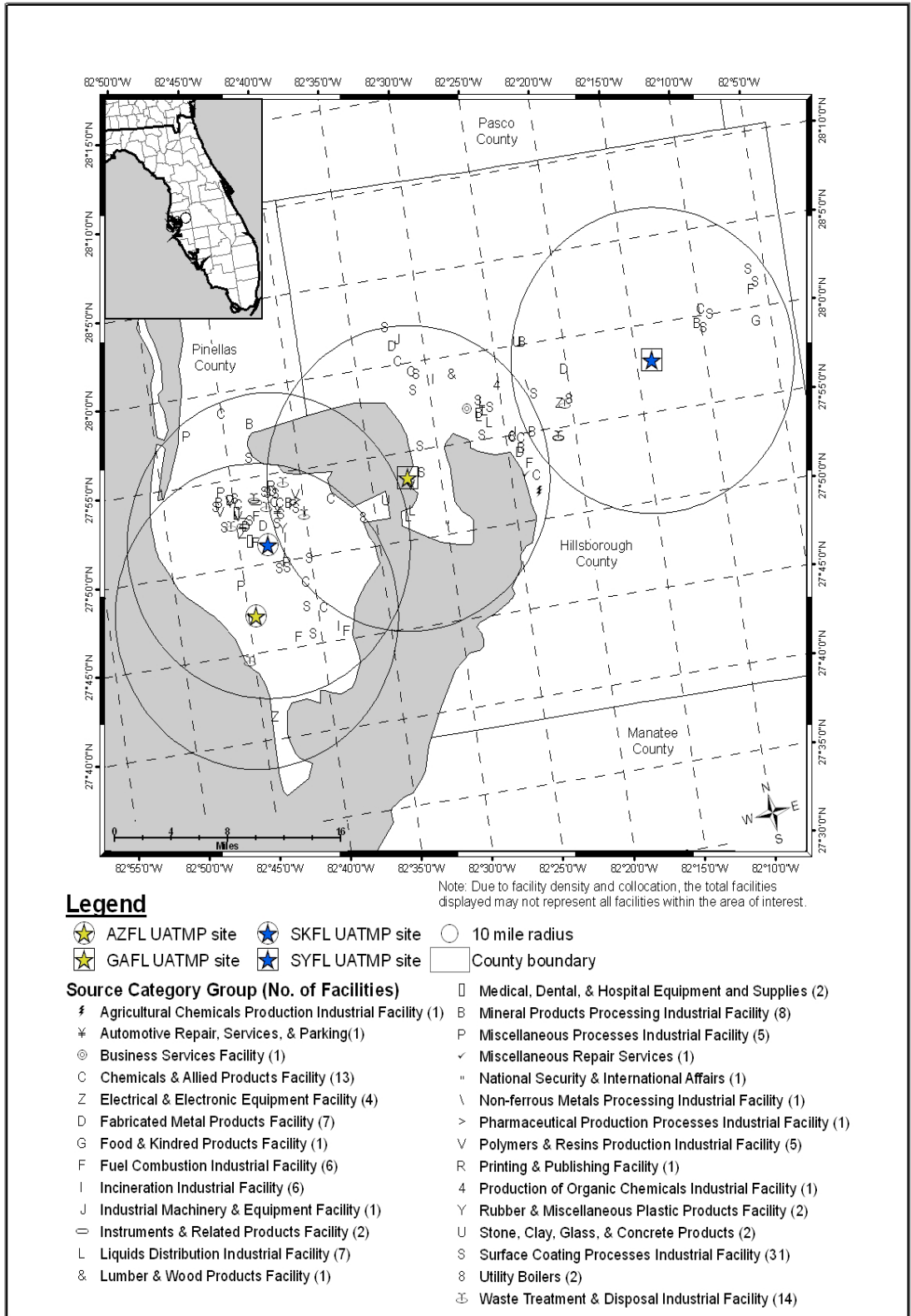


Figure 7-7. Facilities Located Within 10 Miles of ORFL

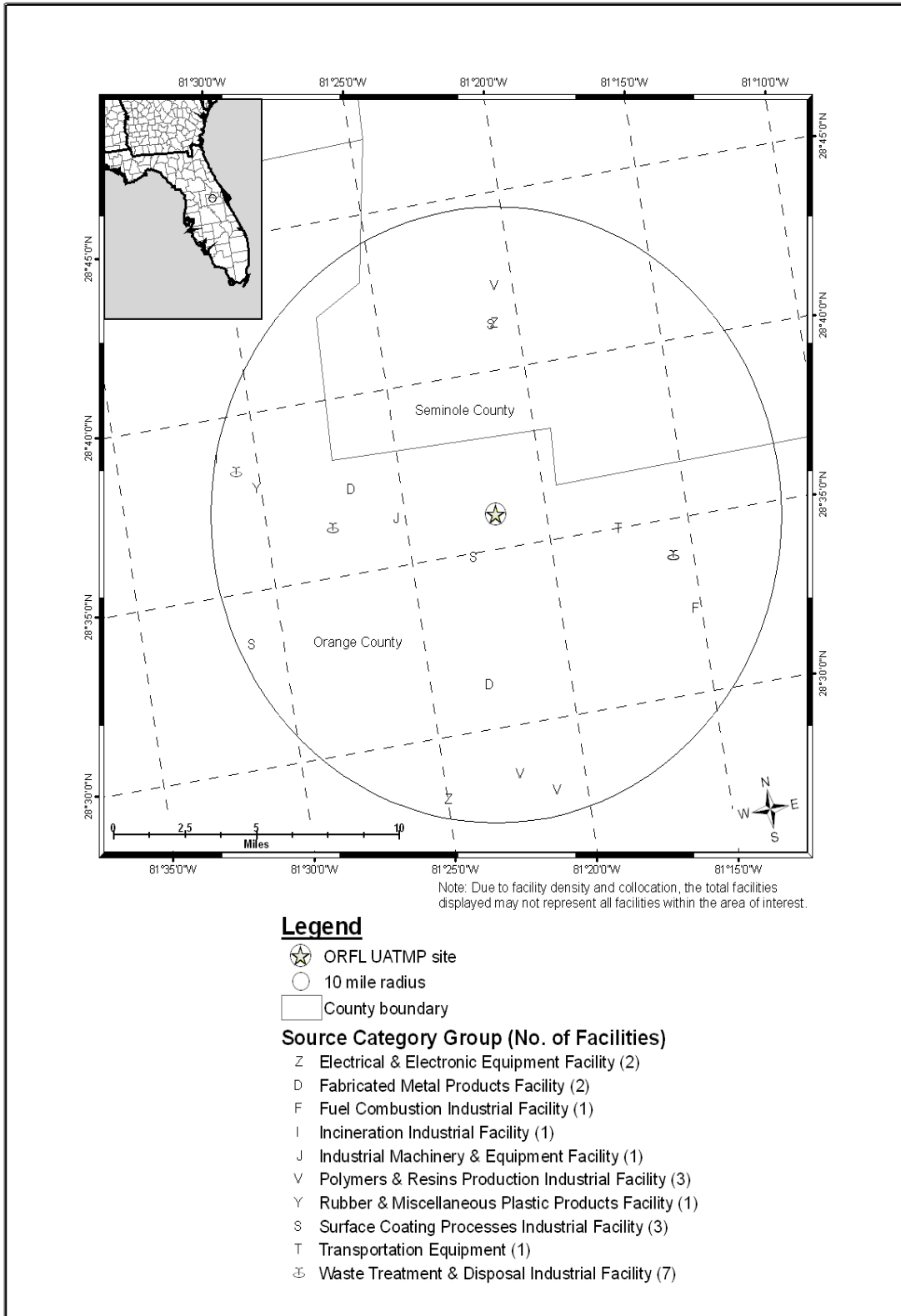


Figure 7-8. Composite Back Trajectory Map for AZFL

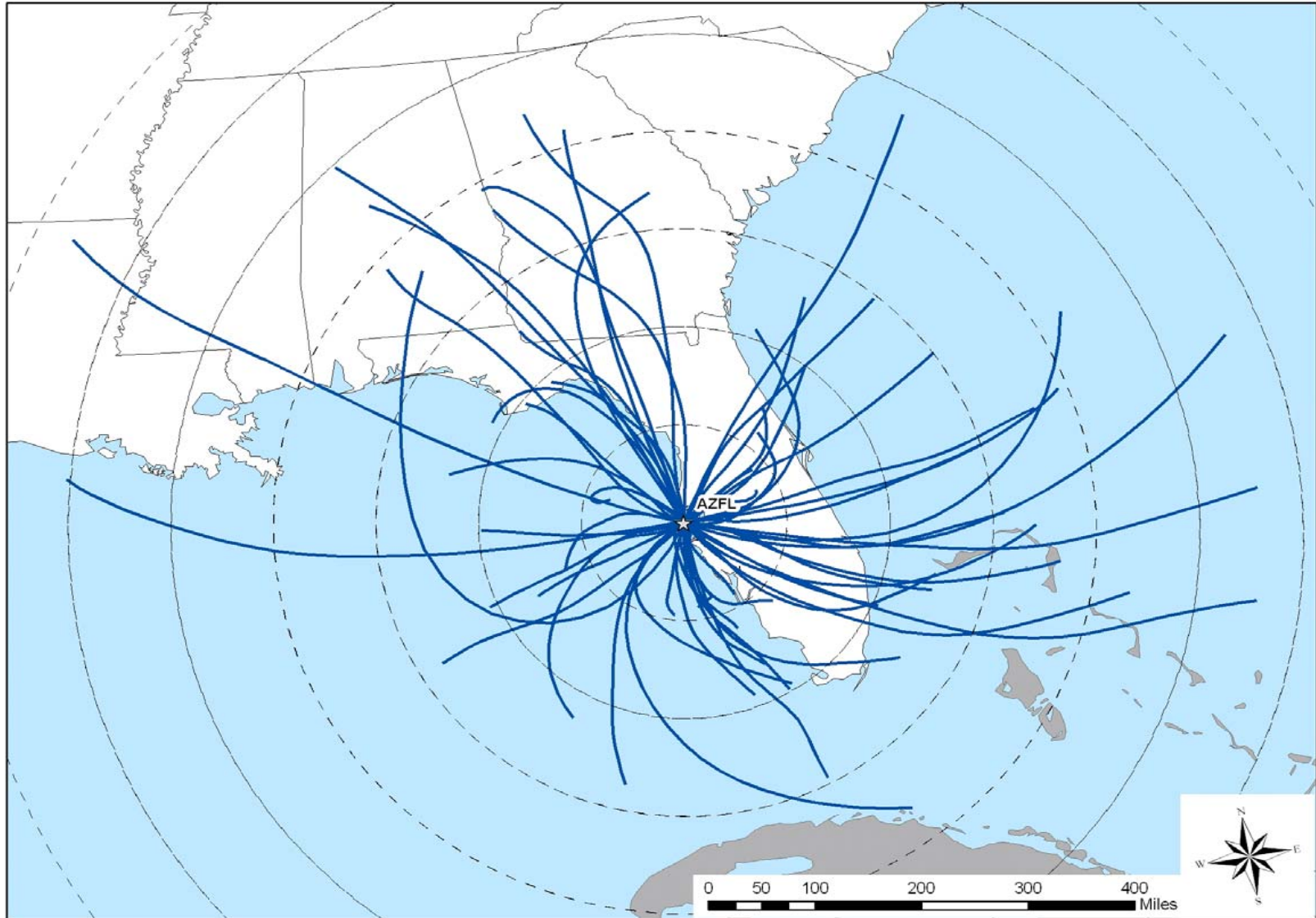


Figure 7-9. Composite Back Trajectory Map for GAFL

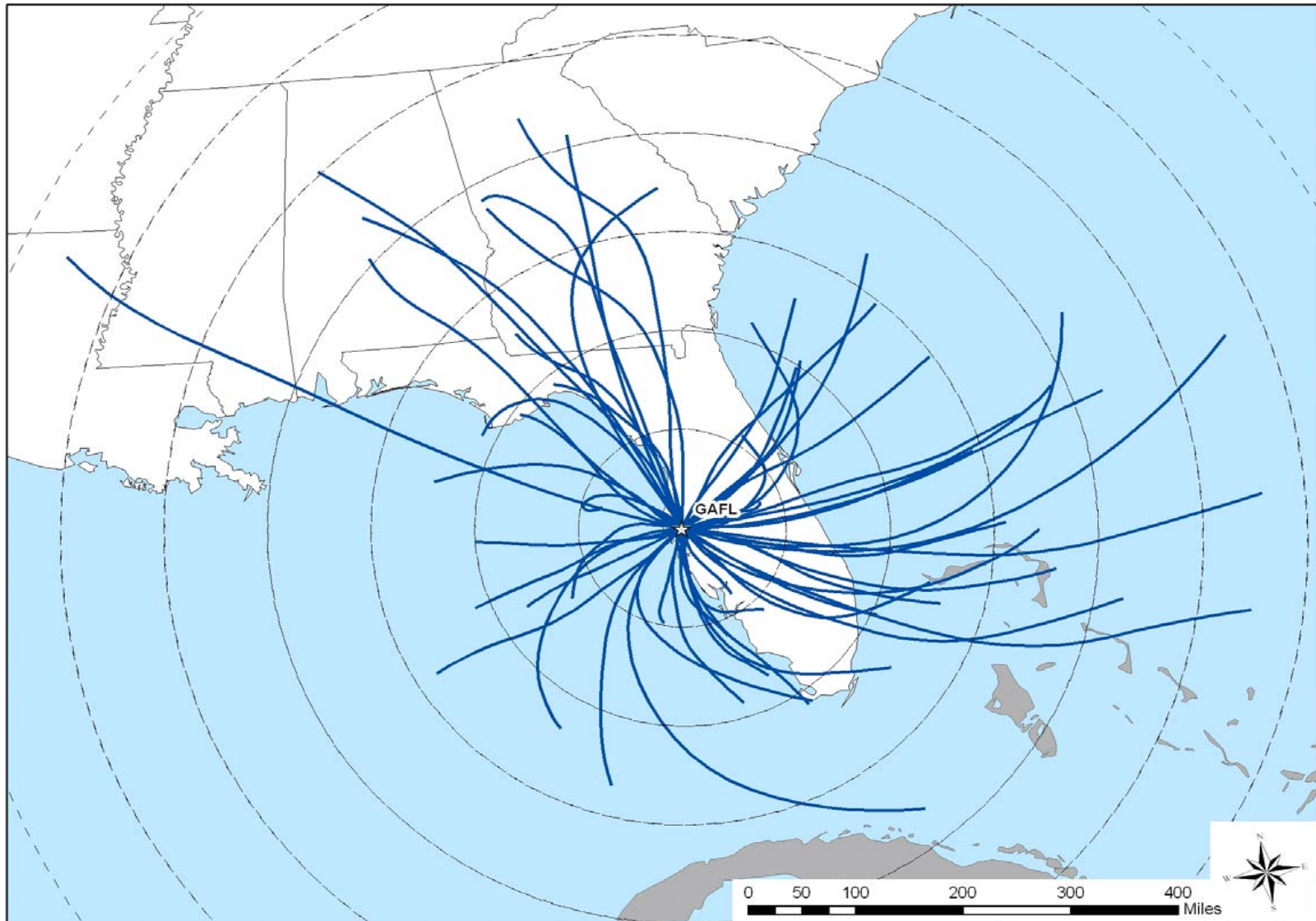


Figure 7-10. Composite Back Trajectory Map for ORFL

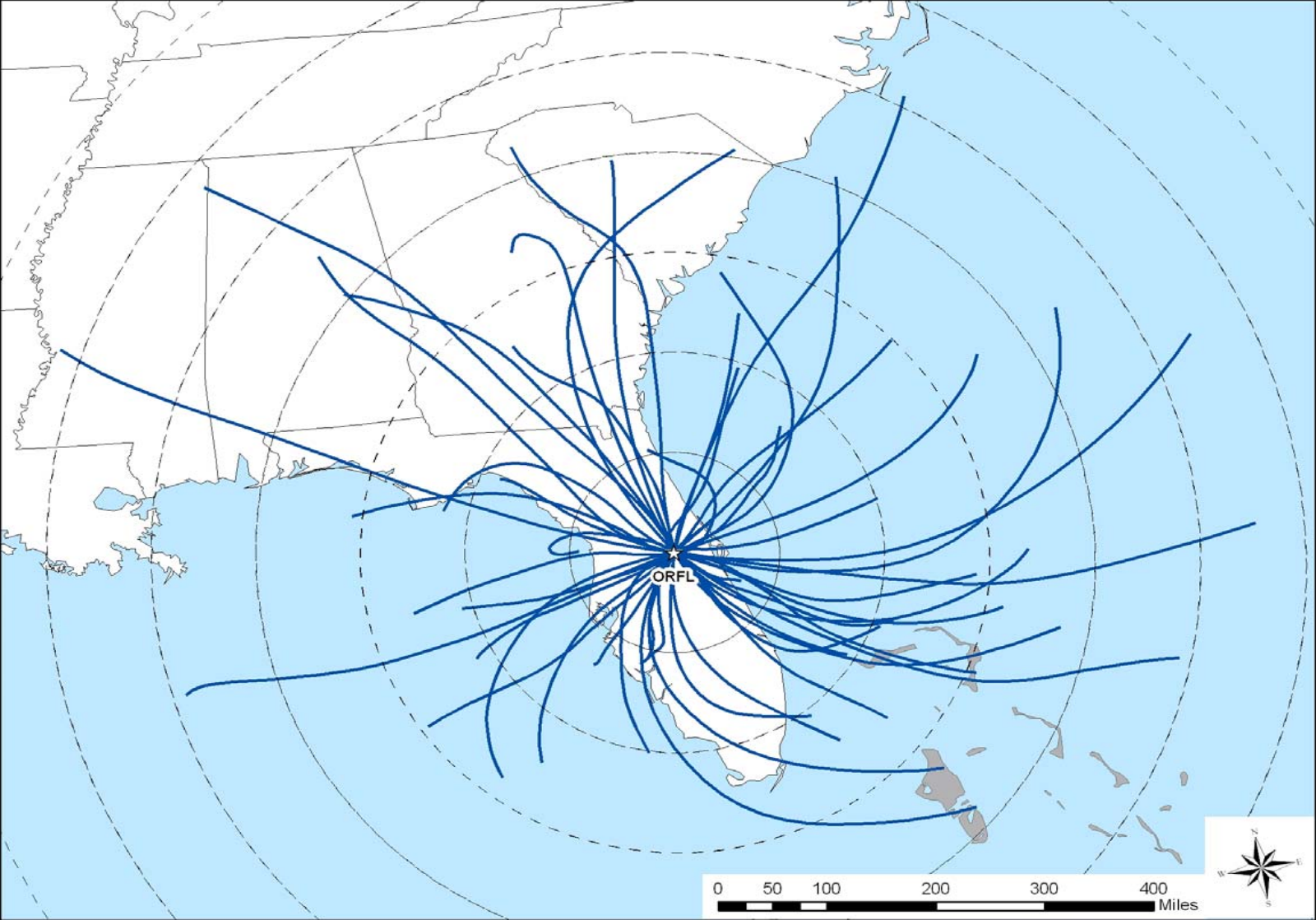


Figure 7-11. Composite Back Trajectory Map for SKFL

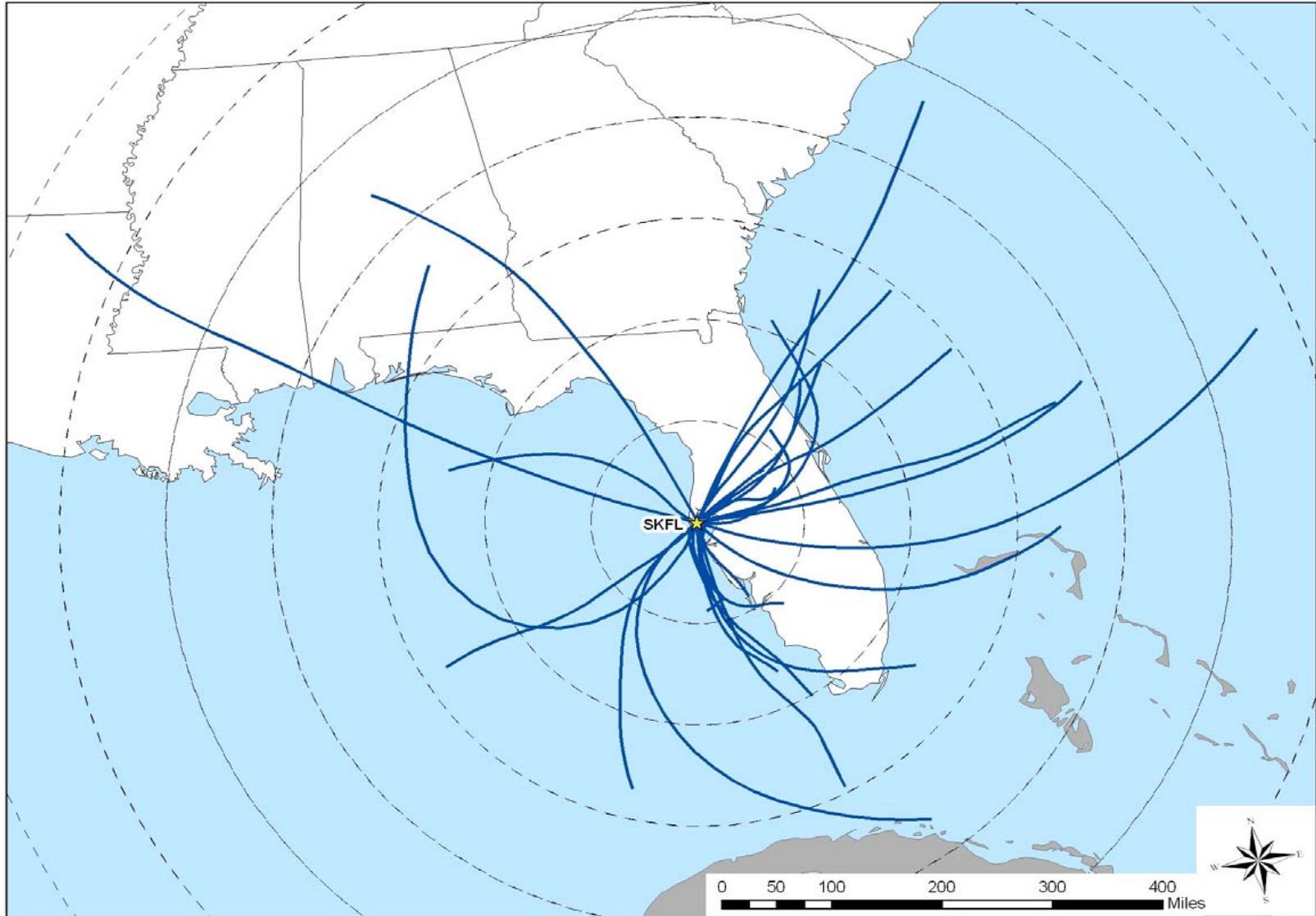


Figure 7-12. Composite Back Trajectory Map for SYFL

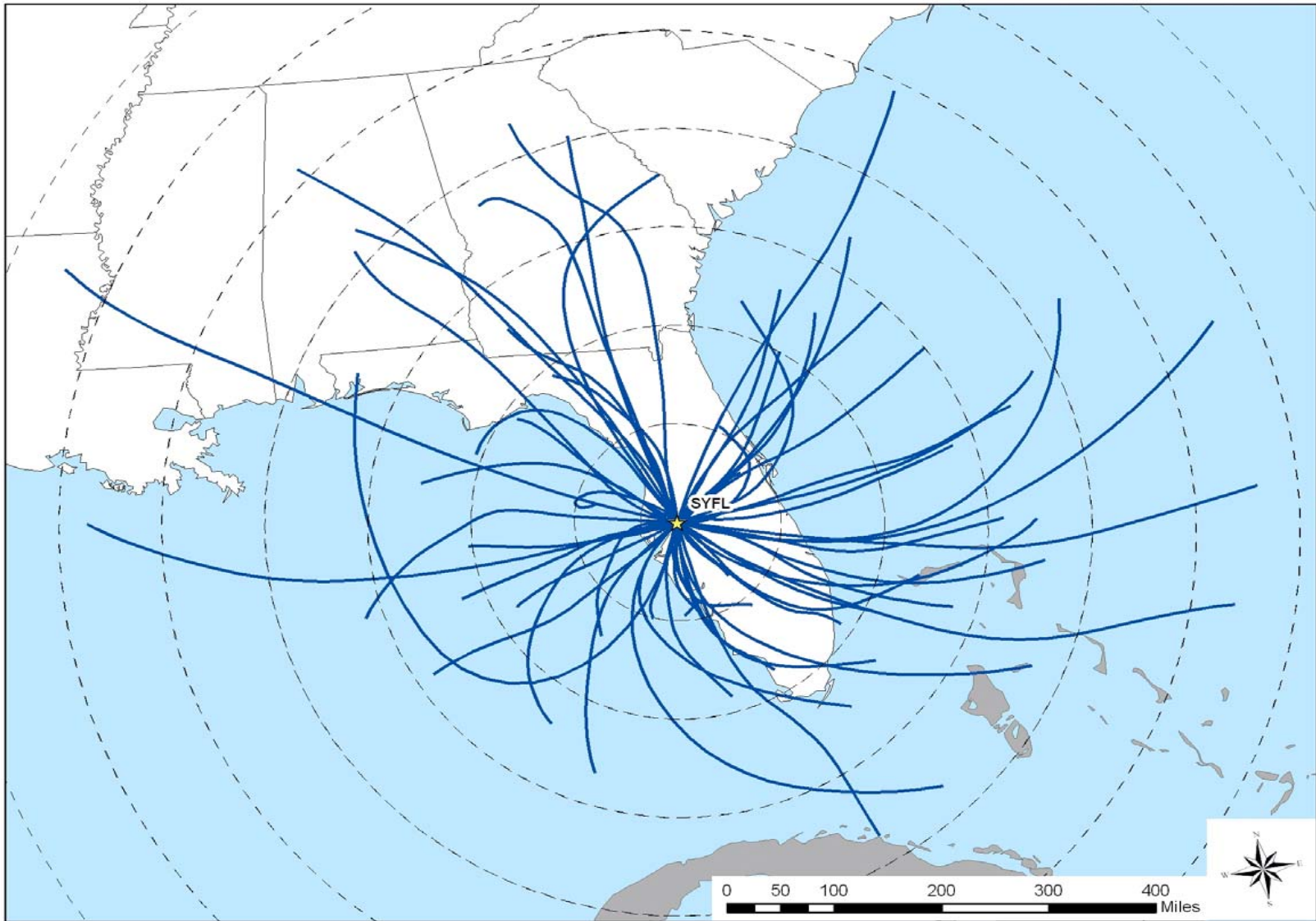


Table 7-1. Average Concentration and Meteorological Parameters for Sites in Florida

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average u -component of the Wind (kts)	Average v -component of the Wind (kts)
AZFL	All 2004		80.37 (± 0.93)	73.69 (± 0.95)	63.64 (± 1.01)	67.42 (± 0.90)	72.30 (± 0.90)	1017.73 (± 0.49)	-1.80 (± 0.50)	-0.54 (± 0.50)
	sample day	7.98 (± 0.65)	79.30 (± 2.26)	72.90 (± 2.32)	63.13 (± 2.53)	66.86 (± 2.23)	72.95 (± 2.28)	1017.30 (± 1.04)	-0.79 (± 1.07)	-1.10 (± 1.28)
GAFL	All 2004		80.72 (± 0.91)	72.35 (± 0.98)	62.45 (± 1.13)	66.30 (± 0.97)	73.10 (± 0.97)	1018.19 (± 0.50)	0.11 (± 0.39)	-0.39 (± 0.37)
	sample day	6.32 (± 0.49)	79.39 (± 2.28)	71.28 (± 2.44)	61.42 (± 2.84)	65.32 (± 2.44)	73.11 (± 2.41)	1018.26 (± 0.95)	0.37 (± 0.82)	-1.32 (± 0.89)
ORFL	All 2004		81.26 (± 0.94)	72.02 (± 0.96)	62.50 (± 1.16)	66.24 (± 0.98)	74.46 (± 1.05)	1019.09 (± 0.49)	-0.70 (± 0.47)	-0.07 (± 0.44)
	sample day	8.13 (± 0.60)	79.69 (± 2.53)	70.75 (± 2.55)	61.39 (± 2.96)	65.15 (± 2.52)	75.08 (± 2.83)	1019.02 (± 1.06)	-0.06 (± 1.09)	-0.46 (± 1.06)
SKFL	All 2004		80.76 (± 0.92)	72.61 (± 0.96)	63.32 (± 1.10)	66.89 (± 0.95)	74.42 (± 0.90)	1018.14 (± 0.49)	-0.89 (± 0.47)	-0.61 (± 0.49)
	sample day	13.34 (± 10.98)	81.61 (± 2.64)	74.34 (± 2.72)	66.78 (± 3.14)	69.52 (± 2.79)	78.57 (± 2.70)	1016.66 (± 1.91)	-1.40 (± 1.57)	-0.48 (± 2.18)
SYFL	All 2004		82.11 (± 0.97)	72.25 (± 0.97)	61.70 (± 1.11)	65.83 (± 0.95)	72.33 (± 1.01)	1018.57 (± 0.51)	-1.36 (± 0.47)	-0.44 (± 0.44)
	sample day	6.23 (± 0.60)	80.65 (± 2.36)	71.26 (± 2.36)	61.24 (± 2.76)	65.24 (± 2.36)	73.33 (± 2.45)	1018.21 (± 1.01)	-0.59 (± 1.07)	-0.69 (± 0.98)

**Table 7-2. Summary of the Toxic Cancer Compounds at the
St. Petersburg, Tampa, Winter Park, Pinellas Park, and Plant City, Florida Monitoring Sites**

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
St. Petersburg, Florida - AZFL						
Acetaldehyde	7.37 E-06	99.78	99.78	3.35	60	7.37
Formaldehyde	9.79 E-09	0.13	100.00	1.78	60	0.01
Tampa, Florida - GAFL						
Acetaldehyde	5.26 E-06	99.78	99.78	2.39	57	5.26
Formaldehyde	1.51 E-08	0.22	100.00	2.09	57	0.01
Winter Park, Florida - ORFL						
Acetaldehyde	4.89 E-06	99.63	99.63	2.22	52	4.89
Formaldehyde	1.80 E-08	0.37	100.00	3.27	52	0.02
Pinellas Park, Florida - SKFL						
Acetaldehyde	1.07 E-05	99.77	99.77	4.58	28	10.74
Formaldehyde	2.52 E-08	0.23	0.23	4.58	28	0.03
Plant City, Florida - SYFL						
Acetaldehyde	3.44 E-06	99.68	99.68	1.56	59	3.44
Formaldehyde	1.10 E-08	0.32	100.00	1.99	60	0.01

**Table 7-3. Summary of the Toxic Noncancer Compounds at the
St. Petersburg, Tampa, Winter Park, Pinellas Park, and Plant City, Florida Monitoring Sites**

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
St. Petersburg, Florida - AZFL						
Acetaldehyde	3.12 E-01	67.21	67.21	3.35	60	0
Formaldehyde	1.82 E-01	32.79	100.00	1.78	60	0
Tampa, Florida - GAFL						
Acetaldehyde	2.06 E-01	55.43	55.43	2.39	57	0
Formaldehyde	2.14 E-01	44.57	100.00	2.09	57	0
Winter Park, Florida - ORFL						
Acetaldehyde	3.33 E-01	57.45	57.45	3.27	52	0
Formaldehyde	2.47 E-01	42.55	100.00	2.22	52	0
Pinellas Park, Florida - SKFL						
Acetaldehyde	5.42 E-01	53.70	53.70	4.88	28	1
Formaldehyde	4.68 E-01	46.30	100.00	4.58	28	1
Plant City, Florida - SYFL						
Acetaldehyde	2.03 E-01	53.94	53.94	1.99	60	0
Formaldehyde	1.74 E-01	46.06	100.00	1.56	59	0

Table 7-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the St. Petersburg, Tampa, Winter Park, Pinellas Park, and Plant City, Florida Sites

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
St. Petersburg, Florida - AZFL								
Acetaldehyde	0.10	0.01	-0.04	-0.02	-0.14	0.29	-0.53	-0.09
Formaldehyde	0.21	0.16	0.14	0.15	-0.03	0.16	-0.44	-0.03
Tampa, Florida - GAFL								
Acetaldehyde	0.13	0.06	0.03	0.04	-0.10	0.27	-0.32	0.27
Formaldehyde	0.22	0.16	0.15	0.15	0.03	0.25	-0.12	0.27
Winter Park, Florida - ORFL								
Acetaldehyde	0.04	0.02	-0.10	-0.07	-0.30	-0.23	0.33	0.12
Formaldehyde	0.66	0.61	0.40	0.48	-0.27	-0.25	0.32	0.32
Pinellas Park, Florida - SKFL								
Acetaldehyde	0.22	0.15	0.11	0.12	0.03	0.14	-0.05	-0.05
Formaldehyde	0.31	0.25	0.22	0.23	0.01	0.04	-0.02	-0.02
Plant City, Florida - SYFL								
Acetaldehyde	0.07	0.05	0.00	0.01	-0.23	-0.11	0.03	0.20
Formaldehyde	0.17	0.15	0.11	0.12	-0.19	-0.10	0.18	0.16

Table 7-5. Motor Vehicle Information vs. Daily Concentration for Florida Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Population: Registration)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
AZFL	926,146	936,194	1.01	572,722	578,449	51,000	7.98 (± 0.65)
GAFL	1,073,407	1,020,861	0.95	462,119	439,013	81,400	6.32 (± 0.49)
ORFL	964,865	916,248	0.95	962,938	914,791	59,000	8.13 (± 0.60)
SKFL	926,146	936,194	1.01	698,981	705,971	50,000	13.34 (± 10.98)
SYFL	1,073,407	1,020,861	0.95	259,538	246,561	5,142	6.23 (± 0.60)

8.0 Sites in Illinois

This section presents meteorological, concentration, and spatial trends for the two UATMP sites in Illinois (NBIL and SPIL). Both of these sites are located in the Chicago-Naperville-Joliet, IL-IN-WI metropolitan statistical area (MSA). Figures 8-1 and 8-2 are topographical maps showing the monitoring sites in their urban locations. Figure 8-3 identifies facilities within 10 miles of these sites that reported to the 2002 NEI. The NBIL and SPIL sites are within several miles of each other, with numerous sources surrounding them. SPIL is surrounded by more sources than NBIL. Fuel combustion facilities are the most numerous source category group surrounding these sites.

Hourly meteorological data were retrieved for all of 2004 at two weather stations near these sites for calculating correlations of meteorological data with ambient air concentration measurements. The two weather stations are Palwaukee Municipal Airport and O'Hare International Airport (WBAN 4838 and 94846, respectively).

SPIL sampled for VOC only while NBIL sampled for VOC and SNMOC. Table 8-1 highlights the average UATMP concentration (VOC only) at each of these sites, along with temperature (average maximum and average), moisture (average dewpoint temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*-components of the wind) for the entire year and on days samples were taken. Daily weather fluctuations are common for the Chicago area due to its Great Lakes location. The proximity of Chicago to Lake Michigan offers moderating effects from the continental climate of the region. In the summertime, lake breezes can cool the city when winds from the south and southwest push temperatures upward. How much and what kind of winter precipitation depends on the origin of the air mass. The largest snowfalls tend to occur when cold air masses flow southward over Lake Michigan. Wind speeds average around 10 mph, contrary to the city's nickname, "The Windy City", which comes from the enhanced wind speeds from channeling between tall buildings downtown. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

8.1 Prevalent Compounds at the Illinois Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 8-2 summarizes the cancer weighting scores, while Table 8-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

As can be shown in Table 8-2, all of the prevalent cancer compounds reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. Only acrylonitrile, benzene, carbon tetrachloride, 1,3-butadiene, *p*-dichlorobenzene, and tetrachloroethylene were considered prevalent at both sites. For the noncancer compounds summarized in Table 8-3, most of the prevalent non-cancer compounds were listed among the nationwide noncancer prevalent list. Only *trans*-1,3-dichloroprene (at both sites), carbon tetrachloride (at both sites), and chloroform (at NBIL) were considered prevalent and were not on the nationwide noncancer prevalent list.

Prevalent toxic compounds not detected at either of the Chicago sites were: *cis*-1,3-dichloropropene; vinyl chloride; and ethyl acrylate. Note, carbonyl compounds were not sampled at the IL sites. Acetaldehyde and formaldehyde would therefore not be detected.

8.2 Toxicity Analysis

At the SPIL site, acrylonitrile made up over 50% of the cancer toxicity score, while only making up 25% of the toxicity at the NBIL site. Interestingly, acrylonitrile was only detected once at NBIL and twice at SPIL. Benzene had the largest number of detects at both sites.

At both sites, acetonitrile, acrylonitrile, and 1,3-butadiene made up at least 50% of the total noncancer toxicity. As previously mentioned, benzene, which was detected the most, only contributed to 9% of the noncancer toxicity at NBIL, and 5% at SPIL.

The acrylonitrile cancer risk at SPIL was the highest between the two sites at 45.01 in a million, while at NBIL, the acrylonitrile cancer risk was 26.56 in a million. For the compounds that may lead to adverse noncancer health effects, the average acetonitrile toxicity at SPIL was 0.33 (over 1 indicates a significant chance of a noncancer health effect). None of the measured concentrations at these sites was above their noncancer RfC weighting factor.

8.3 Meteorological and Concentration Averages at the Illinois Sites

As previously mentioned, the Chicago sites did not sample for carbonyl compounds. As indicated in Table 8-1, the average UATMP (VOC only) concentration at NBIL was higher than the average UATMP concentration at SPIL.

The NBIL site also opted to have total and speciated nonmethane organic compounds (TNMOC/SNMOC) sampled during its air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for NBIL was 244.69 ppbC, of which nearly 79% could be identified through speciation. Of the speciated compounds, ethylene measured the highest concentration at the NBIL site (931.00 ppbC). This information is presented in Table 8-4.

Table 8-5 presents the summary of calculated Pearson Correlation coefficients for each of the site-specific prevalent compounds and selected meteorological parameters. Identification of the site-specific prevalent compounds is discussed earlier in this section. At SPIL, most of the correlations between the weather parameters and the prevalent compounds were weak. The strongest correlations were between xylenes (total) and the temperature parameters, dewpoint, and wet bulb temperature. However, it is interesting to note that all of the correlations between the prevalent compounds and the maximum, average, dewpoint, and wet bulb temperatures were all positive. Pearson correlations could not be computed for acrylonitrile, bromomethane, *p*-dichlorobenzene, and *trans*-1,3-dichloropropene due to the low number of detects (fewer than 4).

The NBIL site had stronger correlations. The strongest correlation was between 1,3-butadiene and wet bulb temperature (-0.80). This compound also had very strong negative correlations with temperature variables and dewpoint, and a strong negative correlation with sea level pressure. Benzene had moderately strong negative correlations with the temperature variables, dewpoint and wet bulb temperatures. Acetonitrile had a strong negative correlation with relative humidity and a strong positive correlation with the *u*-component of the wind. Pearson correlations could not be computed for seven prevalent compounds due to the low number of detects (fewer than 4).

Figures 8-4 and 8-5 show the composite back trajectories for the Chicago, IL sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in these figures, the back trajectories primarily originate from the southwest, northwest, and north. Each circle around the sites in Figures 8-4 and 8-5 represents 100 miles; 63% to 64% of the trajectories originated within 400 miles, and 97% to 98% within 700 miles from the Illinois sites. The 24-hour airshed domain for SPIL appears somewhat larger than for NBIL. The farthest a SPIL back trajectory originated was over 800 miles away, while the farthest a NBIL back trajectory originated was about 700 miles away.

8.4 Spatial Analysis

County-level vehicle registration and population information for Cook County, IL, were obtained from the Illinois Secretary of State and the U.S. Census Bureau, and are summarized in Table 8-6. Table 8-6 also includes a vehicle registration to county population ratio. In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 8-6 also contains the average daily traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at each Illinois site in Table 8-6. The SPIL site has both the largest amount of traffic passing by on a

daily basis and the largest estimated number of vehicles owned within a 10 mile radius of the Illinois sites. The SPIL site also has the largest traffic volume of any UATMP site.

A roadside study conducted to measure emissions from motor vehicles determined that the concentration ratios of the BTEX compounds were relatively consistent from urban area to urban area (for more information on this study, refer to section 3.4.2.). Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. SPIL more closely resembles the ratios of the roadside study of the two Chicago sites, although its benzene-ethylbenzene ratio and its xylenes-ethylbenzene ratio are closer together than those of the roadside study. At NBIL, the benzene-ethylbenzene ratio is the highest and the xylenes-ethylbenzene ratio is the lowest, unlike the roadside study.

As previously stated, NBIL sampled for SNMOC in addition to VOC. Acetylene and ethylene are SNMOCs that are primarily emitted from mobile sources. Tunnel studies conducted on mobile source emissions have found that ethylene and acetylene are typically detected in a 1.7 to 1 ratio. For more information, please refer to Section 3.4.4. Listed in Table 8-4 is the ethylene-acetylene ratio for NBIL and what percent of the expected 1.7 ratio it represents. As shown, NBIL's ethylene-acetylene ratio is within 89% of the expected 1.7 ratio (1.51). This would indicate that the concentrations near NBIL are influenced primarily by mobile source emissions.

8.5 RFG Analysis

The Chicago-Naperville-Joliet, IL-IN-WI MSA participates in the federally-mandated reformulated fuel program (EPA, 1999c). Throughout the year, the oxygen content in gasoline must be at least 2% by weight, boosting the octane quality, increasing combustion, and reducing exhaust emissions. Additionally, the benzene content must not be greater than 1% by volume (EPA, 1994). The oxygenates used as RFG additives in the Chicago MSA are MTBE and ethanol (EPA, 2003b).

A survey at 7 service stations during the summer of 2002 in the Chicago MSA showed the oxygen content of the fuel at 3.50% by weight and the benzene content at 0.746% by volume. MTBE and ethanol also averaged 0.01% and 10.09% by weight, respectively, from the summer survey (EPA, 2003b). A survey at 4 service stations during the winter of 2002 in this MSA showed the oxygen content of the fuel at 3.64% by weight and the benzene content at 0.751% by volume. MTBE and ethanol also averaged 0.01% and 10.48% by weight, respectively, from the winter survey (EPA, 2003b). Figures 8-6 and 8-7 are the VOC profiles at the Illinois sites.

At NBIL (Figure 8-6), the total VOC concentrations were highest in December, although the highest concentration occurred on July 14, 2004. On that day, the stationary source and VOC non-HAP contribution was much higher than other sampling days. The mobile non-BTEX HAP concentrations were low throughout the year. The sampling at NBIL ran from January 4 - December 29. The NBIL BTEX concentration was compared to the BTUT BTEX concentration. BTUT is located in a non-RFG requirement area, but the two sites have similar traffic volumes (NBIL = 34,900; BTUT = 33,310). The BTEX concentrations at NBIL are less than at BTUT ($9.01 \mu\text{g}/\text{m}^3$ vs. $12.71 \mu\text{g}/\text{m}^3$, respectively). It appears that the RFG requirements may be effective at NBIL.

At SPIL (Figure 8-7), the total VOC concentrations were highest in late summer and fall, with the highest concentration occurring on September 30, 2004. On that day, the BTEX and VOC non-HAP contribution was much higher than other sampling days. The sampling at SPIL ran from January 4 - December 29. The non-HAP VOC concentrations were fairly low. The SPIL BTEX concentration was compared to the ELNJ BTEX concentration. Both sites are located in RFG mandated areas, sampled for VOCs and have high volumes of traffic passing by their monitor (SPIL daily traffic = 214,900; ELNJ daily traffic = 170,000). The BTEX concentrations are lower at SPIL than ELNJ ($9.02 \mu\text{g}/\text{m}^3$ vs. $11.43 \mu\text{g}/\text{m}^3$, respectively), which indicates that the RFG requirements may be more effective at SPIL.

8.6 NATTS Site Analysis

One of the Chicago sites, NBIL, is an EPA-designated NATTS site. A description of the NATTS program is provided in Section 3.6. A regulation analysis and an emission tracer analysis for each of the NATTS sites was conducted. Details on each type of analysis are also provided in Section 3.6.

8.6.1 Regulation Analysis

Table 3-10 summarizes the reduction of emissions that is expected from the promulgation of regulations applicable to facilities located within 10 miles of the monitoring site. This analysis includes only regulations implemented after 2002 (regulations implemented prior to 2003 would already be in effect at the time of the 2002 National Emissions Inventory and no further reduction would be expected). As indicated in Table 3-10, fifteen future regulations would be applicable to the facilities located within 10 miles of NBIL. Since NBIL sampled only VOC, only VOC reductions are considered. Based on analysis, the regulations shown are expected to achieve between less than 1% (dichloromethane, tetrachloroethylene, and trichloroethylene) and 60% (chloromethane) reduction in emissions of various VOC. A 14% reduction of total VOC is expected as a result of these regulations, as shown in Table 3-10. These reductions are expected to occur over the next few years as the last compliance date for the applicable regulations is April 2007.

8.6.2 Emission Tracer Analysis

No prevalent noncancer compounds exceeded their noncancer adverse health threshold, therefore, no emission tracer analysis was conducted for NBIL.

8.7 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

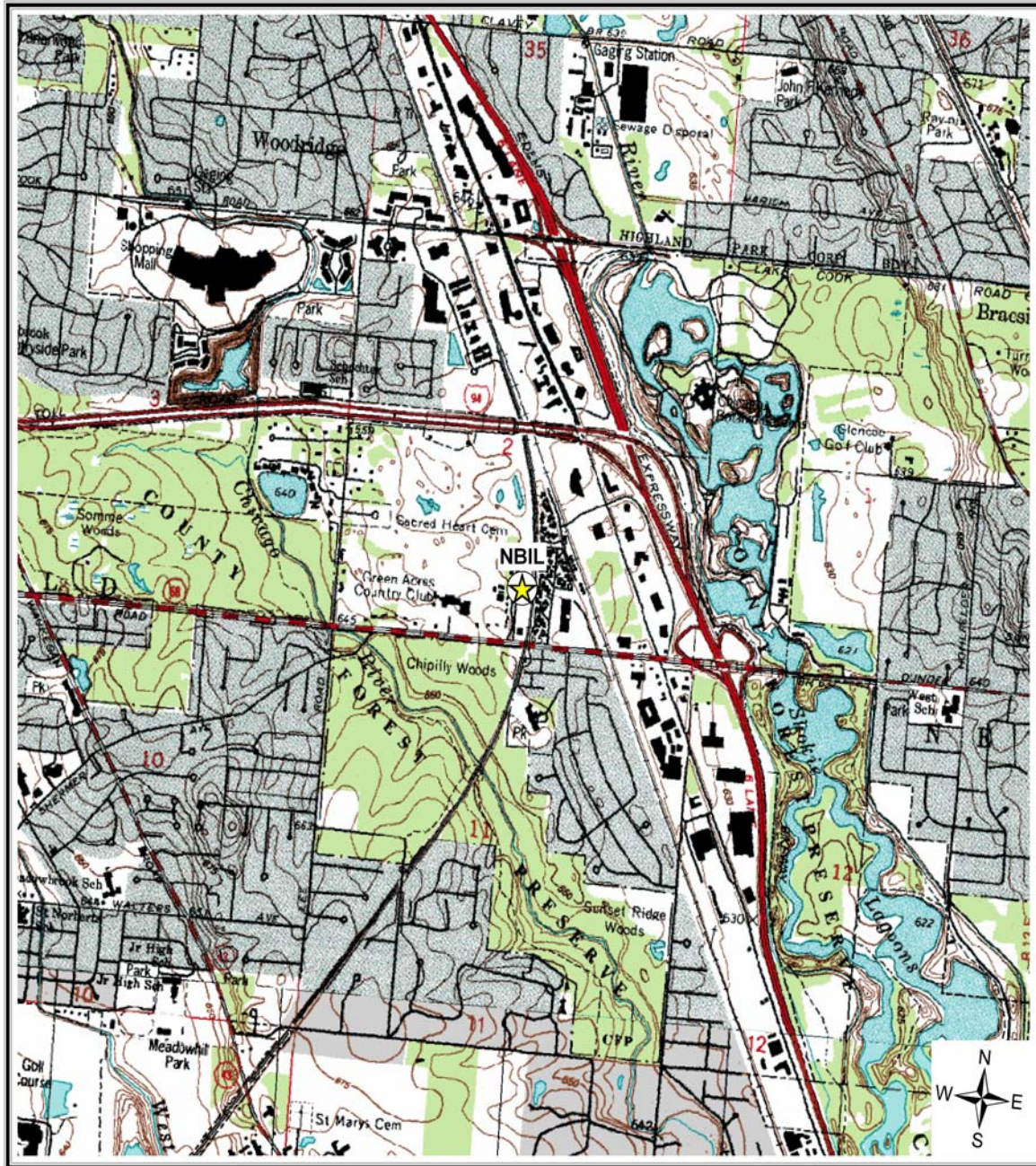
8.7.1 Site-Specific Trends Analyses

NBIL and SPIL have been participants in the UATMP since 2003. Therefore, a site-specific trends analysis was not conducted.

8.7.2 MSA-Specific Trends Analyses

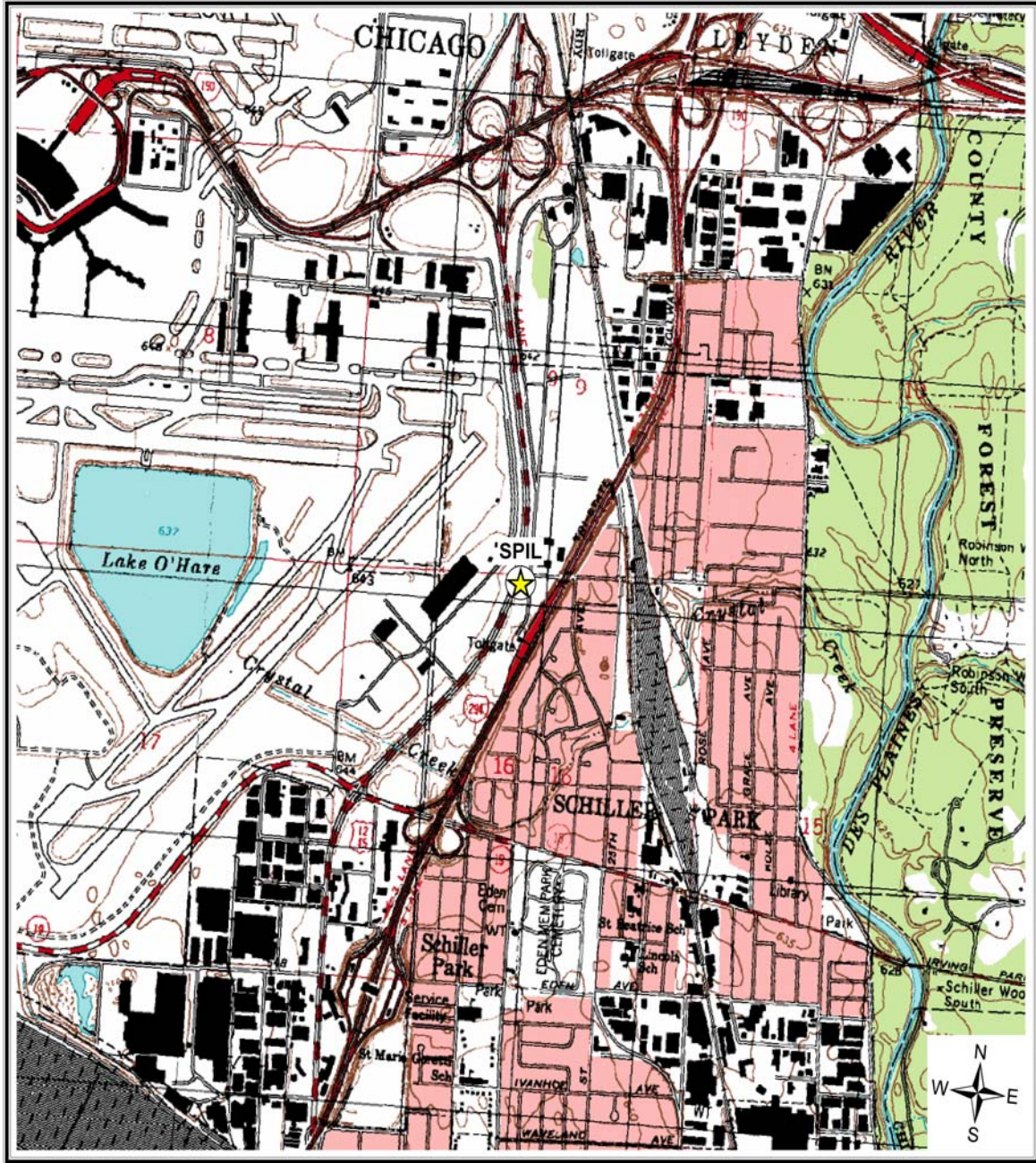
Both Chicago sites reside in the Chicago-Naperville-Joliet, IL-IN-WI MSA. The Chicago MSA has experienced a 14.1% increase in population and a 34.3% increase in vehicle miles traveled (VMT) from 1990 to 2003. VOC emissions have decreased up to 66% between 1990 and 2002. VOC measured concentrations have decreased significantly during this time period (up to 93%), as well. 2004 VOC concentrations for this MSA, as represented by UATMP sites NBIL and SPIL, appear to continue this decreasing trend, with the exception of xylenes, which show little change. Trends for these and other compounds of interest can be found in Table 3-13. This MSA participates in the reformulated gasoline program.

Figure 8-1. Chicago, Illinois Site 1 (NBIL) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-2. Chicago, Illinois Site 2 (SPIL) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 8-3. Facilities Located Within 10 Miles of NBIL and SPIL

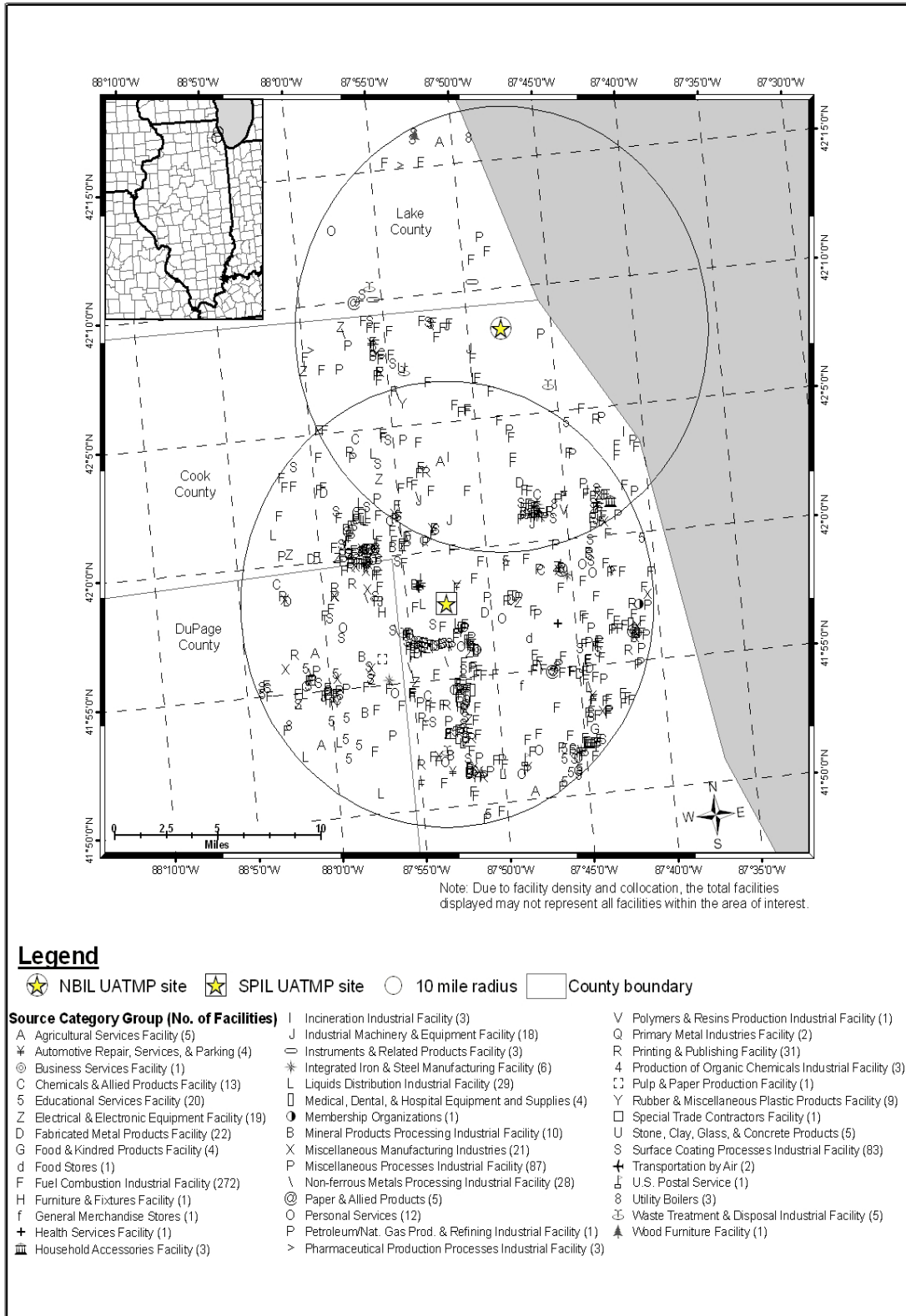


Figure 8-4. Composite Back Trajectory Map for NBIL

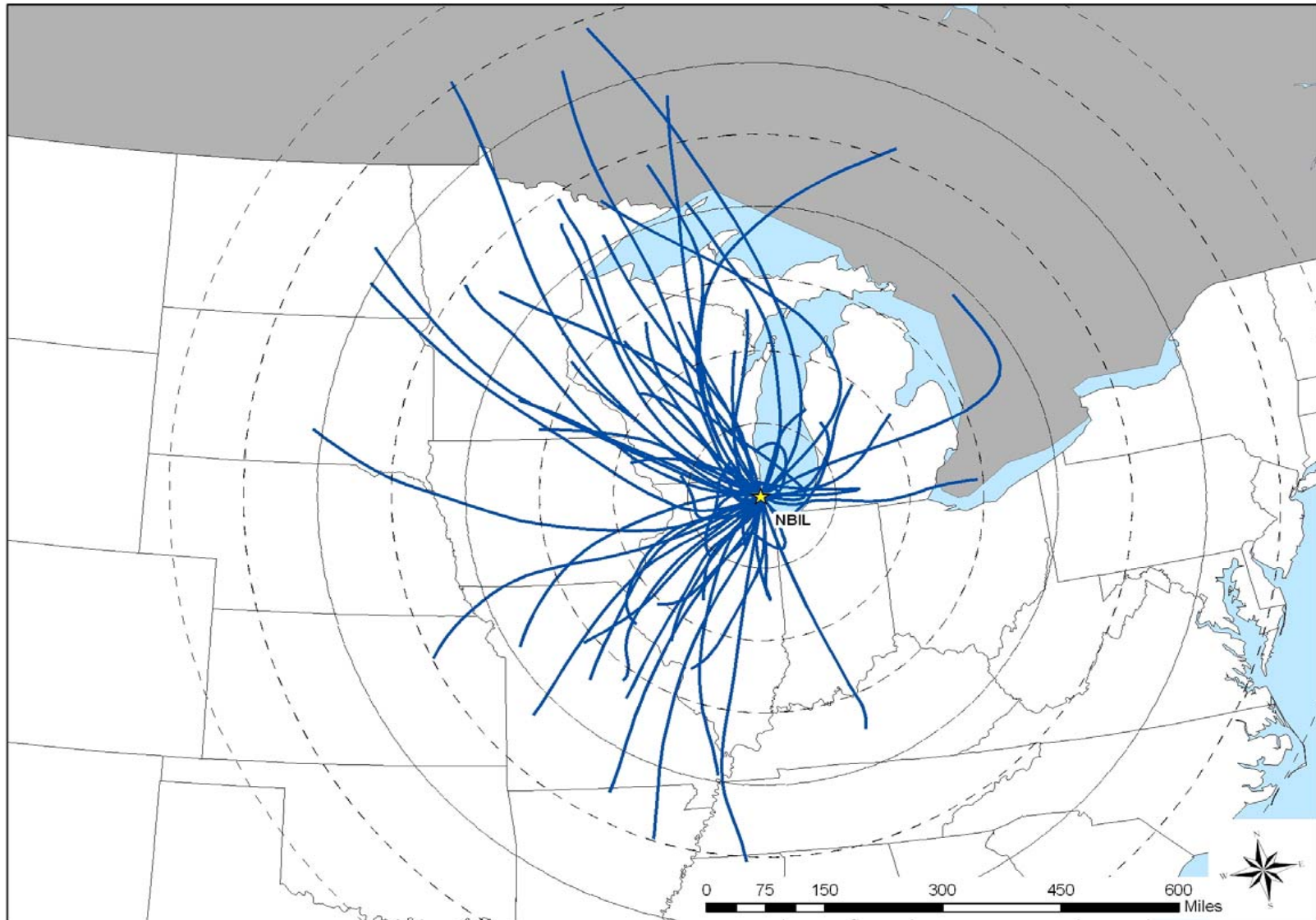


Figure 8-5. Composite Back Trajectory Map for SPIL

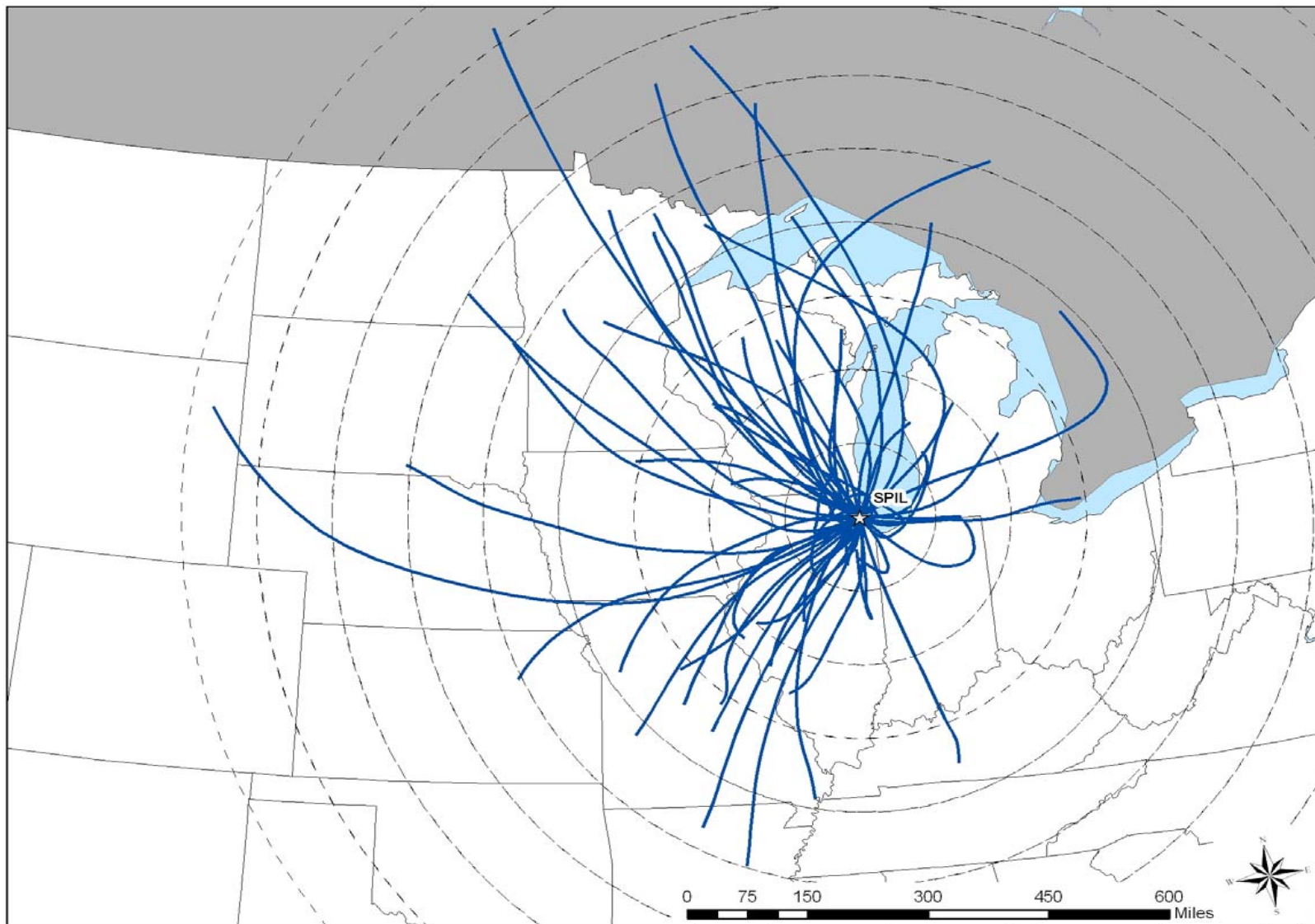


Figure 8-6. 2004 Total VOC Profile at NBIL

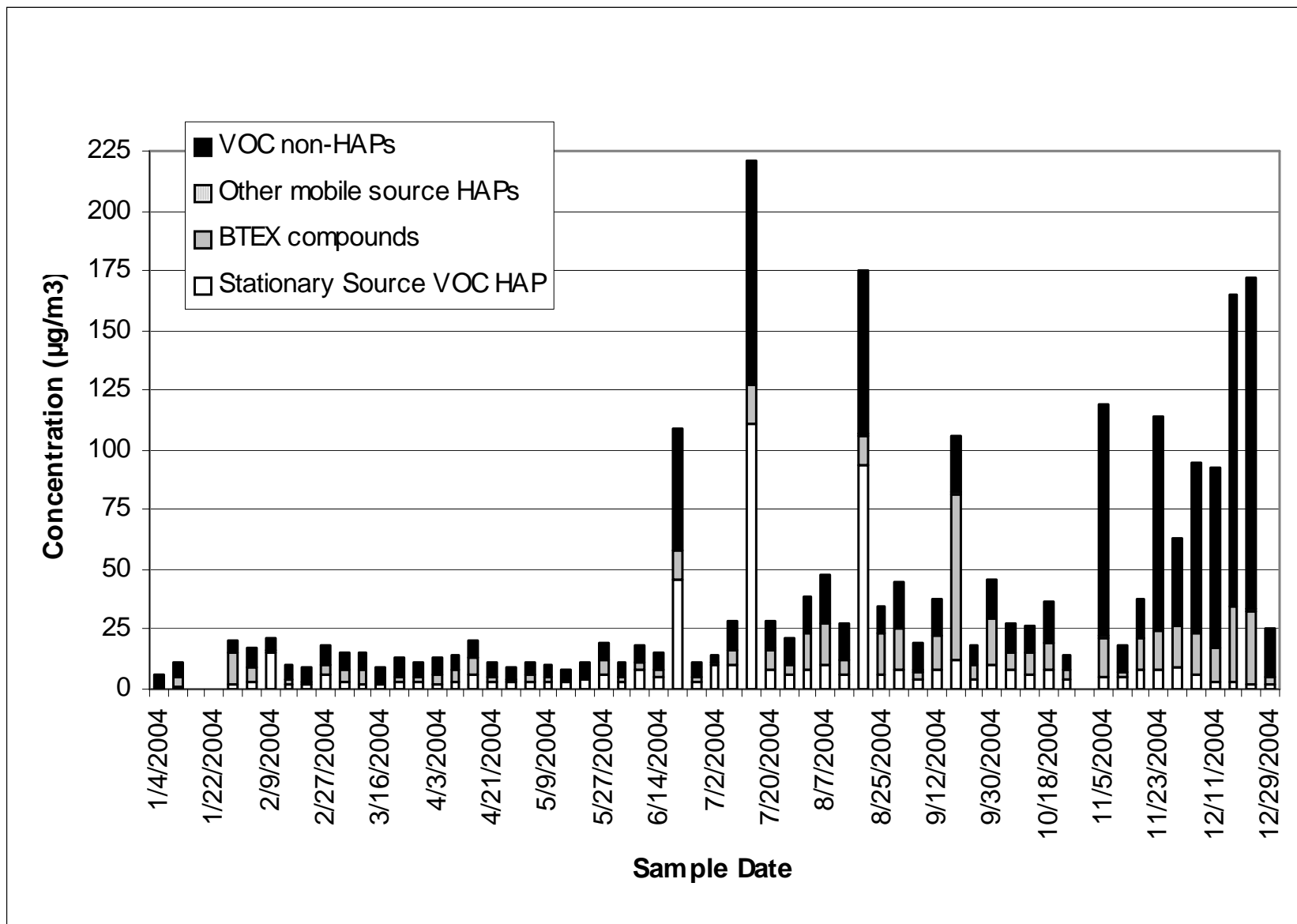


Figure 8-7. 2004 Total VOC Profile at SPIL

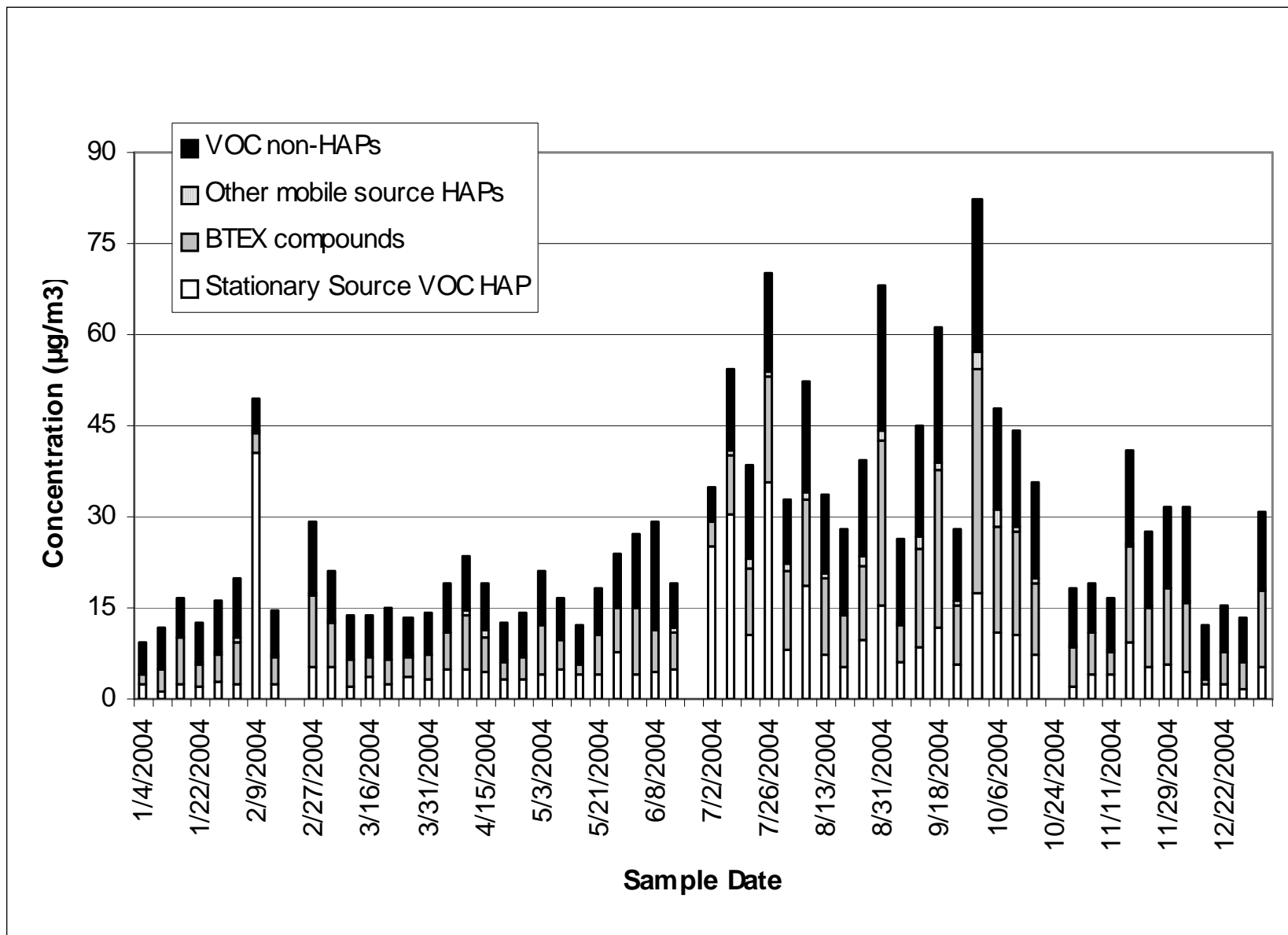


Table 8-1. Average Concentration and Meteorological Parameters for Sites in Illinois

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
NBIL	All 2004	/ / / / / / / /	58.57 (± 2.06)	50.58 (± 1.90)	40.97 (± 1.90)	45.97 (± 1.76)	72.05 (± 1.22)	1018.15 (± 0.71)	1.46 (± 0.44)	0.34 (± 0.52)
	sample day	41.11 (± 12.40)	59.98 (± 5.28)	51.81 (± 4.74)	41.33 (± 4.56)	46.73 (± 4.30)	70.47 (± 3.00)	1018.42 (± 1.56)	1.61 (± 1.09)	0.23 (± 1.23)
SPIL	All 2004	/ / / / / / / /	58.31 (± 2.06)	50.34 (± 1.91)	39.90 (± 1.90)	45.38 (± 1.75)	69.85 (± 1.20)	1017.36 (± 0.71)	1.59 (± 0.54)	0.08 (± 0.53)
	sample day	28.19 (± 4.26)	57.02 (± 5.68)	49.01 (± 5.12)	37.84 (± 5.05)	43.81 (± 4.65)	68.11 (± 3.26)	1017.90 (± 1.64)	1.39 (± 1.53)	-0.07 (± 1.35)

Table 8-2. Summary of the Toxic Cancer Compounds at the Northbrook and Schiller Park, Illinois Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Cancer Risk (Out of 1 Million)
Northbrook, Illinois						
Acrylonitrile	2.66 E-05	25.36	25.36	0.39	1	26.56
Benzene	2.12 E-05	20.20	45.55	2.71	58	21.16
Carbon Tetrachloride	1.32 E-05	12.62	58.17	0.88	55	13.22
1,3-Butadiene	1.04 E-05	9.94	68.11	0.35	11	10.42
1,2-Dichloroethane	9.47 E-06	9.04	77.15	0.36	1	9.47
<i>p</i> -Dichlorobenzene	7.94 E-06	7.58	84.73	0.72	2	7.94
1,2-Dichloropropane	7.90 E-06	7.54	92.27	0.42	1	7.90
Tetrachloroethylene	3.66 E-06	3.50	95.77	0.62	15	3.66
<i>trans</i> -1,3-Dichloropropane	1.82 E-06	1.73	97.50	0.45	2	1.82
Trichloroethylene	1.24 E-06	1.19	98.69	0.62	19	1.24
Bromoform	9.70 E-07	0.93	99.62	0.88	2	0.97
Dichloromethane	4.02 E-07	0.38	100.00	0.86	42	0.40
Schiller Park, Illinois						
Acrylonitrile	4.50 E-05	51.07	51.07	0.66	2	45.01
Benzene	1.18 E-05	13.44	64.51	1.52	57	11.85
Carbon Tetrachloride	1.09 E-05	12.40	76.91	0.73	55	10.93
1,3-Butadiene	8.05 E-06	9.13	86.05	0.27	31	8.05
<i>p</i> -Dichlorobenzene	4.41 E-06	5.00	91.05	0.40	3	4.41
Tetrachloroethylene	3.90 E-06	4.42	95.47	0.66	31	3.90
Trichloroethylene	2.10 E-06	2.38	97.85	1.05	35	2.10
<i>trans</i> -1,3-Dichloropropane	1.51 E-06	1.72	99.57	0.38	3	1.51
Dichloromethane	3.79 E-07	0.43	100.00	0.81	45	0.38

Table 8-3. Summary of the Toxic Noncancer Compounds at the Northbrook and Schiller Park, Illinois Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Northbrook, Illinois						
Acrylonitrile	1.95 E-01	21.63	21.63	0.39	1	0
1,3-Butadiene	1.60 E-01	17.75	39.39	0.32	11	0
Acetonitrile	1.04 E-01	11.56	50.94	6.26	10	0
1,2-Dichloropropane	1.04 E-01	11.52	62.46	0.42	1	0
Benzene	8.16 E-02	9.04	71.49	2.45	58	0
Bromomethane	7.25 E-02	8.03	79.52	0.36	3	0
Chloroform	4.83 E-02	5.34	84.87	4.73	41	0
Chloroprene	3.10 E-02	3.44	88.30	0.22	1	0
Xylenes	2.75 E-02	3.04	91.35	2.75	54	0
<i>trans</i> -1,3-Dichloropropene	2.27 E-02	2.51	93.86	0.45	2	0
Carbon Tetrachloride	2.20 E-02	2.44	96.30	0.88	55	0
Chloromethane	1.63 E-02	1.81	98.11	1.47	58	0
Toluene	5.00 E-03	0.55	98.66	2.00	57	0
<i>n</i> -Hexane	3.20 E-03	0.35	99.02	0.64	42	0
Tetrachloroethylene	2.30 E-03	0.25	99.27	0.62	15	0
Trichloroethylene	1.04 E-03	0.11	99.39	0.62	19	0
1,1-Dichloroethene	9.91 E-04	0.11	99.50	0.20	1	0
<i>p</i> -Dichlorobenzene	9.02 E-04	0.10	99.60	0.72	2	0
Dichloromethane	8.56 E-04	0.09	99.69	0.86	42	0
Methyl Isobutyl Ketone	5.94 E-04	0.07	99.76	1.78	6	0
Ethylbenzene	5.66 E-04	0.06	99.82	0.57	50	0
Chlorobenzene	4.60 E-04	0.05	99.87	0.46	1	0
Methyl Ethyl Ketone	3.68 E-04	0.04	99.91	1.84	44	0
Styrene	3.49 E-04	0.04	99.95	0.35	29	0
1,1,1-Trichloroethane	3.11 E-04	0.03	99.98	0.31	10	0

Table 8-3. Summary of the Toxic Noncancer Compounds at the Northbrook and Schiller Park, Illinois Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
1,2-Dichloroethane	1.52 E-04	0.02	100.00	0.36	1	0
Schiller Park, Illinois						
Acrylonitrile	3.31 E-01	34.45	34.45	0.66	2	0
Acetonitrile	2.13 E-01	22.14	56.59	12.76	10	0
1,3-Butadiene	1.34 E-01	13.97	70.55	0.27	31	0
Bromomethane	1.24 E-01	12.93	83.48	0.62	1	0
Benzene	5.06 E-02	5.27	88.75	1.52	57	0
Xylenes	3.76 E-02	3.91	92.66	3.76	56	0
<i>trans</i> -1,3-Dichloropropene	1.89 E-02	1.97	94.63	0.38	3	0
Carbon Tetrachloride	1.82 E-02	1.90	96.53	0.73	55	0
Chloromethane	1.53 E-02	1.60	98.13	1.38	57	0
Toluene	8.07 E-03	0.84	98.97	3.23	57	0
Tetrachloroethylene	2.45 E-03	0.25	99.22	0.66	31	0
Chloroform	2.39 E-03	0.25	99.47	0.23	8	0
Trichloroethylene	1.75 E-03	0.18	99.65	1.05	35	0
Dichloromethane	8.07 E-04	0.08	99.74	0.81	45	0
Ethylbenzene	6.10 E-04	0.06	99.80	0.61	54	0
Styrene	5.66 E-04	0.06	99.86	0.57	43	0
<i>p</i> -Dichlorobenzene	5.01 E-04	0.05	99.91	0.40	3	0
Methyl Ethyl Ketone	3.29 E-04	0.03	99.94	1.65	45	0
1,1,1-Trichloroethane	2.73 E-04	0.03	99.97	0.27	5	0
Methyl Isobutyl Ketone	2.61 E-04	0.03	100.00	0.78	14	0

Table 8-4. TNMOC Measured by the Chicago, Illinois (NBIL) Monitoring Site

Monitoring Site	Average TNMOC Speciated (ppbC)	Average TNMOC w/ Unknowns (ppbC)	% TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)	Ethylene to Acetylene Ratio	% of Expected Ratio
NBIL	192.86	244.69	79%	Ethylene (931.00)	1.51	89%

**Table 8-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters
in Northbrook and Schiller Park, Illinois Sites**

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Northbrook, Illinois - NBIL								
1,2-Dichloroethane	NA							
1,2-Dichloropropane	NA							
1,3-Butadiene	-0.78	-0.79	-0.79	-0.80	-0.13	0.66	0.37	-0.28
Acetonitrile	0.15	0.26	0.07	0.17	-0.69	-0.40	0.62	0.00
Acrylonitrile	NA							
Benzene	-0.35	-0.35	-0.37	-0.36	-0.12	0.06	0.20	-0.13
Bromomethane	NA							
Carbon Tetrachloride	0.20	0.25	0.26	0.25	0.03	0.08	-0.13	-0.16
Chloroform	0.14	0.20	0.14	0.17	-0.15	0.04	0.05	-0.19
Chloroprene	NA							
<i>p</i> -Dichlorobenzene	NA							
Tetrachloroethylene	0.06	-0.05	-0.09	-0.06	0.02	0.58	-0.28	0.04
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	0.24	0.25	0.26	0.25	0.04	0.06	-0.17	0.04
Schiller Park, Illinois - SPIL								
1,3-Butadiene	0.14	0.09	0.05	0.07	-0.06	0.15	-0.20	0.14
Acetonitrile	0.00	0.04	0.02	0.03	-0.27	-0.18	0.15	-0.06
Acrylonitrile	NA							
Benzene	0.27	0.24	0.24	0.24	0.08	0.12	-0.16	0.17
Bromomethane	NA							
Carbon Tetrachloride	0.27	0.31	0.32	0.32	0.10	-0.01	-0.11	0.14
<i>p</i> -Dichlorobenzene	NA							
Tetrachloroethylene	0.07	0.04	0.03	0.04	0.01	0.28	-0.20	0.24
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	0.40	0.39	0.37	0.38	0.03	0.05	-0.18	0.11

Table 8-6. Motor Vehicle Information vs. Daily Concentration for Illinois Monitoring Sites

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
NBIL	5,351,552	2,005,291	0.37	883,969	327,069	29,600	41.11 (± 12.40)
SPIL	5,351,552	2,005,291	0.37	2,087,514	772,380	214,900	28.19 (± 4.26)

9.0 Site in Indiana

This section presents meteorological, concentration, and spatial trends for the UATMP site in Indiana (INDEM). This site is located in the Chicago-Naperville-Joliet, IL-IN-WI metropolitan statistical area (MSA). Figure 9-1 is a topographical map showing the monitoring site in their urban locations. Figure 9-2 identifies facilities within 10 miles of these sites that reported to the 2002 NEI. Due in part to INDEM's proximity to Lake Michigan, most of the facilities near INDEM are located in part to the east or west of the monitor. The bulk of these facilities are involved in fuel combustion.

Hourly meteorological data were retrieved for all of 2004 at a weather station near this site for calculating correlations of meteorological data with ambient air concentration measurements. The closest weather station is Lansing Municipal Airport (WBAN 04879).

This Chicago area site sampled for carbonyls only. Table 9-1 highlights the average UATMP concentration (carbonyl only) for this site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*-components of the wind) for the entire year and on days samples were taken. Gary is located to the southeast of Chicago, and at the southern-most tip of Lake Michigan. Gary's proximity to Lake Michigan is an important factor controlling the weather of the area. In the summer, warm temperatures can be suppressed, while cold winter temperatures are often moderated. Winds that blow across Lake Michigan and over Gary in the winter can provide abundant amounts of lake-effect snow. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987) and at <http://www.garychamber.com/geoclimate.asp>.

9.1 Prevalent Compounds at the Indiana Site

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 9-2 summarizes the cancer weighting scores, while Table 9-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total

site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

As can be shown in Tables 9-2 and 9-3, the prevalent compounds reflect the nationwide prevalent compound list, as listed in Section 3 of this report. Acetaldehyde was the only prevalent compound at INDEM, while both acetaldehyde and formaldehyde are considered prevalent noncancer compounds. Acetaldehyde and formaldehyde are the only nationwide prevalent carbonyl compounds.

9.2 Toxicity Analysis

At the INDEM site, acetaldehyde made up nearly 98% of the cancer toxicity score, while only making up 10% of the noncancer toxicity, even though the number of detects is the same for both acetaldehyde and formaldehyde. The cancer risk of acetaldehyde was 9.44 in a million at this site. Forty-seven of fifty-three formaldehyde concentrations exceeded the adverse noncancer threshold at INDEM, while only one acetaldehyde concentration exceeded the adverse noncancer threshold.

9.3 Meteorological and Concentration Averages at the Indiana Site

Only carbonyl compounds were measured at this site, as indicated in Tables 3-3 and 3-4. The average UATMP concentration at this site is presented in Table 9-1. This table also lists the averages for selected meteorological parameters from January 2004 to December 2004, and for days on which sampling occurred.

Table 9-4 presents the summary of calculated Pearson Correlation coefficients for each of the site-specific prevalent compounds and selected meteorological parameters. Identification of the site-specific prevalent compounds is discussed earlier in this section. As previously mentioned, the INDEM site sampled only for carbonyl compounds. At INDEM, the correlations between the temperature and moisture parameters (with the exception of relative humidity) and the prevalent compounds were fairly strong, while the correlations with relative humidity, pressure, and wind components were weak.

Figure 9-3 shows the composite back trajectory for the INDEM site for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in Figure 9-3, the back trajectories originated predominantly from the south, southwest, northwest, and north of this site. Each circle around the site in Figure 9-3 represents 100 miles; 68% of the trajectories originated within 400 miles, and 97% within 800 miles from the INDEM site. The 24-hour airshed domain is extremely large. Back trajectories originated nearly 900 miles away.

9.4 Spatial Analysis

County-level vehicle registration and population information for Lake County, IN were obtained from the Indiana Bureau of Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 9-5. Table 9-5 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 9-5 also contains daily traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the Indiana site in Table 9-5.

9.5 RFG Analysis

The Chicago-Naperville-Joliet, IL-IN-WI MSA participates in the federally-mandated reformulated fuel program (EPA, 1999c). Throughout the year, the oxygen content in gasoline must be at least 2% by weight, boosting the octane quality, increasing combustion, and reducing exhaust emissions. Additionally, the benzene content must not be greater than 1% by volume (EPA, 1994). The oxygenates used as RFG additives in the Chicago MSA are MTBE and ethanol (EPA, 2003b).

A survey at 7 service stations during the summer of 2002 in the Chicago MSA showed the oxygen content of the fuel at 3.50% by weight and the benzene content at 0.746% by volume. MTBE and ethanol also averaged 0.01% and 10.09% by weight, respectively, from the summer

survey (EPA, 2003b). A survey at 4 service stations during the winter of 2002 in this MSA showed the oxygen content of the fuel at 3.64% by weight and the benzene content at 0.751% by volume. MTBE and ethanol also averaged 0.01% and 10.48% by weight, respectively, from the winter survey (EPA, 2003b). Because VOCs were not sampled at INDEM, a RFG analysis was not performed.

9.6 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

9.6.1 Site-Specific Trends Analyses

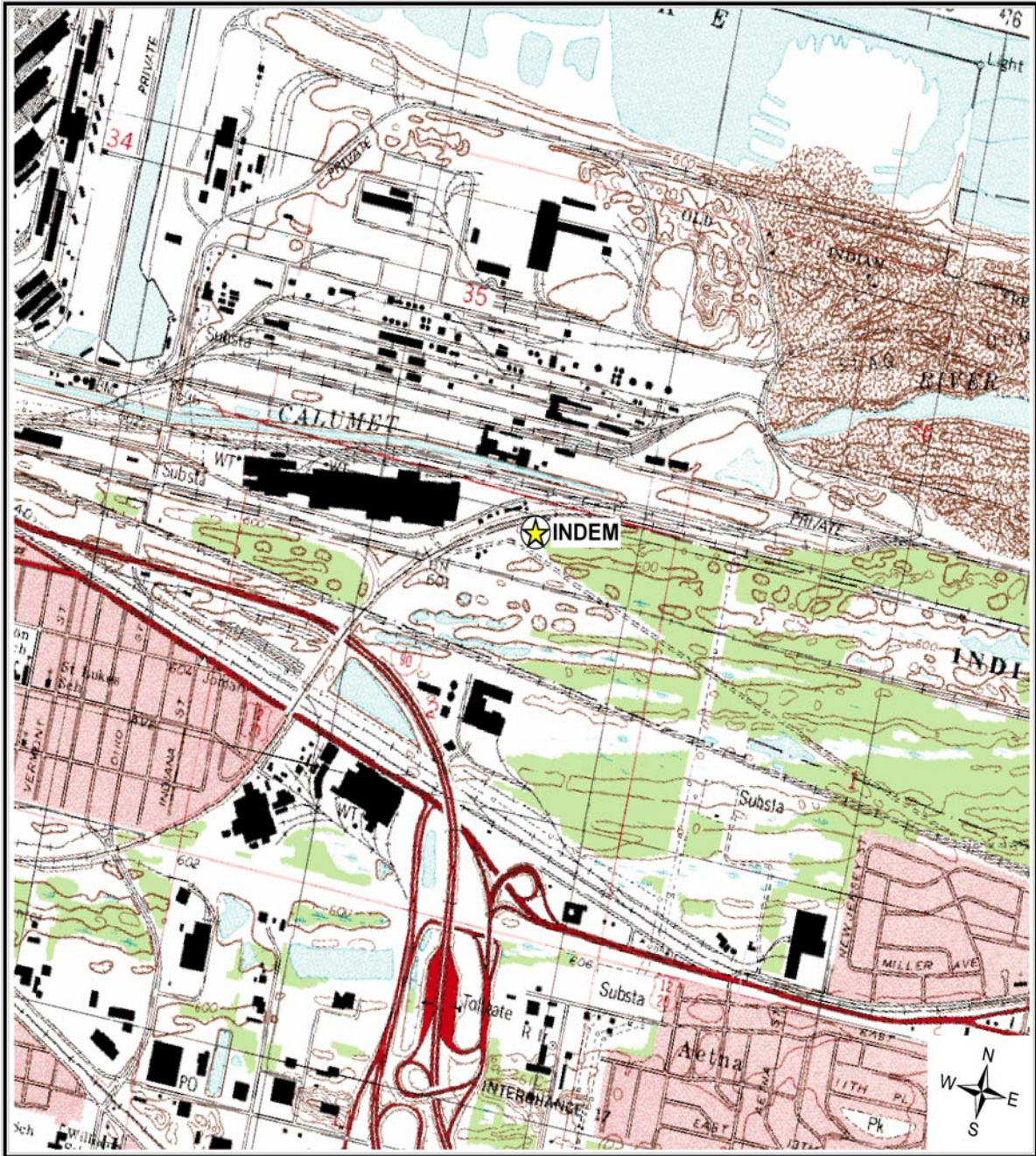
INDEM is new to the UATMP this year, therefore, no site-specific trends analysis was conducted.

9.6.2 MSA-Specific Trends Analyses

INDEM resides in the Chicago-Naperville-Joliet, IL-IN-WI MSA. The Chicago MSA has experienced a 14.1% increase in population and a 34.3% increase in vehicle miles traveled (VMT) from 1990 to 2003. Acetaldehyde and formaldehyde emissions have decreased approximately 30% and 59% respectively, between 1990 and 2002. Acetaldehyde concentrations have decreased significantly between 1990-1994 and 2002-2003, although the 2004 average concentration, based on UATMP site that represent this MSA (INDEM), appears to be up from the 2002-2003 average. While formaldehyde emissions have decreased significantly over the period, concentrations have risen and the 2004 UATMP MSA average is much higher than both the 1990-1994 and 2002-2003 average. This observation is similar to the formaldehyde trend in the Hartford, CT MSA. Research has shown that formaldehyde concentrations tend to increase when fuels containing ethanol are combusted. Ethanol is one of the components in the

formulated gasoline that this MSA uses. Trends for these and other compounds of interest can be found in Table 3-13.

Figure 9-1. Gary, Indiana (INDEM) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 9-2. Facilities Located Within 10 Miles of INDEM

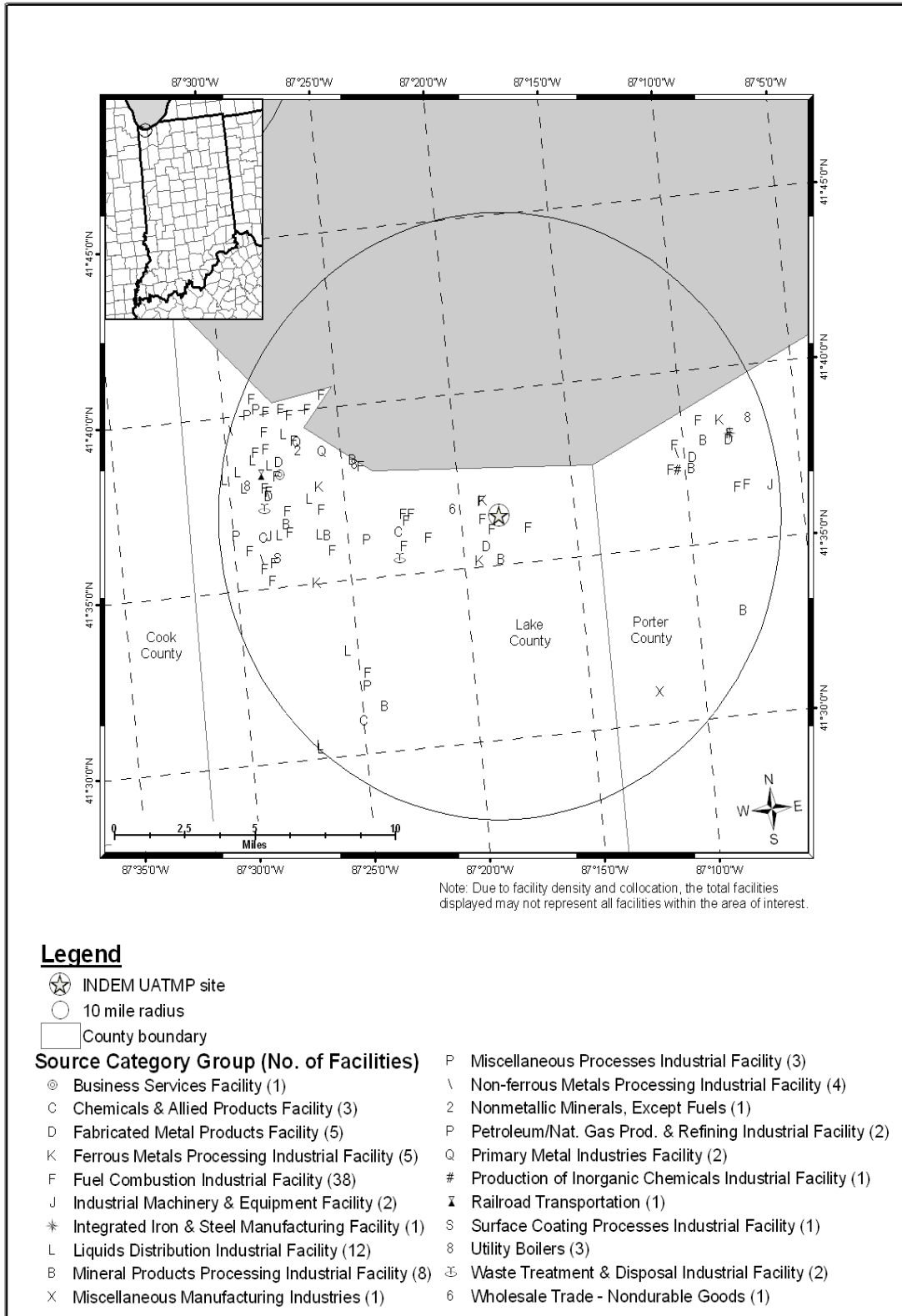


Figure 9-3. Composite Back Trajectory Map for INDEM

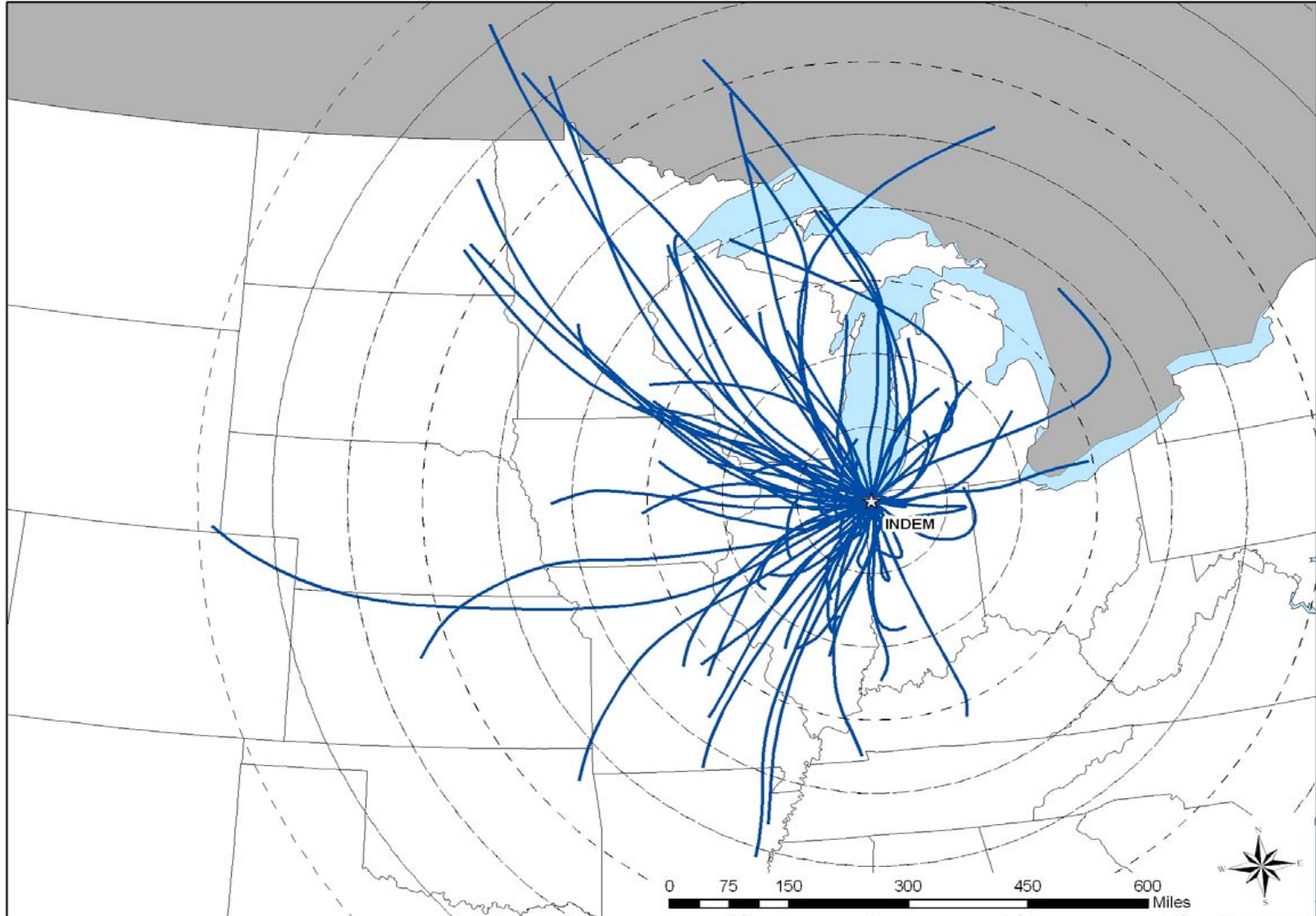


Table 9-1. Average Concentration and Meteorological Parameters for Site in Indiana

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
INDEM	All 2004	/ / / / / / / /	60.02 (± 2.09)	51.82 (± 1.91)	42.70 (± 1.89)	47.35 (± 1.77)	73.47 (± 1.17)	1017.10 (± 6.47) ¹	1.55 (± 0.49)	0.97 (± 0.55)
	sample day	55.15 (± 12.74)	62.72 (± 4.61)	54.03 (± 4.24)	44.26 (± 4.11)	49.12 (± 3.87)	72.15 (± 2.49)	1017.08 (± 1.19)	1.55 (± 1.15)	0.67 (± 1.13)

¹ Sea-level pressure was not recorded at this station. Station pressure in inches of Mercury was converted to mb to yield an “uncorrected sea level pressure.”

Table 9-2. Summary of the Toxic Cancer Compounds at the Gary, Indiana Monitoring Site - INDEM

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Acetaldehyde	9.44 E-06	97.65	97.65	4.29	53	9.44
Formaldehyde	2.27 E-07	2.35	100.00	41.23	53	0.23

Table 9-3. Summary of the Toxic Noncancer Compounds at the Gary, Indiana Monitoring Site - INDEM

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Formaldehyde	4.21 E+00	89.82	89.82	41.23	53	47
Acetaldehyde	4.77 E-01	10.18	100.00	4/29	53	1

**Table 9-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters
in Gary, Indiana (INDEM)**

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
Acetaldehyde	0.59	0.61	0.59	0.61	-0.08	-0.16	0.03	0.14
Formaldehyde	0.46	0.46	0.46	0.47	0.02	0.02	0.05	0.16

Table 9-5. Motor Vehicle Information vs. Daily Concentration for Indiana Monitoring Site

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicle per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
INDEM	487,476	275,061	0.56	404,545	226,545	42,950	55.15 (± 12.74)

10.0 Site in Massachusetts

This section presents meteorological, concentration, and spatial trends for the UATMP site in Massachusetts (BOMA). This site is located in the Boston-Lawrence-Worcester metropolitan statistical area (MSA). Figure 10-1 is a topographical map showing the monitoring site in its urban location. Figure 10-2 identifies facilities within 10 miles of this site that reported to the 2002 NEI. BOMA is located near a number of facilities, mainly to the north and west of the site. A majority of the industries are involved in waste treatment and disposal and liquids distribution.

Hourly meteorological data were retrieved for all of 2004 at a weather station near this site for calculating correlations of meteorological data with ambient air concentration measurements. The nearest weather station is Logan International Airport (WBAN 14739).

The BOMA site sampled for metals only. Table 10-1 highlights the average metals concentration, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*-components of the wind) for the entire year and on days samples were taken. Boston's location on the East Coast ensures that the city experiences a fairly active weather pattern. Most storm systems track across the Northeast, bringing ample precipitation to the area. The proximity to the Atlantic Ocean helps moderate cold outbreaks and hot spells, while at the same time allowing winds to gust higher than they would farther inland. Winds generally flow from the northwest in the winter and southwest in the summer. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

10.1 Prevalent Compounds at the Massachusetts Site

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 10-2 summarizes the cancer weighting scores, while Table 10-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95%

of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

As the BOMA site only sampled for metals, only metal compounds are listed in the tables of toxic cancer and noncancer compounds, which is reflected in Tables 10-2 and 10-3. The nationwide list of cancer and non-cancer prevalent compounds does not contain any metal compounds, although all of the metals sampled have either a cancer or noncancer toxicity value. Manganese, nickel, arsenic, and cadmium compounds are prevalent at the BOMA site.

Because BOMA only sampled for metals, it cannot be determined what other, if any, toxic compounds have concentrations above detectable limits and to what extent these other toxic compounds would contribute towards toxicity in the area.

10.2 Toxicity Analysis

Arsenic and cadmium compounds are the prevalent cancer compounds at the BOMA site. Arsenic compounds contribute to 77% of the average cancer toxicity, although both arsenic and cadmium had the same number of detects. Manganese compounds contribute to 58% of the average noncancer toxicity, while the other three prevalent noncancer metals, nickel, arsenic, and cadmium compounds, contribute almost equally to the toxicity scores.

The arsenic compounds cancer risk was the highest among the toxic metal compounds at 3.12 in a million. For the compounds that may lead to adverse noncancer health effects, the average manganese compound toxicity was 0.114 (over 1 indicates a significant chance of a noncancer health effect). None of the metal compound concentrations were above their noncancer RfC weighting factors.

10.3 Meteorological and Concentration Averages at the Massachusetts Site

Only metal compounds were sampled at BOMA, and the average metal concentration is listed in Table 10-1. Table 10-4 is the summary of calculated Pearson Correlation coefficients for each of the site-specific prevalent compounds and selected meteorological parameters. Identification of the site-specific prevalent compounds is discussed earlier in this section. At the BOMA site, nearly all of the correlations were weak. The strongest correlation was computed between the *v*-component of the wind and nickel compounds (-0.45).

Figure 10-3 shows the composite back trajectory for the BOMA site for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring location on a sampling day. As shown in Figure 10-3, the back trajectories originate from many directions, although there is a large cluster originating from the southwest and another from the northwest of this site. Each circle around the site in Figure 10-3 represents 100 miles; 60% of the trajectories originated within 400 miles, and 96% within 800 miles from the BOMA site. The 24-hour airshed domain is extremely large. Back trajectories originated over 800 miles away.

10.4 Spatial Analysis

County-level vehicle registration was not available in Suffolk County, MA. Thus, state-level vehicle registration from the Energy Information Administration (EIA) was allocated to the county-level using the county-level population proportion. County-level population information was obtained from the U.S. Census Bureau, and is summarized in Table 10-5. Table 10-5 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimate of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 10-5 also contains traffic information, which represents the average daily traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily metals concentration at the BOMA site in Table 10-5.

10.5 RFG Analysis

Since VOCs were not sampled at BOMA, an RFG analysis could not be performed. However, the Boston MSA voluntarily participates in a federal RFG program (EPA, 1994) and uses gasoline additives to reduce VOC emissions. During the summer period, MTBE and TAME are used; in the winter, MBTE, ethanol and TAME are used.

A summer 2002 survey of three service stations in Boston showed the oxygen content of fuels as 2.09% by weight with a benzene content of 0.579% by volume. MTBE and TAME also averaged 10.36% and 1.29% by weight, respectively (EPA, 2003b). A winter 2002 survey of two service stations showed the oxygen content of the fuel as 2.05% by weight with a benzene content of 0.663% by volume. MTBE, TAME, and ethanol averaged 9.98%, 1.05%, and 0.18% by weight, respectively (EPA, 2003b).

10.6 NATTS Site Analysis

The Boston site is an EPA-designated NATTS site. A description of the NATTS program is provided in Section 3.6. A regulation analysis and an emission tracer analysis for each of the NATTS sites was conducted. Details on each type of analysis are also provided in Section 3.6.

10.6.1 Regulation Analysis

Table 3-10 summarizes the reduction of emissions that is expected from the promulgation of regulations applicable to facilities located within 10 miles of the monitoring location. This analysis includes only regulations implemented after 2002 (regulations implemented prior to 2003 would already be in effect at the time of the 2002 National Emissions Inventory and no further reduction would be expected). As indicated in Table 3-10, four future regulations would be applicable to the facilities located within 10 miles of BOMA. Since BOMA sampled only metal compounds, only metal reductions are considered. Based on analysis, the regulations shown are expected to achieve less than a 2% reduction in emissions of UATMP metal compounds. Individual pollutant reductions are less than 1% (antimony and nickel compounds) to up to 19% (selenium compounds). These reductions are expected to occur over the next several years as the last compliance date for the applicable regulations is January 2010.

10.6.2 Emission Tracer Analysis

No prevalent noncancer compounds exceeded their noncancer adverse health threshold at BOMA. Therefore, an emission tracer analysis was not conducted.

10.7 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

10.7.1 Site-Specific Trends Analyses

BOMA has been a participant in the UATMP since 2003. Therefore, a site-specific trends analysis could not be conducted.

10.7.2 MSA-Specific Trends Analyses

BOMA resides in the Boston-Cambridge-Quincy, MA-NH MSA. The Boston MSA has experienced a 47.4% increase in population and a 73.9% increase in vehicle miles traveled (VMT) from 1990 to 2003. Metal compound emissions have decreased between 54% and 84% between 1990 and 2002. Lead concentrations have decreased 89% primarily due to the phase-out of leaded gasoline. The 2004 cadmium and mercury concentrations, based on the UATMP site that represents this MSA (BOMA), have decreased significantly from the 2002-2003 time period, while lead concentrations have increased. Trends for these and other compounds of interest can be found in Table 3-13. This MSA voluntarily participates in the reformulated gasoline program.

Figure 10-1. Boston, Massachusetts (BOMA) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 10-2. Facilities Located Within 10 Miles of BOMA

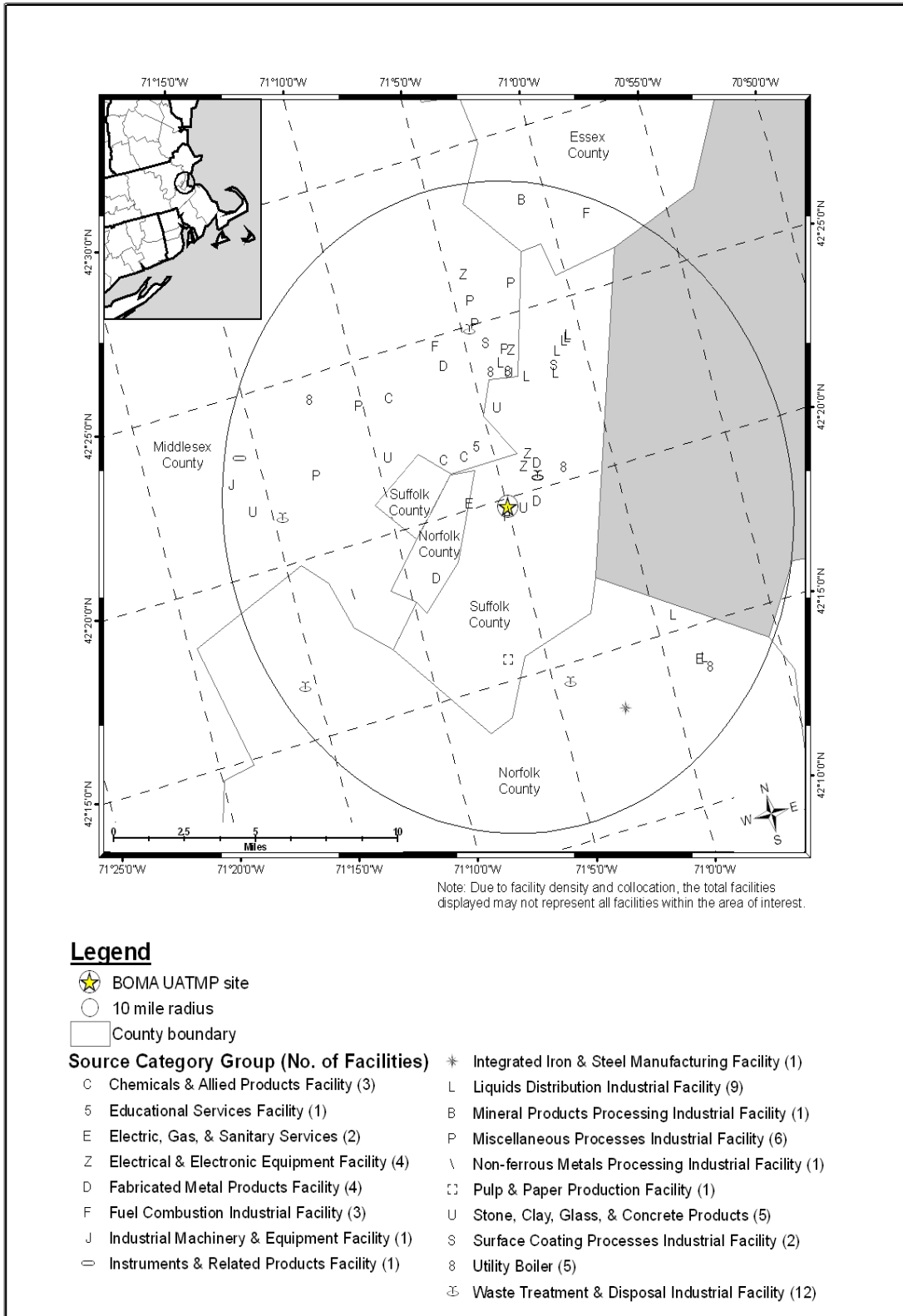


Figure 10-3. Composite Back Trajectory Map for BOMA

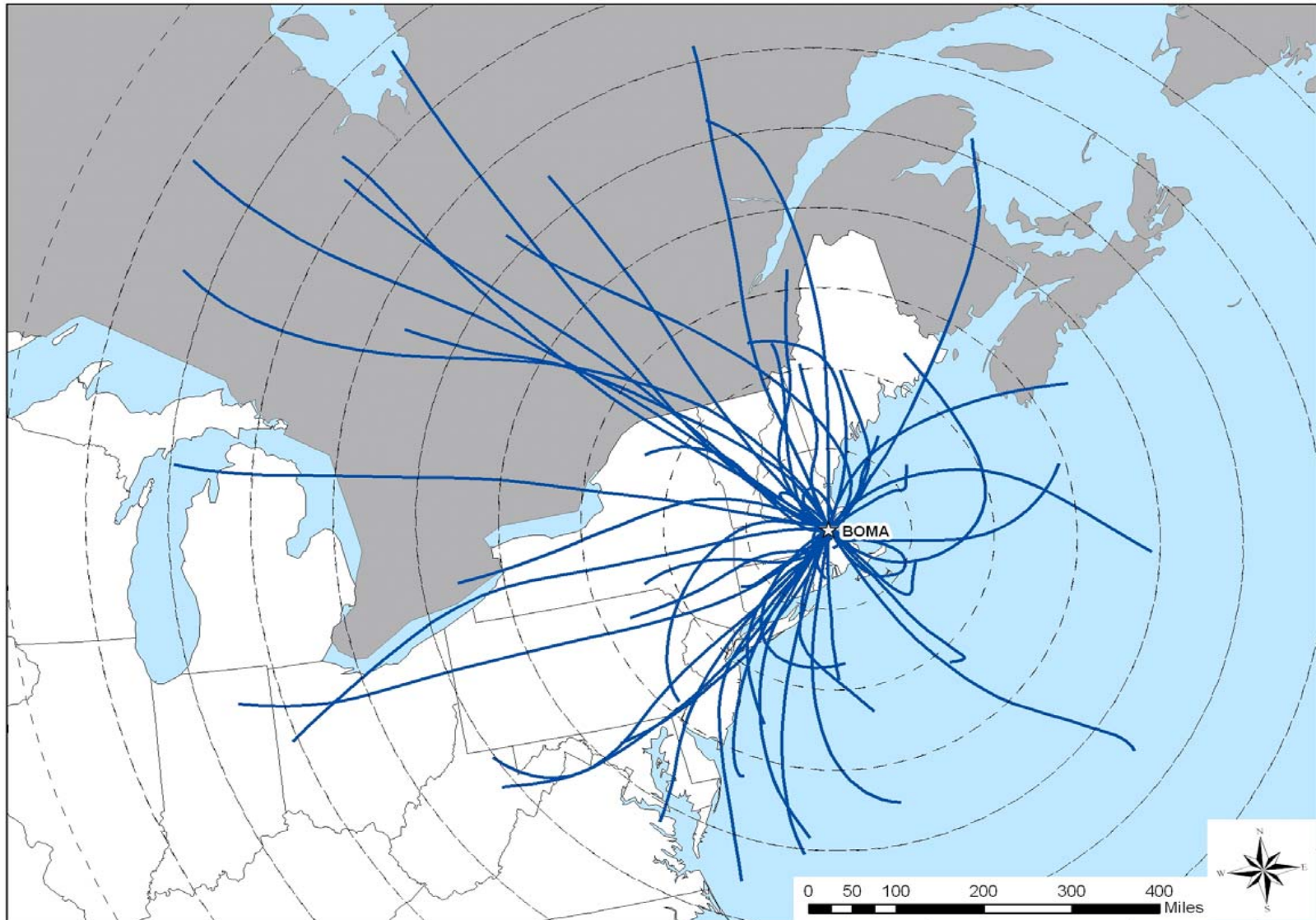


Table 10-1. Average Concentration and Meteorological Parameters for the BOMA Site in Massachusetts

Site Name	Type	Average Metals Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
BOMA	All 2004	/ / / / / / / /	57.49 (± 1.87)	50.49 (± 1.76)	38.26 (± 2.03)	45.21 (± 1.67)	65.58 (± 1.64)	1016.83 (± 0.81)	2.63 (± 0.65)	-0.40 (± 0.57)
	sample day	0.023 (± 0.009)	57.60 (± 4.89)	50.75 (± 4.75)	39.17 (± 5.82)	45.92 (± 4.63)	67.44 (± 4.75)	1015.68 (± 2.23)	2.55 (± 1.59)	-0.07 (± 1.63)

Table 10-2. Summary of the Toxic Cancer Compounds at the Boston, Massachusetts Monitoring Site - BOMA

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Arsenic Compounds	3.21 E-06	77.19	77.19	7.46 E-04	45	3.21
Cadmium Compounds	9.15 E-07	22.02	99.22	5.08 E-04	45	0.91
Beryllium Compounds	3.26 E-08	0.78	100.00	1.36 E-05	33	0.03

Table 10-3. Summary of the Toxic Noncancer Compounds at the Boston, Massachusetts Monitoring Site - BOMA

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Manganese Compounds	1.14 E-01	58.06	58.06	5.72 E-03	45	0
Cadmium Compounds	2.54 E-02	12.89	70.95	5.08 E-04	45	0
Arsenic Compounds	2.49 E-02	12.61	83.56	7.46 E-04	45	0
Nickel Compounds	2.33 E-02	11.84	95.40	4.67 E-03	45	0
Lead Compounds	4.28 E-03	2.17	97.57	6.42 E-03	45	0
Cobalt Compounds	3.96 E-03	2.01	99.58	3.96 E-04	45	0
Beryllium Compounds	6.79 E-04	0.34	99.92	1.36 E-05	33	0
Mercury Compounds	1.06 E-04	0.05	99.98	3.18 E-05	29	0
Selenium Compounds	4.33 E-05	0.02	100.00	8.65 E-04	44	0

Table 10-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Boston, Massachusetts Site (BOMA)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
Arsenic Compounds	0.21	0.22	0.18	0.20	0.03	0.24	-0.05	0.06
Cadmium Compounds	-0.13	-0.09	-0.11	-0.11	-0.12	0.27	-0.03	-0.16
Manganese Compounds	0.15	0.15	0.09	0.12	-0.07	0.21	-0.05	0.06
Nickel Compounds	-0.32	-0.28	-0.23	-0.25	0.03	-0.14	-0.23	-0.45

Table 10-5. Motor Vehicle Information vs. Daily Concentration for Massachusetts Monitoring Site

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily Metals Concentration ($\mu\text{g}/\text{m}^3$)
BOMA	680,705	579,762	0.85	1,589,367	1,350,962	27,287	0.023 (± 0.009)

11.0 Sites in Michigan

This section presents meteorological, concentration, and spatial trends for the five UATMP sites in Michigan. Three sites, APMI, DEMI, and YFMI, are located in the Detroit area, while the HOMI site is in north-central Michigan near Houghton Lake, and the ITCMI site is in Sault Saint Marie on the Upper Peninsula. Figures 11-1 through 11-5 are topographical maps showing the monitoring sites in their urban and rural locations. Figures 11-6 through 11-8 identify facilities within 10 miles of the sites that reported to the 2002 NEI. The Detroit sites are within a few miles of each other. Many facilities surround these sites, mostly fuel combustion or waste treatment facilities. HOMI has few industrial facilities nearby, most of which are involved in waste treatment and disposal. All of the industrial facilities within 10 miles of ITCMI are involved in waste treatment and disposal.

Hourly meteorological data were retrieved for all of 2004 at four weather stations near the sites for calculating correlations of meteorological data with ambient air concentration measurements. The weather stations are Detroit-Metropolitan Airport, Detroit City Airport, Houghton Lake/Roscommon Airport, and Sault Ste. Marie International Airport (WBAN 94847, 14822, 94814, and 14847, respectively).

Table 11-1 highlights the average UATMP concentration at each of the sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), wind information (average *u*- and *v*-components of the wind), and pressure (average sea level pressure) for the entire year and on days samples were taken. The Detroit area is located in the Great Lakes region, a place for active weather, as several storm tracks run across the region. Hence, winters can be cold and wet, while summers are generally mild. The urbanization of the area along with Lake St. Clair to the east are two major influences on the city's weather. The lake tends to keep Detroit warmer in the winter and cooler in the summer than more inland areas. The urban heat island tends to keep the city warmer than outlying areas. Winds are often breezy and generally flow from the southwest on average. Houghton Lake is a small lake in north-central Michigan and does not have quite the moderating effect of Lake St. Clair. The area is rural, without an urban heat island effect, which

allows a greater temperature fluctuation than in the Detroit area. Sault Saint Marie is located on the northeast edge of Michigan's Upper Peninsula. While this area also experiences an active weather pattern, its climate is somewhat tempered by the surrounding waters of Lakes Superior and Huron, as the city resides on the channel between the two lakes. This location experiences ample precipitation, especially during a lake-effect snow event. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987), and at the following Web sites: <http://meetings.sixcontinentshotels.com/destinations/detroit/weather.html> and http://areas.wildernet.com/pages/area.cfm?areaID=091004&CU_ID=1.

11.1 Prevalent Compounds at the Michigan Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 11-2 summarizes the cancer weighting scores, while Table 11-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site. It is important to note that not all of the Michigan sites sampled for the same types of compounds. APMI, HOMI, and DEMI sampled carbonyl compounds and VOC; ITCMI and YFMI sampled for VOC and SVOC. Therefore, the site-specific prevalent compounds are going to vary somewhat from site to site.

As shown in Table 11-2, all of the prevalent cancer compounds for these sites reflect the nationwide prevalent cancer compounds list, as listed in Section 3 of this report. For the noncancer compounds summarized in Table 11-3, most of the prevalent noncancer compounds reflect the nationwide prevalent noncancer compounds list. However, many of the other detected compounds do not.

Prevalent toxic compounds not detected at any of the Michigan sites were: 1,2-dichloropropane; chloroprene; and ethyl acrylate.

11.2 Toxicity Analysis

Benzene, 1,3-butadiene, and carbon tetrachloride were the only prevalent cancer compounds at all five sites. Tetrachloroethylene contributed to over 70% of the cancer toxicity score at APMI and HOMI, while acrylonitrile contributed to over 80% of the cancer toxicity score at DEMI and ITCMI. Benzene was detected most frequently at four of the five sites. The acrylonitrile cancer risk at DEMI was the highest among the five sites at 416.64 in a million, while at ITCMI, the acrylonitrile cancer risk was 233.16 in a million. The tetrachloroethylene cancer risk at APMI was 196.82 in a million, and ranged from 4.64 to 39.22 in a million at the other sites.

For the compounds that may lead to adverse noncancer health effects, an average toxicity over 1 indicates a significant chance of a noncancer health effect. At DEMI, acrylonitrile and formaldehyde's average toxicity was greater than 1 (3.06 and 1.29, respectively); at HOMI, acetonitrile's average toxicity was greater than 1 (1.54); and at ITCMI, acrylonitrile's average toxicity was greater than 1 (1.71). Of the 10 adverse health concentrations measured at the Michigan sites, two were acrylonitrile, two were acetonitrile, two were actaldehyde, and four were formaldehyde.

11.3 Meteorological and Concentration Averages at the Michigan Sites

Carbonyl compounds and/or VOCs were measured at four of the five sites as indicated in Tables 3-3 and 3-4. HOMI had the highest UATMP concentration ($76.75 \pm 58.31 \mu\text{g}/\text{m}^3$) of the Michigan sites, while ITCMI (19.38 ± 4.75) had the lowest. SVOC were sampled at the ITCMI and YFMI sites. The average SVOC concentration at ITCMI was $27.80 \text{ ng}/\text{m}^3$ and $52.83 \text{ ng}/\text{m}^3$ at YFMI. Information on SVOC is given in Table 11-4.

Table 11-5 summarizes calculated Pearson correlation coefficients for each of the site-specific prevalent compounds and selected meteorological parameters by site. Identification of the site-specific prevalent compounds is discussed in Section 3. For compounds detected fewer than four times, Pearson correlations were not computed. The HOMI site only sampled for these days in January, therefore no Pearson correlations were computed.

At each of the Detroit sites, 1,3-butadiene had negative correlations with the temperature and moisture parameters (except relative humidity), while the remaining compounds (with few exceptions) had positive correlations with these parameters. This trend is especially noticeable with carbon tetrachloride, where the correlations ranged from moderately strong to very strong. 1,3-butadiene and benzene each have strong positive correlations with relative humidity at YFMI, and although considerably weaker, the positive correlations continued DEMI and APMI. Benzene also has a strong positive correlation with the *v*-component of the wind at YFMI, and, although much weaker, this trend continues at APMI and DEMI.

All of the correlations at ITCMI were weak. The strongest correlations occurred between carbon tetrachloride and both the dewpoint and wet bulb temperatures (both 0.24). Pearson correlations could not be computed for 1,3-butadiene, acrylonitrile, or bromomethane due to the low number of detects (fewer than 4).

Figures 11-9 through 11-13 show the composite back trajectories for the Michigan sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. For the Detroit sites (APMI, DEMI, and YFMI), only DEMI sampled throughout the entire year. As shown in Figures 11-9, 11-10, and 11-13, the DEMI back trajectories originate primarily from the southwest, northwest, and north. This trend is apparent with both the APMI and YFMI sites as well, although there are fewer trajectories. Each circle around the sites in Figure 11-9 through 11-10 and 11-13 represents 100 miles; between 30% (APMI) and 76% (DEMI) of the trajectories originated within 300 miles, and between 80% (APMI) and 90% (DEMI) within 600 miles from the Detroit sites. The 24-hour airshed domain is large. Back trajectories originated over 700 miles away.

Figure 11-11 shows few back trajectories as HOMI sampled during only January and February 2004. There are too few trajectories to determine where back trajectories predominantly originated from. Each circle around the site in Figure 11-11 represents 100 miles; 67% of the trajectories originated within 100 miles, and 100% within 900 miles from the HOMI

site (HOMI had three sample days in 2004). The 24-hour airshed domain for HOMI appears extremely large. One back trajectory originated over 800 miles away.

Figure 11-12 shows that back trajectories originated predominantly from the southwest, northwest, and north of ITCMI. There is an apparent lack of trajectories from the east. Each circle around the site in Figure 11-12 represents 100 miles; 62% of the trajectories originated within 400 miles, and 92% within 700 miles from the ITCMI site. The 24-hour airshed domain for ITCMI is also large. Back trajectories originated over 700 miles away.

11.4 Spatial Analysis

County-level vehicle registration and population information for Chippewa County, Missaukee County, and Wayne County, Michigan, were obtained from the Michigan Secretary of State and the U.S. Census Bureau, and are summarized in Table 11-6. Table 11-6 also contains a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 11-6 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the sites listed in Table 11-6. The Dearborn site (DEMI) has the highest estimated vehicle ownership within a 10-mile radius, although the ITCMI site has the highest daily traffic volume passing a Michigan monitor.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. APMI and DEMI's ratios most resemble those of the roadside study, although both of their benzene-ethylbenzene and xylenes-ethylbenzene ratios are much closer together, and their toluene-ethylbenzene ratios are higher. ITCMI's benzene-ethylbenzene and toluene-ethylbenzene ratios are nearly equal. YFMI's benzene-ethylbenzene ratio is the highest and xylene-ethylbenzene ratio is the lowest, unlike the roadside study. Ethylbenzene was not detected at HOMI and is therefore not included in the BTEX analysis.

11.5 NATTS Site Analysis

One of the Detroit sites, DEMI, is an EPA-designated NATTS site. A description of the NATTS program provided in Section 3.6. A regulation analysis and an emission tracer analysis for each of the NATTS sites was conducted. Details on each type of analysis are also provided in Section 3.6.

11.5.1 Regulation Analysis

Table 3-10 summarizes the reduction of emissions that is expected from the promulgation of regulations applicable to facilities located within 10 miles of the monitoring site. This analysis includes only regulations implemented after 2002 (regulations implemented prior to 2003 would already be in effect at the time of the 2002 National Emissions Inventory and no further reduction would be expected). As indicated in Table 3-10, eleven future regulations would be applicable to the facilities located within 10 miles of DEMI. Based on analysis, the regulations shown are expected to achieve reductions in emissions of the following UATMP pollutants: acetaldehyde (18%), formaldehyde (68%), benzene (1%), 1,3-butadiene (7%), benzene (16%), ethylbenzene (1%), methyl ethyl ketone (4%), methyl isobutyl ketone (3%), styrene (27%), toluene (1%), and total xylenes (1%). Carbonyl compounds are expected to see the greatest reduction of the two compound types shown in Table 3-10. These reductions are expected to occur over the next few years as the last compliance date for the applicable regulations is June 2007.

11.5.2 Emission Tracer Analysis

The highest acrylonitrile, acetaldehyde, and formaldehyde noncancer toxicity scores were further examined. Figures 11-14 through 11-15 are the pollution roses for acetaldehyde and formaldehyde at DEMI. The highest concentration of acetaldehyde and formaldehyde occurred on September 6, 2004 and winds on that day point to possible emission sources south of the monitor. Figures 11-16 and 11-17 are back trajectory maps for this date, which shows air originating to the south of the monitor. Acetaldehyde and formaldehyde stationary emission sources near this site and in the general direction of the back trajectory are also plotted in Figures 11-16 and 11-17. According to the 2002 NEI, several acetaldehyde and many

formaldehyde sources are located to the south of the monitoring site. Air sampled at DEMI on this date probably passed over these sources earlier in the day.

Figure 11-18 is the pollution rose for acrylonitrile at DEMI. The highest concentration of acrylonitrile occurred on October 18, 2004 and winds on that day point to possible emission sources east of the monitor. Figure 11-19 is a back trajectory map for this date, which shows air originating to the east of the monitor. Acrylonitrile stationary emission sources near this site and in the general direction of the back trajectory are also plotted in Figure 11-19. According to the 2002 NEI, there is one acrylonitrile source located to the east of the monitoring site. This site is located within three miles of DEMI. Air sampled at DEMI on this date likely passed nearby this source earlier in the day.

11.6 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

11.6.1 Site-Specific Trends Analyses

APMI and DEMI have been participants in the UATMP since 2001; HOMI since 2002; ITCMI since 2003; and YFMI since 2001, although it did not participate in 2003. Different combinations of pollutants have been sampled for at each site. For example, APMI sampled for VOC and carbonyl compounds in 2001, 2002, and 2004, but only VOC in 2003. It is important to keep this in mind when referring to the figures and reading the text of the site-specific trends analysis.

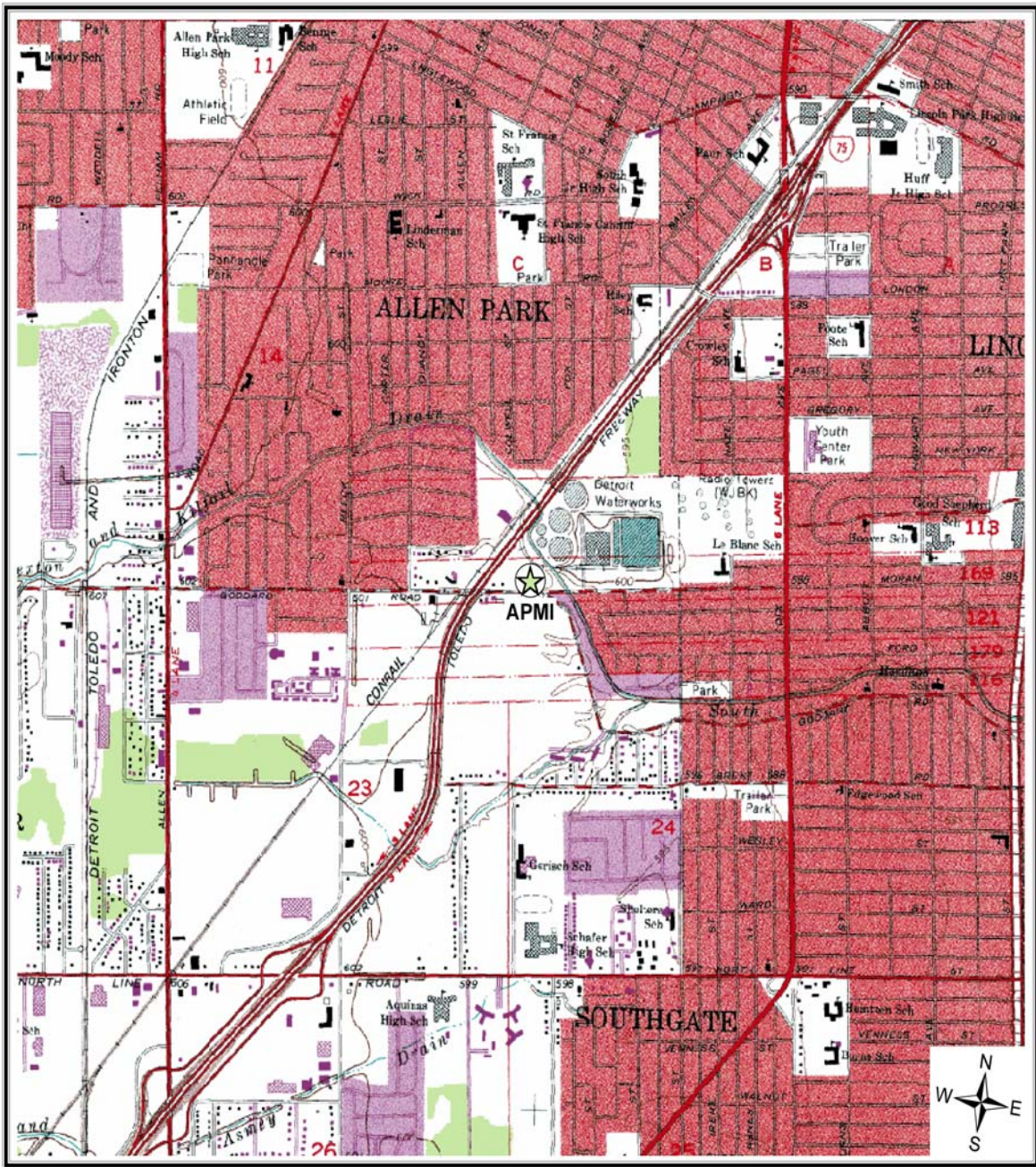
At APMI, all three pollutants appeared to have increased in 2004 from 2002 and 2003 levels (although no 2003 formaldehyde level was available). This is true at DEMI as well, especially for formaldehyde. At HOMI, formaldehyde concentrations decreased from 2003 while

benzene slightly increased (1,3-butadiene was not detected any of the years). However, HOMI only sampled for a month in 2004. Benzene levels for 2004 at YFMI are down significantly from 2001 and 2002, while 1,3-butadiene concentrations increased somewhat from 2002. A site-specific trends analysis was not conducted for ITCMI. Please refer to Figures 3-27, 3-33, 3-38, and 3-50.

11.6.2 MSA-Specific Trends Analyses

Three Michigan sites reside in the Detroit-Warren-Livonia, MI MSA (APMI, DEMI, and YFMI). The Detroit, MI MSA has experienced a 5.5% increase in population and a 28.9% increase in vehicle miles traveled (VMT) from 1990 to 2003. VOC and carbonyl compound emissions have decreased between 1990 and 2002. The 2004 Detroit MSA VOC and carbonyl compound concentrations, as represented by the UATMP sites APMI, DEMI, and YFMI, have either decreased significantly from the 2002-2003 time period or stayed about the same. Trends for these and other compounds of interest can be found in Table 3-13. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

Figure 11-1. Detroit, Michigan Site 1 (APMI) Monitoring Site



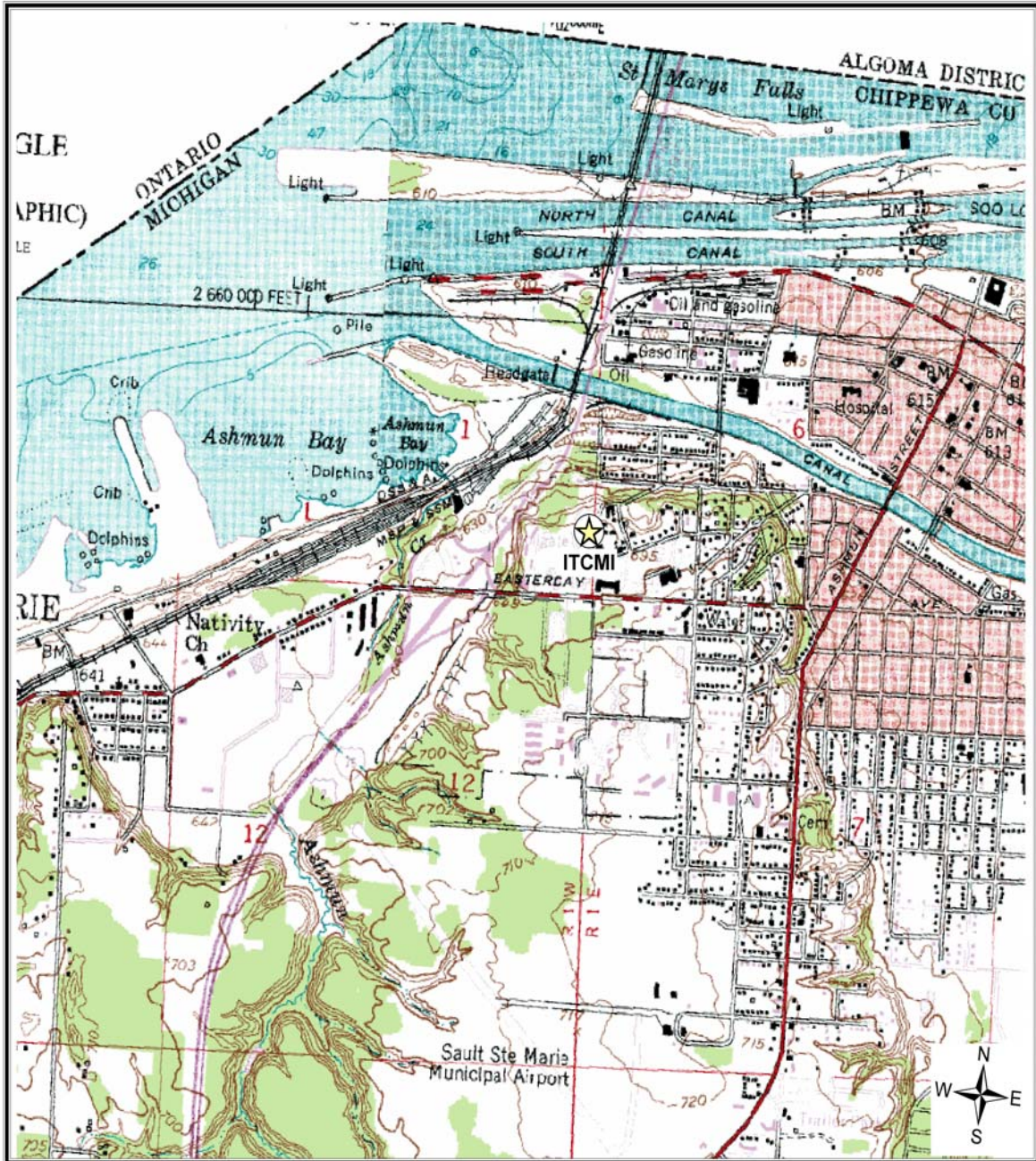
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-3. Houghton Lake, Michigan (HOMI) Monitoring Site



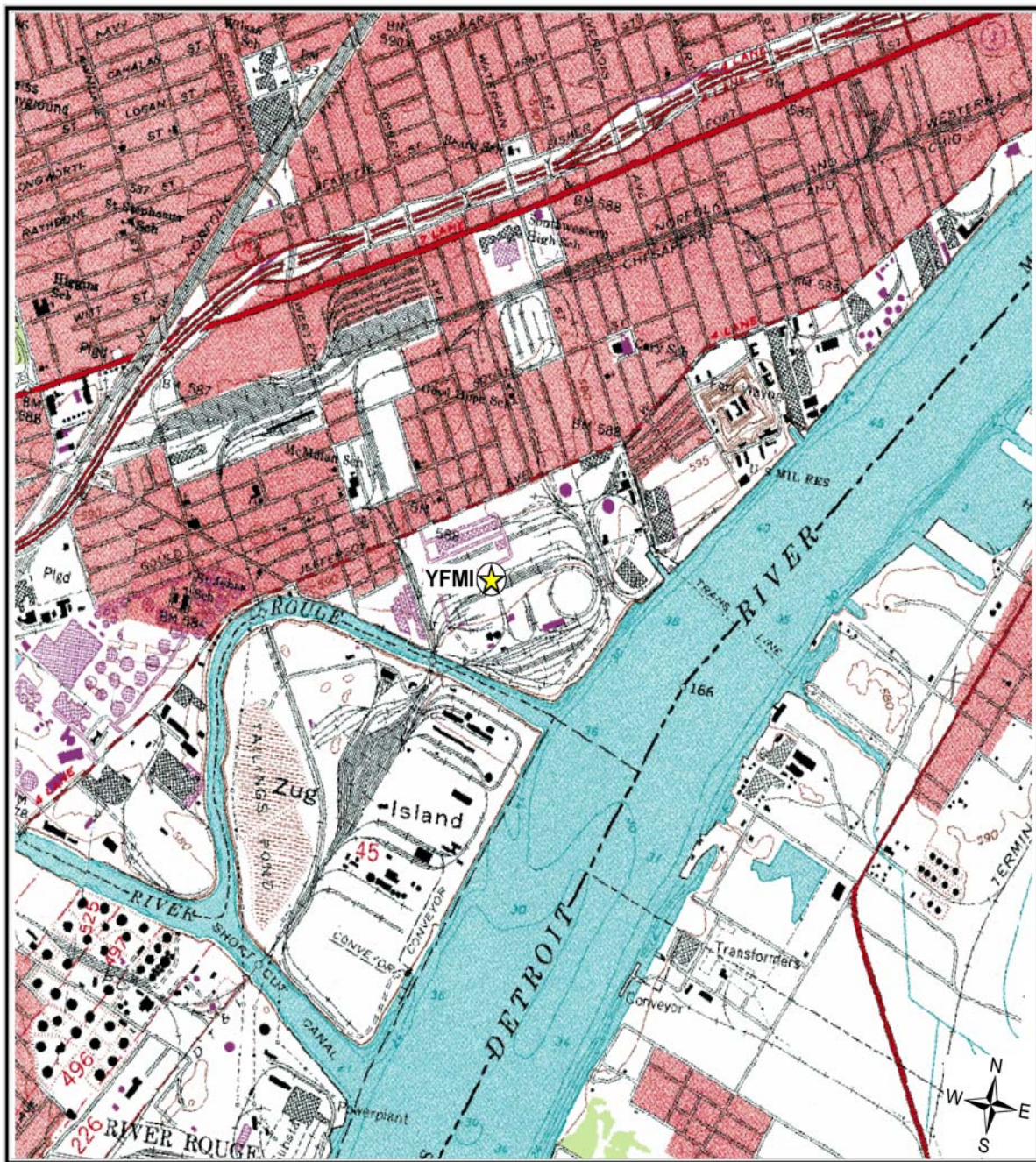
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 11-4. Sault Ste. Marie, Michigan (ITCMI) Monitoring Site



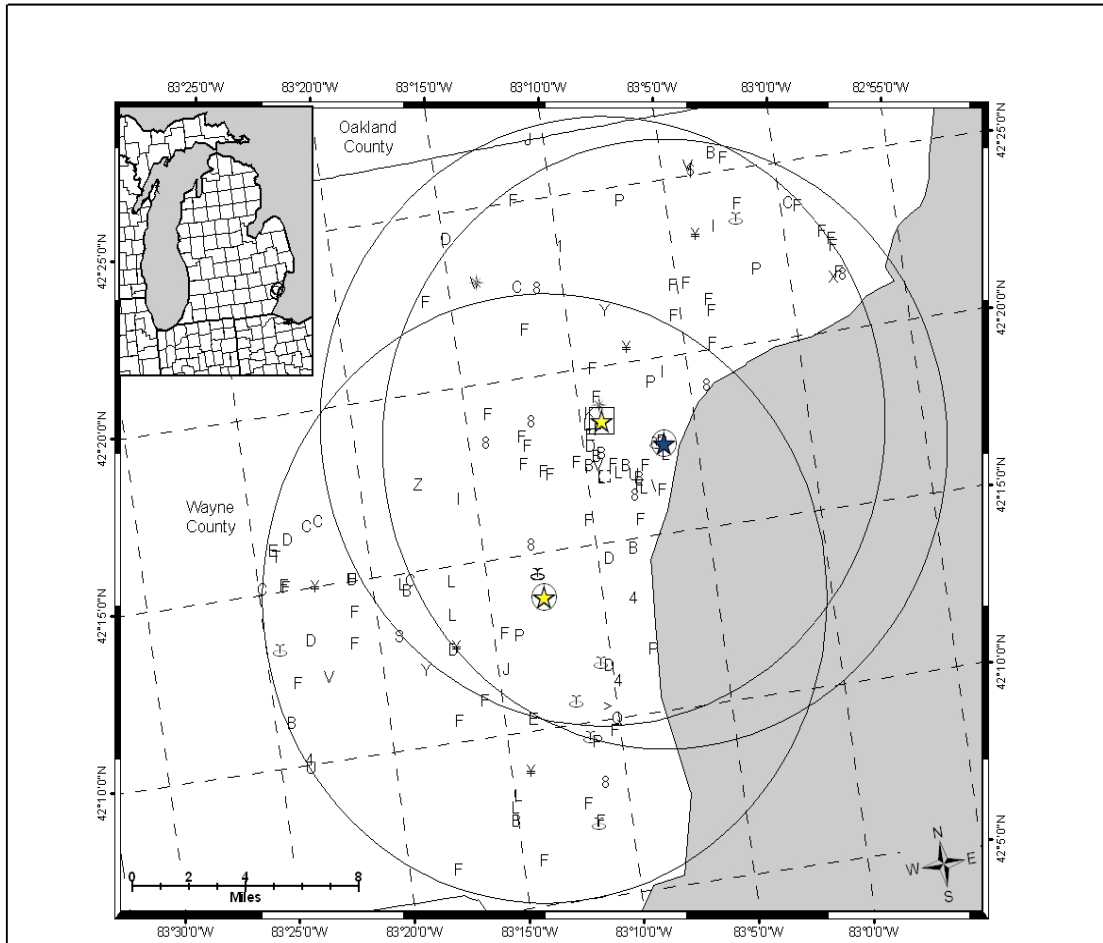
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-5. Yellow Freight, Detroit, Michigan (YFMI) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 11-6. Facilities Located Within 10 Miles of APMI, DEMI, and YFMI



Note: Due to facility density and collocation, the total facilities displayed may not represent all facilities within the area of interest.

Legend

- APMI UATMP site
- DEMI UATMP site
- YFMI UATMP site
- 10 mile radius
- County boundary

Source Category Group (No. of Facilities)

- ⌘ Automotive Repair, Services, & Parking (5)
- C Chemicals & Allied Products Facility (6)
- E Electric, Gas, & Sanitary Services (3)
- Z Electrical & Electronic Equipment Facility (1)
- D Fabricated Metal Products Facility (7)
- K Ferrous Metals Processing Industrial Facility (1)
- F Fuel Combustion Industrial Facility (56)
- I Incineration Industrial Facility (3)
- J Industrial Machinery & Equipment Facility (2)
- * Integrated Iron & Steel Manufacturing Facility (2)
- L Liquids Distribution Industrial Facility (10)
- B Mineral Products Processing Industrial Facility (10)
- X Miscellaneous Manufacturing Industries (1)
- P Miscellaneous Processes Industrial Facility (7)
- \ Non-ferrous Metals Processing Industrial Facility (2)
- 1 Petroleum & Coal Products (1)
- > Pharmaceutical Production Processes Industrial Facility (1)
- V Polymers & Resins Production Industrial Facility (3)
- Q Primary Metal Industries Facility (1)
- 4 Production of Organic Chemicals Industrial Facility (3)
- ⌘ Pulp & Paper Production Facility (1)
- Y Rubber & Miscellaneous Plastic Products Facility (2)
- U Stone, Clay, Glass, & Concrete Products (3)
- S Surface Coating Processes Industrial Facility (1)
- T Transportation Equipment (1)
- 8 Utility Boilers (8)
- ⌘ Waste Treatment & Disposal Industrial Facility (17)
- ⌘ Wholesale Trade - Durable Goods (1)

Figure 11-7. Facilities Located Within 10 Miles of HOMI

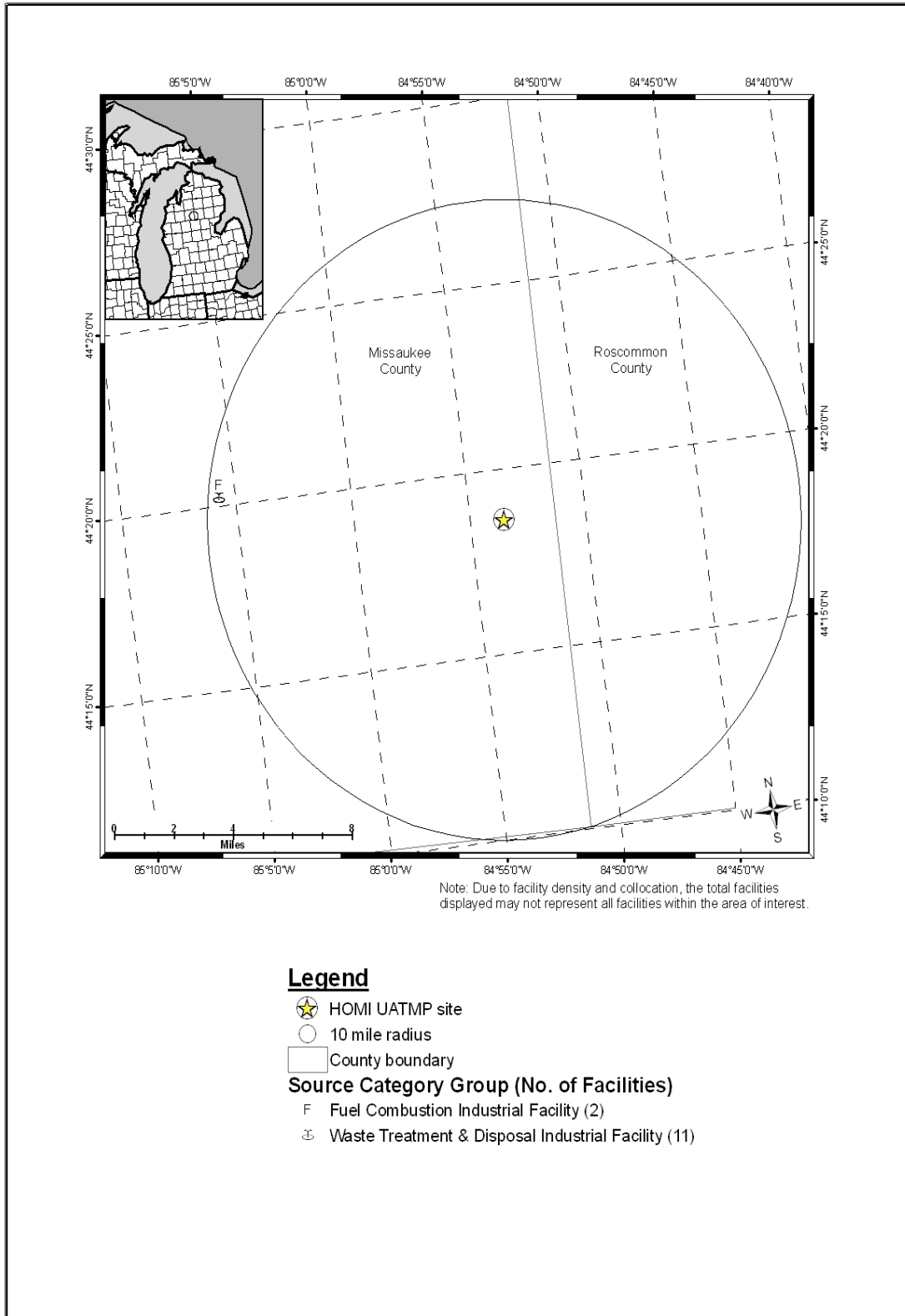


Figure 11-8. Facilities Located Within 10 Miles of ITCMI

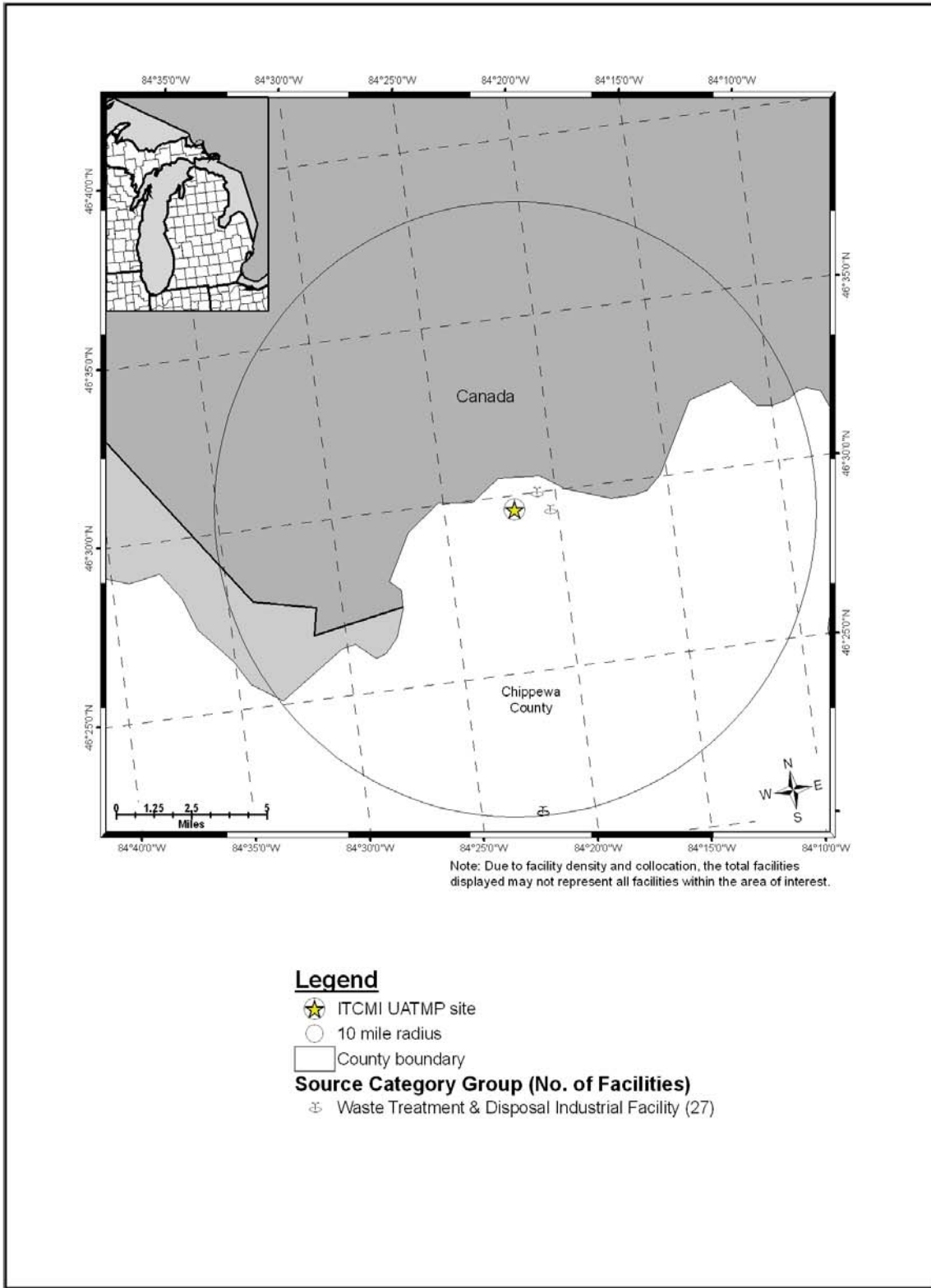


Figure 11-9. Composite Back Trajectory Map for APMI

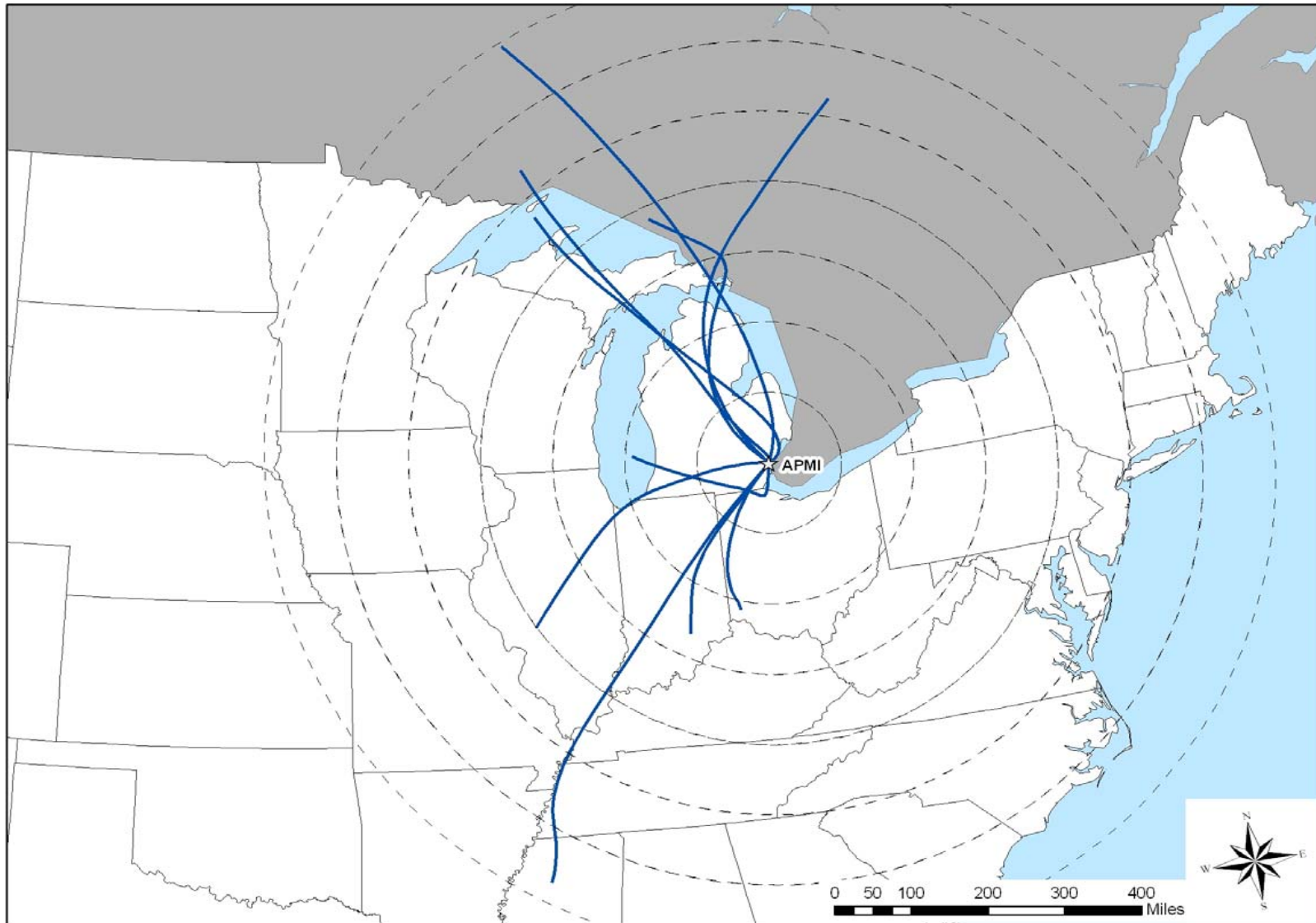


Figure 11-10. Composite Back Trajectory Map for DEMI

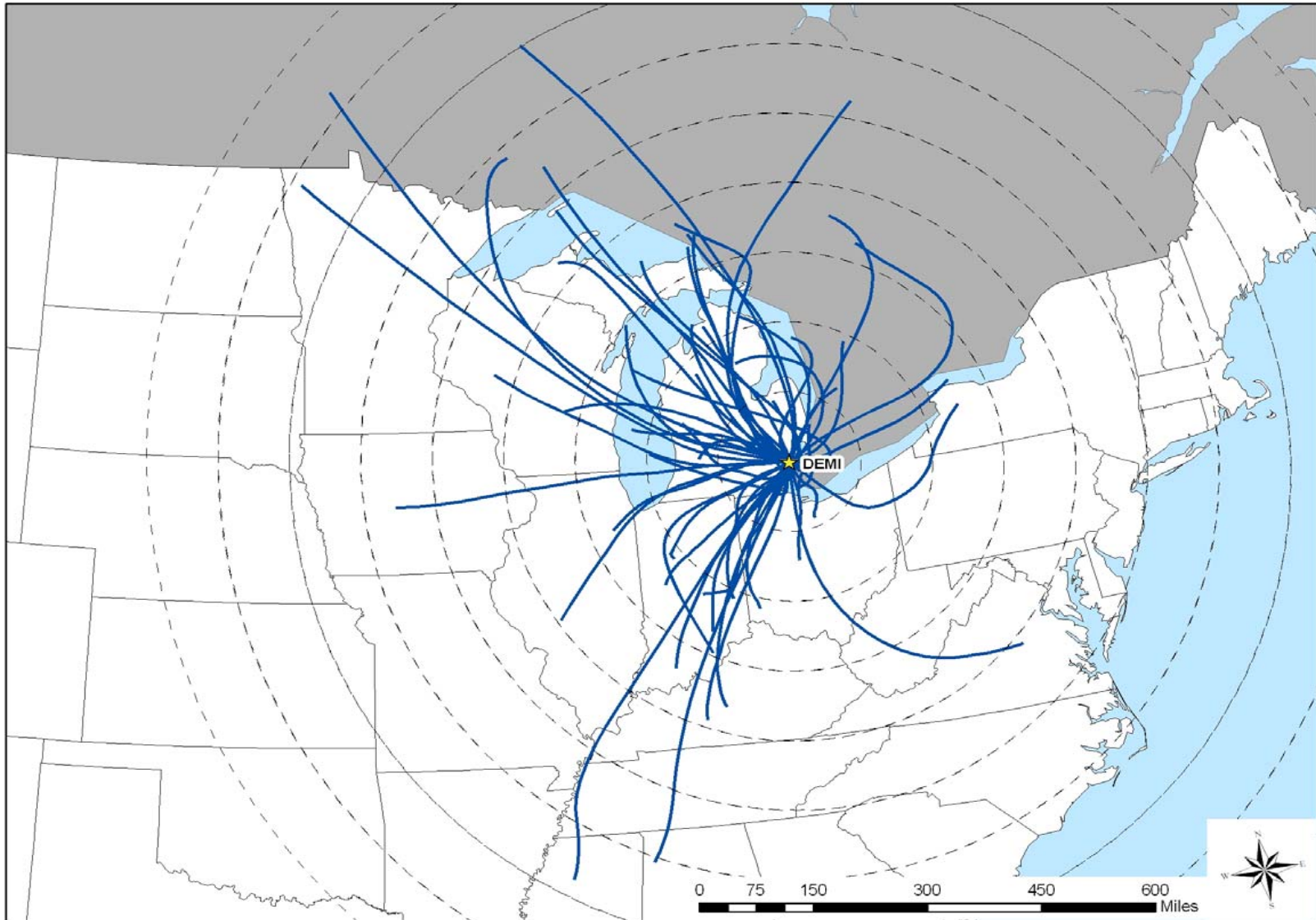
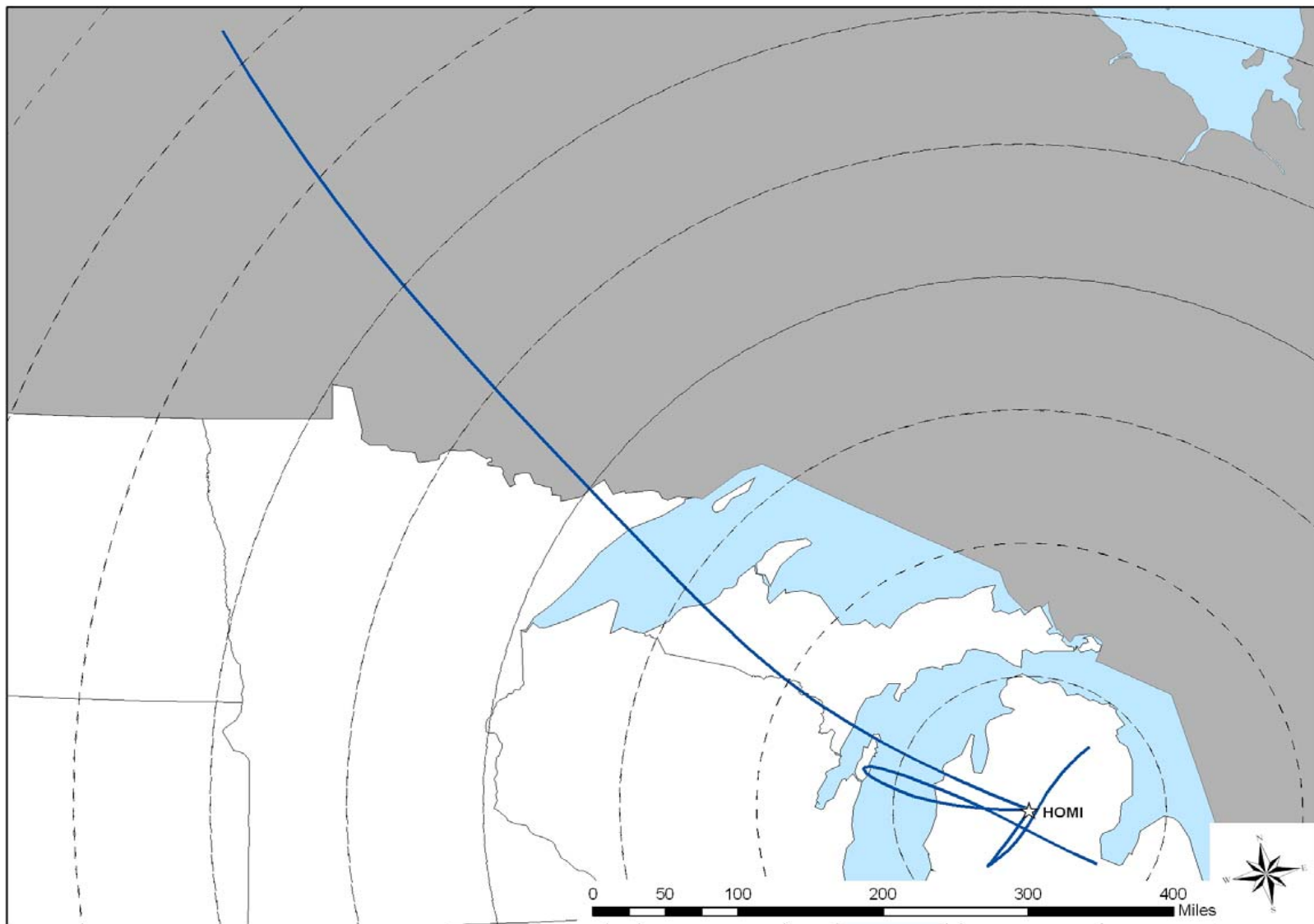


Figure 11-11. Composite Back Trajectory Map for HOMI



11-19

Figure 11-12. Composite Back Trajectory Map for ITCMI

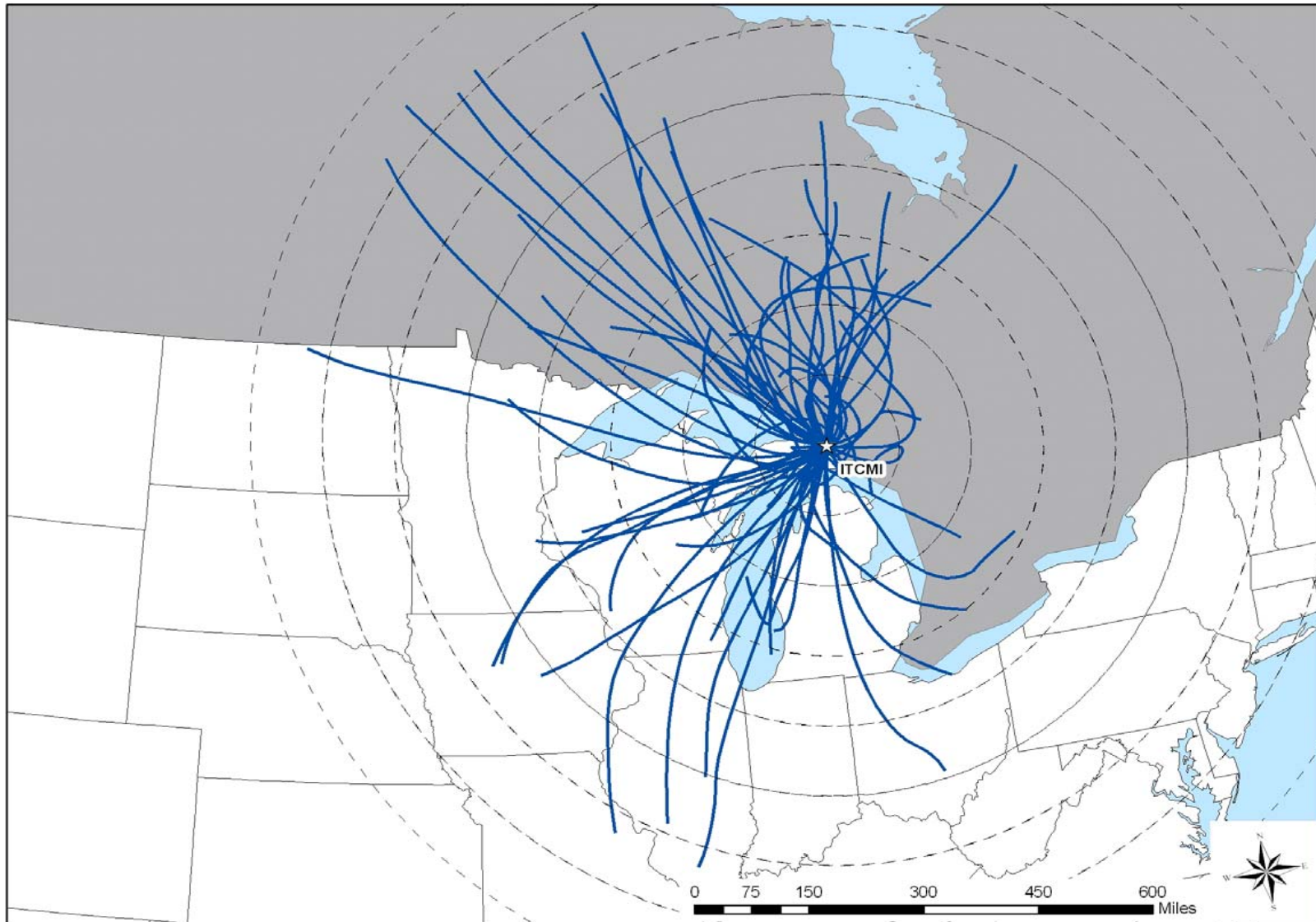


Figure 11-13. Composite Back Trajectory Map for YFMI

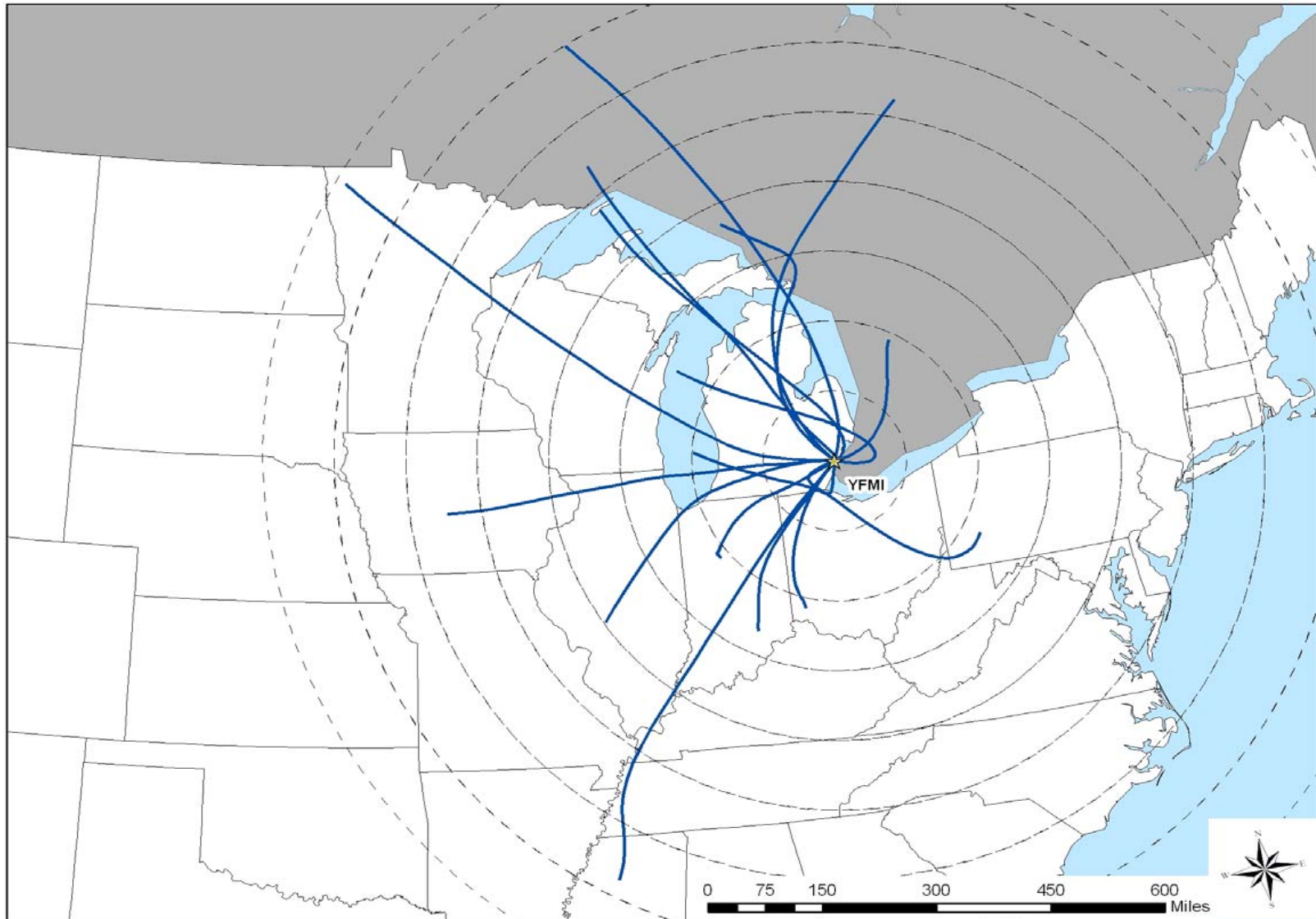


Figure 11-14. Acetaldehyde Pollution Rose for DEMI

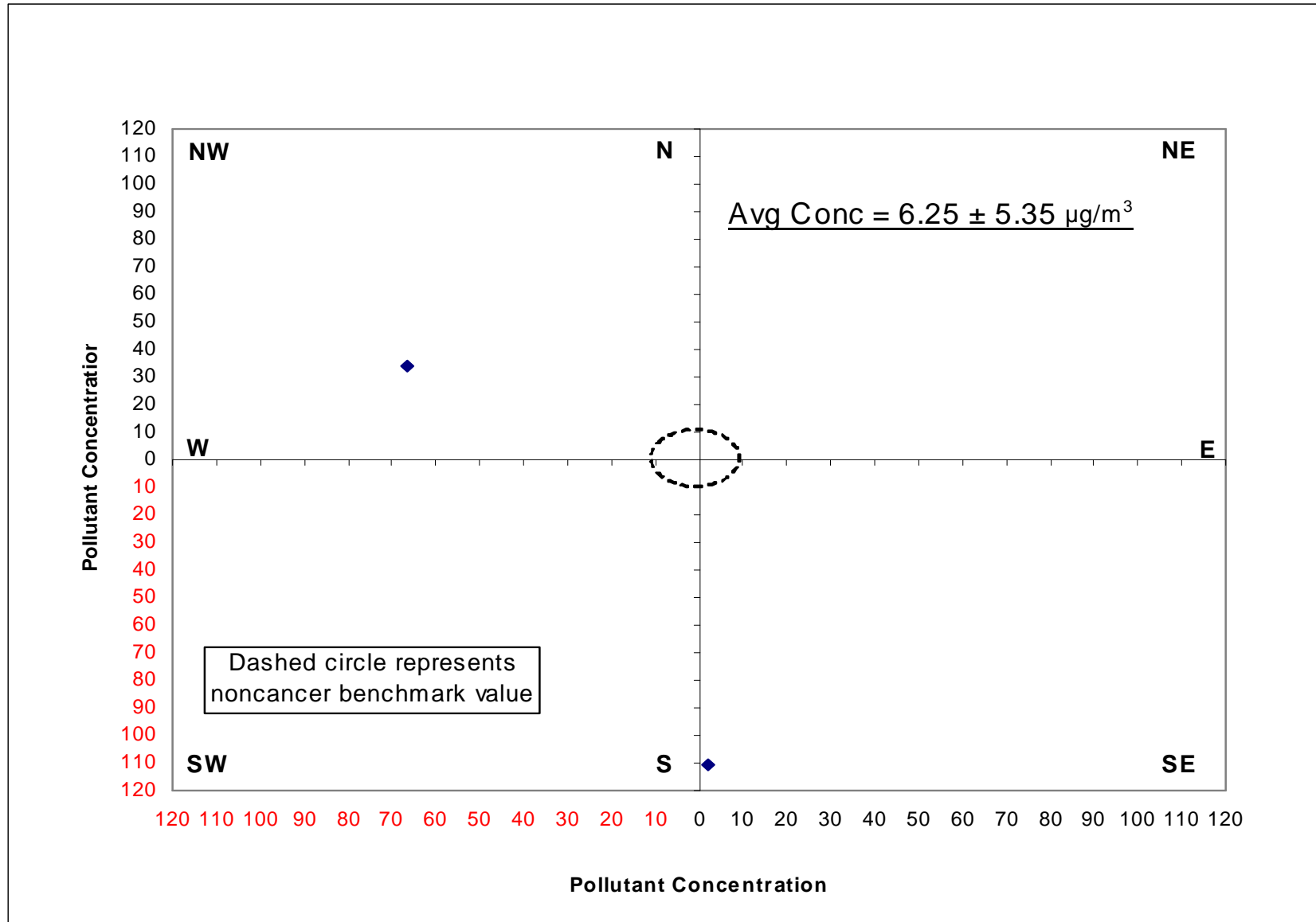


Figure 11-15. Formaldehyde Pollution Rose for DEMI

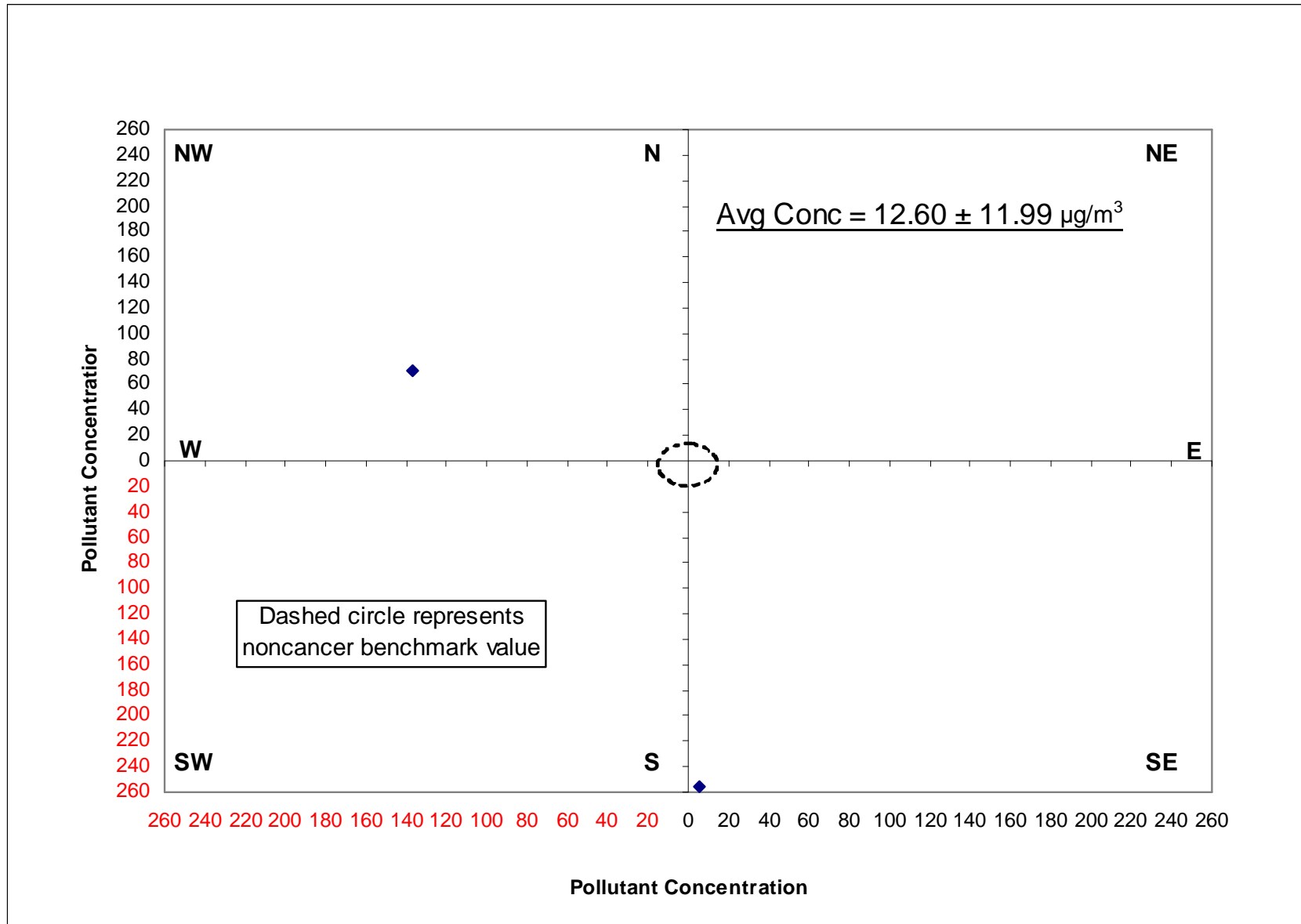


Figure 11-16. Acetaldehyde Sources Along the September 6, 2004 Back Trajectory at DEMI

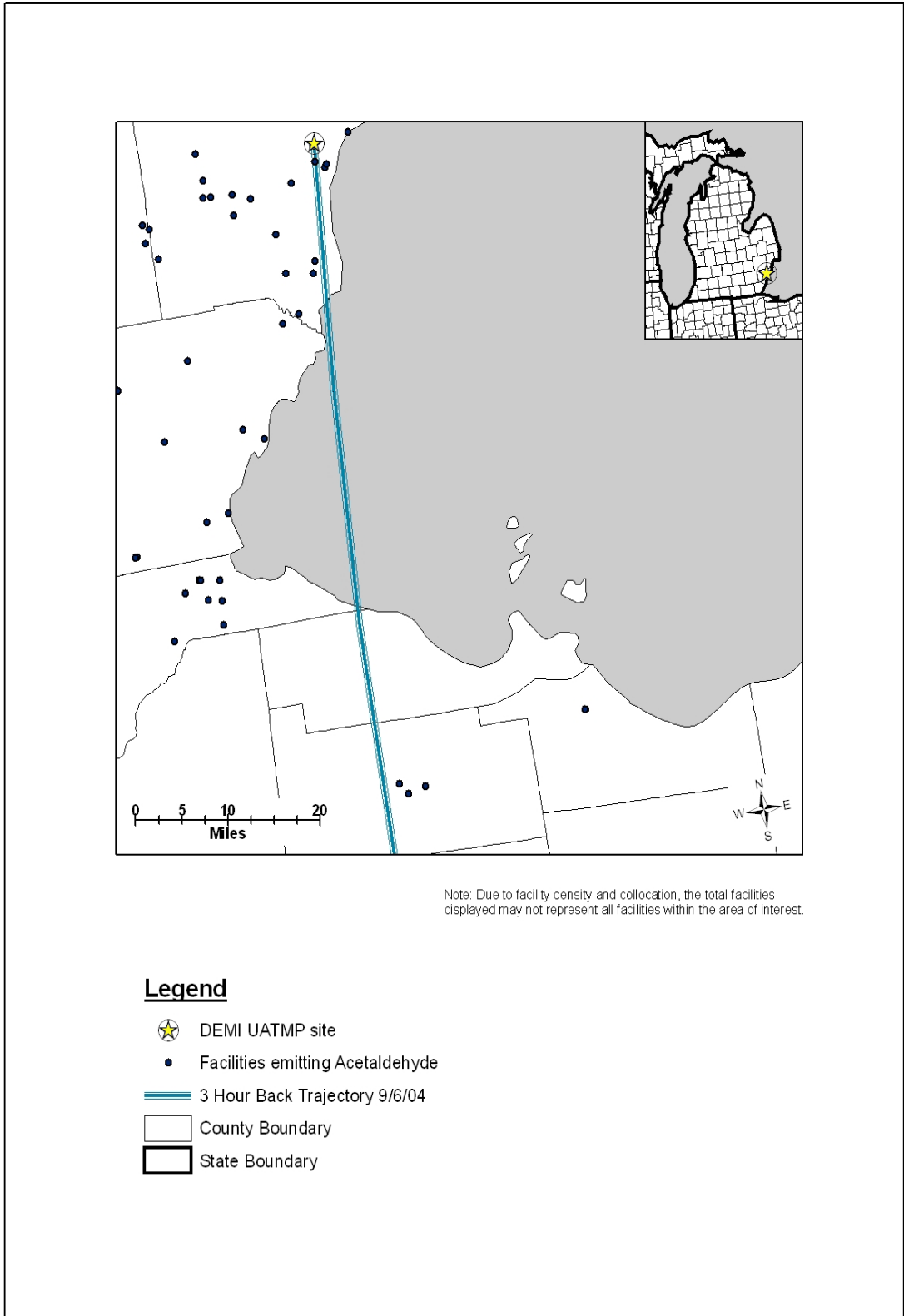
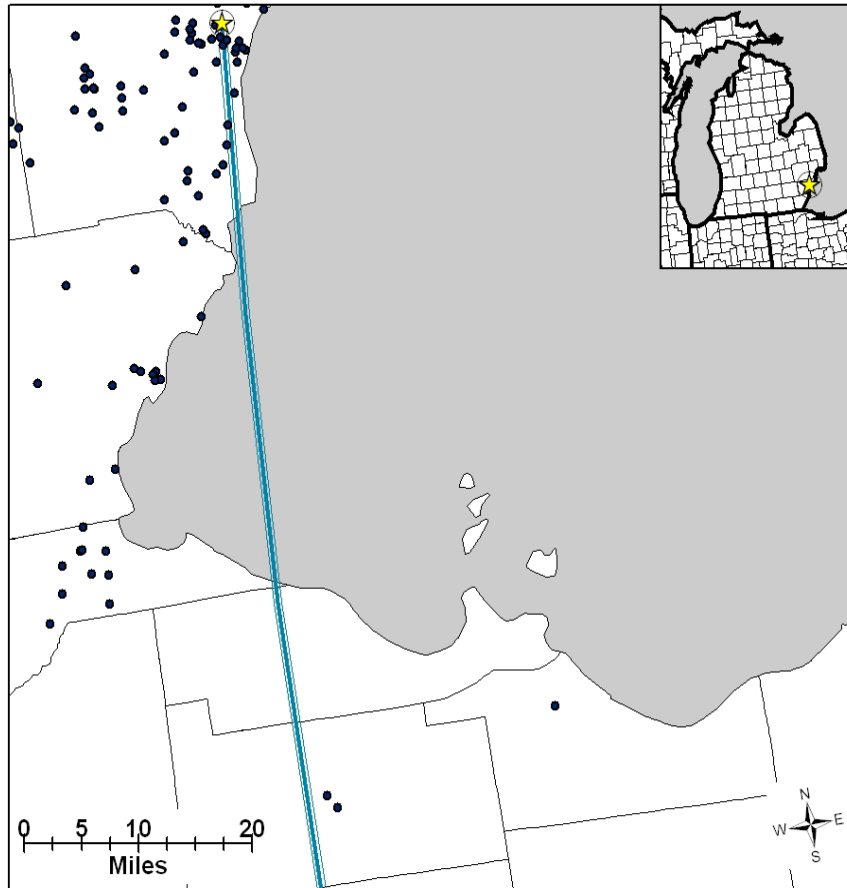


Figure 11-17. Formaldehyde Sources Along the September 6, 2004 Back Trajectory at DEMI



Note: Due to facility density and collocation, the total facilities displayed may not represent all facilities within the area of interest.

Legend






-  DEMI UATMP site
-  Facilities emitting Formaldehyde
-  3 Hour Back Trajectory 9/6/04
-  County Boundary
-  State Boundary

Figure 11-18. Acrylonitrile Pollution Rose for DEMI

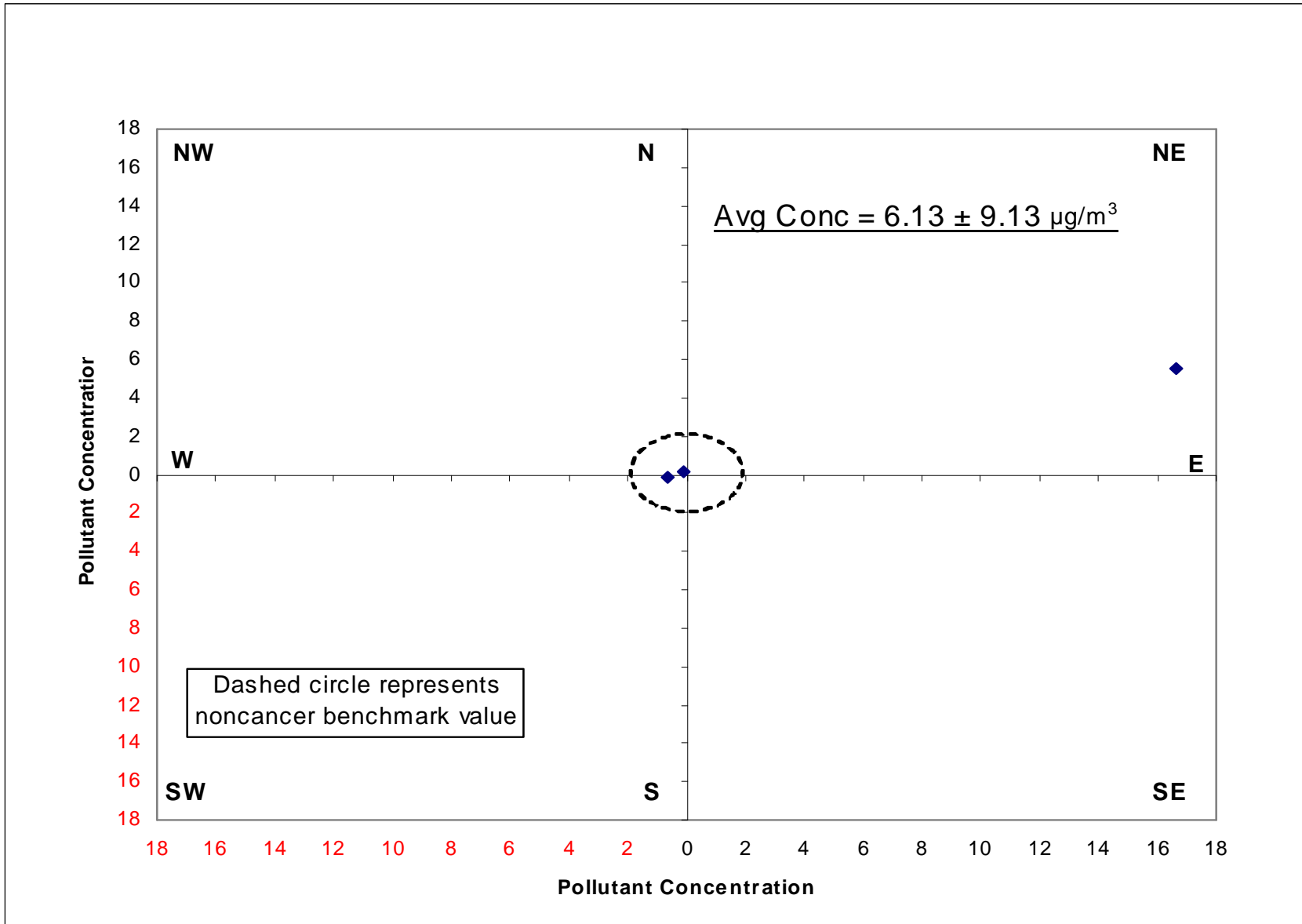


Figure 11-19. Acrylonitrile Sources Along the October 18, 2004 Back Trajectory at DEMI

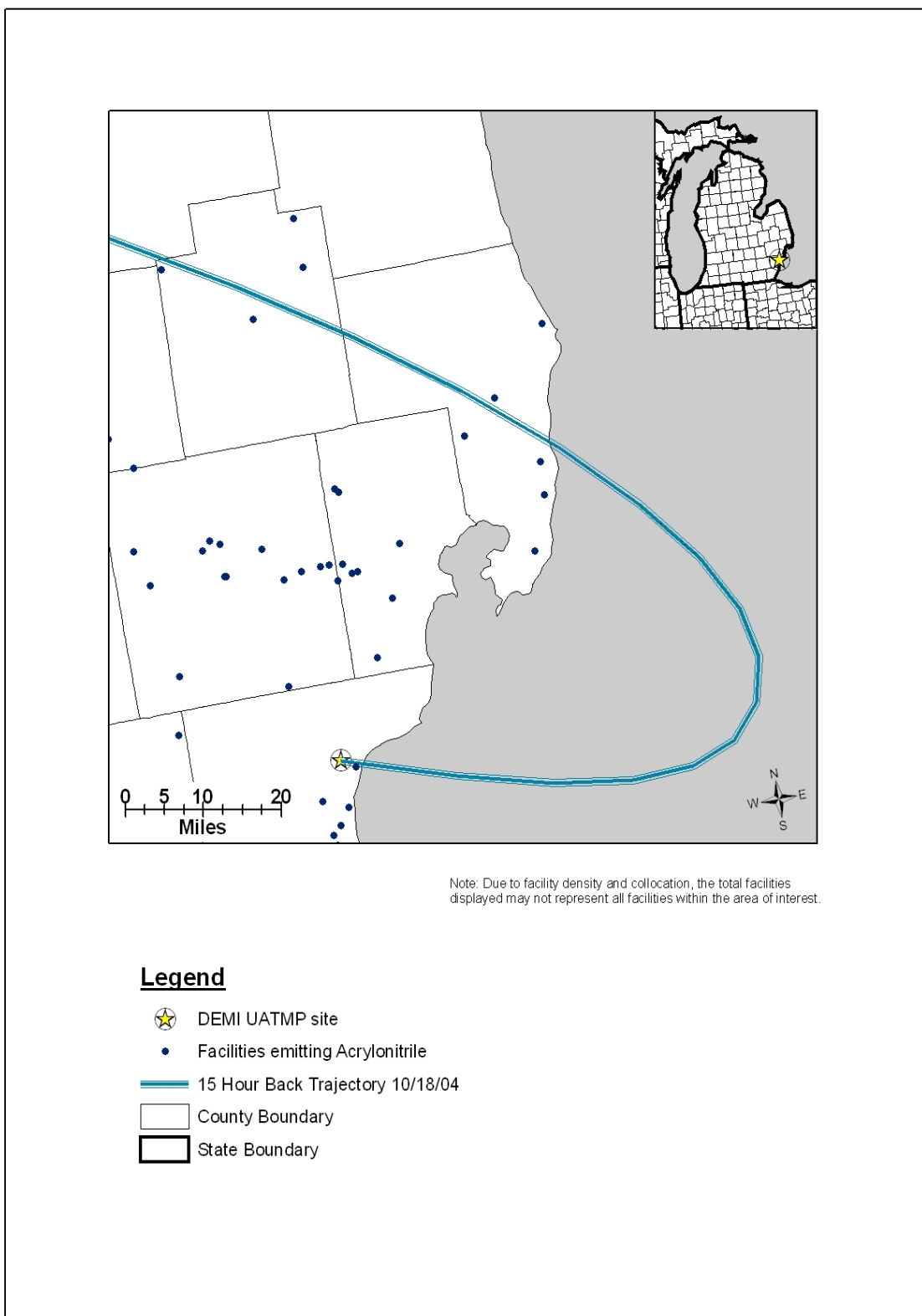


Table 11-1. Average Concentration and Meteorological Parameters for Sites in Michigan

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
APMI	All 2004		57.99 (± 2.04)	50.01 (± 1.90)	40.82 (± 1.88)	45.59 (± 1.76)	72.90 (± 1.10)	1017.65 (± 0.73)	2.22 (± 0.51)	0.51 (± 0.53)
	sample day	75.93 (± 33.62)	49.07 (± 7.12)	42.88 (± 5.87)	35.21 (± 5.85)	39.54 (± 5.43)	76.59 (± 6.20)	1017.58 (± 4.07)	3.26 (± 2.58)	0.28 (± 2.44)
DEMI	All 2004		57.99 (± 2.04)	50.01 (± 1.90)	40.82 (± 1.88)	45.59 (± 1.76)	72.90 (± 1.10)	1017.65 (± 0.73)	2.22 (± 0.51)	0.51 (± 0.53)
	sample day	62.16 (± 24.26)	59.60 (± 5.13)	51.27 (± 4.65)	41.50 (± 4.71)	46.54 (± 4.31)	71.75 (± 3.09)	1017.55 (± 1.91)	2.57 (± 1.32)	0.26 (± 1.20)
HOMI	All 2004		52.78 (± 2.14)	43.68 (± 1.94)	35.30 (± 1.86)	39.84 (± 1.79)	75.22 (± 1.11)	1017.31 (± 0.76)	1.84 (± 0.48)	0.34 (± 0.42)
	sample day	76.75 (± 58.31)	23.33 (± 6.15)	13.89 (± 10.97)	8.40 (± 12.54)	12.61 (± 11.03)	78.92 (± 6.36)	1017.88 (± 8.89)	6.12 (± 4.44)	-0.08 (± 4.37)
ITCMI	All 2004		47.96 (± 2.10)	40.09 (± 1.96)	32.69 (± 1.97)	36.99 (± 1.86)	76.85 (± 1.11)	1016.19 (± 0.79)	1.03 (± 0.49)	-0.40 (± 0.36)
	sample day	19.38 (± 4.75)	48.30 (± 4.93)	40.01 (± 4.61)	32.13 (± 4.69)	36.76 (± 4.39)	75.62 (± 2.67)	1016.12 (± 1.92)	1.86 (± 1.05)	-0.17 (± 0.88)
YFMI	All 2004		57.52 (± 2.03)	50.31 (± 1.91)	39.99 (± 1.84)	45.35 (± 1.74)	70.28 (± 1.27)	1017.71 (± 0.74)	1.47 (± 0.49)	0.01 (± 0.50)
	sample day	41.67 (± 10.00)	49.00 (± 6.68)	43.54 (± 5.59)	36.58 (± 5.49)	40.47 (± 5.16)	78.36 (± 6.06)	1016.90 (± 4.06)	2.86 (± 2.13)	0.39 (± 2.22)

Table 11-2. Summary of the Toxic Cancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Cancer Risk (Out of 1 Million)
Allen Park, Michigan - APMI						
Tetrachloroethylene	1.97 E-04	80.52	80.52	33.36	14	196.82
Benzene	1.69 E-05	6.91	87.43	2.17	14	16.89
Carbon Tetrachloride	1.66 E-05	6.81	94.25	1.11	14	16.65
1,3-Butadiene	1.09 E-05	4.45	98.70	0.36	5	10.88
Acetaldehyde	2.99 E-06	1.22	99.92	1.36	14	2.99
Dichloromethane	1.82 E-07	0.07	100.00	0.39	7	0.18
Formaldehyde	9.87 E-09	<0.01	100.00	1.79	14	0.01
Dearborn, Michigan - DEMI						
Acrylonitrile	4.17 E-04	80.40	80.40	6.13	3	416.64
Tetrachloroethylene	2.80 E-05	5.41	85.82	4.75	47	28.04
Benzene	1.68 E-05	3.25	89.06	2.16	50	16.83
Acetaldehyde	1.38 E-05	2.65	91.72	6.25	47	13.75
Carbon Tetrachloride	1.15 E-05	2.22	93.94	0.77	49	11.53
1,3-Butadiene	9.00 E-06	1.74	95.68	0.30	20	9.00
1,2-Dichloroethane	7.37 E-06	1.42	97.10	0.28	1	7.37
<i>p</i> -Dichlorobenzene	5.29 E-06	1.02	98.12	0.48	3	5.29
<i>cis</i> -1,3-Dichloropropene	2.54 E-06	0.49	98.61	0.64	1	2.54
Trichloroethylene	2.39 E-06	0.46	99.07	1.20	4	2.39
<i>trans</i> -1,3-Dichloropropene	1.66 E-06	0.32	99.39	0.42	3	1.66
Vinyl Chloride	1.57 E-06	0.30	99.70	0.18	1	1.57
1,1-Dichloroethane	1.26 E-06	0.24	99.94	0.79	1	1.26
Dichloromethane	2.33 E-07	0.04	99.99	0.50	36	0.23
Formaldehyde	6.93 E-08	0.01	100.00	12.60	47	0.07

Table 11-2. Summary of the Toxic Cancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Cancer Risk (Out of 1 Million)
Houghton Lake, Michigan - HOMI						
Tetrachloroethylene	3.92 E-05	71.30	71.30	6.65	2	39.22
Carbon Tetrachloride	9.44 E-06	17.16	88.46	0.63	1	9.44
Benzene	4.86 E-06	8.83	97.29	0.62	2	4.86
Acetaldehyde	1.49 E-06	2.70	99.99	0.68	3	1.49
Formaldehyde	4.05 E-09	0.01	100.00	0.74	3	0.00
Sault Ste. Marie, Michigan - ITCMI						
Acrylonitrile	2.33 E-04	85.66	85.66	3.43	1	233.16
Benzene	1.21 E-05	4.45	90.11	1.55	60	12.11
Carbon Tetrachloride	1.20 E-05	4.41	94.52	0.80	55	11.99
1,3-Butadiene	7.96 E-06	2.93	97.44	0.27	1	7.96
<i>p</i> -Dichlorobenzene	4.63 E-06	1.70	99.15	0.42	1	4.63
<i>trans</i> -1,3-Dichloropropene	1.54 E-06	0.57	99.71	0.39	2	1.54
Dibenz (a,h) anthracene	2.53 E-07	0.09	99.81	<0.01	14	0.25
Benzo (a) pyrene	1.81 E-07	0.07	99.87	<0.01	41	0.18
Dichloromethane	1.71 E-07	0.06	99.93	0.36	13	0.17
Benzo (b) fluoranthene	5.11 E-08	0.02	99.95	<0.01	51	0.05
Indeno (1,2,3-cd) pyrene	4.99 E-08	0.02	99.97	<0.01	49	0.05
Benzo (k) fluoranthene	4.13 E-08	0.02	99.99	<0.01	51	0.04
Benzo (a) anthracene	2.92 E-08	0.01	100.00	<0.01	50	0.03
Chrysene	6.20 E-09	<0.01	100.00	<0.01	52	0.01
Yellow Freight, Detroit, Michigan - YFMI						
Benzene	4.82 E-05	59.59	59.59	6.18	14	48.24
Carbon Tetrachloride	1.74 E-05	21.52	81.12	1.16	13	17.42

Table 11-2. Summary of the Toxic Cancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
1,3-Butadiene	8.25 E-06	10.19	91.31	0.27	7	8.25
Tetrachloroethylene	4.64 E-06	5.74	97.04	0.79	10	4.64
Benzo (a) pyrene	1.13 E-06	1.40	98.44	<0.01	8	1.13
Dibenz (a,h) anthracene	5.60 E-07	0.69	99.13	<0.01	3	0.56
Dichloromethane	3.45 E-07	0.43	99.56	0.73	10	0.34
Benzo (b) fluoranthene	1.08 E-07	0.13	99.69	<0.01	9	0.11
Benzo (k) fluoranthene	8.79 E-08	0.11	99.80	<0.01	9	0.09
Benzo (a) anthracene	8.53 E-08	0.11	99.91	<0.01	9	0.09
Indeno (1,2,3-cd) pyrene	6.02 E-08	0.07	99.98	<0.01	8	0.06
Chrysene	1.41 E-08	0.02	100.00	<0.01	9	0.01

Table 11-3. Summary of the Toxic Noncancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Allen Park, Michigan - APMI						
Acetonitrile	3.31 E-01	27.29	27.29	19.85	8	0
Formaldehyde	1.83 E-01	15.11	42.40	1.79	14	0
1,3-Butadiene	1.81 E-01	14.96	57.37	0.36	5	0
Acetaldehyde	1.51 E-01	12.45	69.81	1.36	14	0
Tetrachloroethylene	1.24 E-01	10.19	80.01	33.36	14	0
Benzene	7.22 E-02	5.95	85.96	2.17	14	0
Bromomethane	5.44 E-02	4.48	90.44	0.27	1	0
Xylenes	5.22 E-02	4.30	94.75	5.22	14	0
Carbon Tetrachloride	2.77 E-02	2.29	97.04	1.11	14	0
Chloromethane	2.00 E-02	1.65	98.68	1.80	14	0
Toluene	1.04 E-02	0.86	99.55	4.18	14	0
Chloroform	3.14 E-03	0.26	99.80	0.31	4	0
Ethylbenzene	7.91 E-04	0.07	99.87	0.79	14	0
Dichloromethane	3.87 E-04	0.03	99.90	0.39	7	0
1,1,1-Trichloroethane	3.37 E-04	0.03	99.93	0.34	6	0
Styrene	3.04 E-04	0.03	99.95	0.30	7	0
Methyl Isobutyl Ketone	2.70 E-04	0.02	99.98	0.81	4	0
Methyl Ethyl Ketone	2.35 E-04	0.02	100.00	1.18	9	0
Chloroethane	4.88 E-05	<0.01	100.00	0.49	2	0
Dearborn, Michigan - DEMI						
Acrylonitrile	3.06 E+00	55.44	55.44	6.13	3	1
Formaldehyde	1.29 E+00	23.28	78.72	12.60	47	4
Acetaldehyde	6.95 E-01	12.57	91.28	6.25	47	2

Table 11-3. Summary of the Toxic Noncancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
1,3-Butadiene	1.50 E-01	2.71	94.00	0.30	20	0
Benzene	7.19 E-02	1.30	95.30	2.16	50	0
Acetonitrile	6.64 E-02	1.20	96.50	3.98	22	0
Zylenes	6.10 E-02	1.10	97.61	6.10	50	0
<i>cis</i> -1,3-Dichloropropene	3.18 E-02	0.57	98.18	0.64	1	0
<i>trans</i> -1,3-Dichloropropene	2.08 E-02	0.38	98.56	0.42	3	0
Carbon Tetrachloride	1.92 E-02	0.35	98.91	0.77	49	0
Tetrachloroethylene	1.76 E-02	0.32	99.22	4.75	47	0
Chloromethane	1.65 E-02	0.30	99.52	1.48	49	0
Toluene	1.38 E-02	0.25	99.77	5.51	50	0
Chloroform	2.95 E-03	0.05	99.82	0.29	11	9
Trichloroethylene	1.99 E-03	0.04	88.86	1.20	4	0
Vinyl Chloride	1.79 E-03	0.03	99.89	0.18	1	0
1,1-Dichloroethane	1.58 E-03	0.03	99.92	0.79	1	0
Ethylbenzene	9.11 E-04	0.02	99.94	0.91	50	0
<i>p</i> -Dichlorobenzene	6.01 E-04	0.01	99.95	0.48	3	0
Chlorobenzene	5.98 E-04	0.01	99.96	0.60	1	0
Dichloromethane	4.96 E-04	0.01	99.97	0.50	36	0
Styrene	4.26 E-04	0.01	99.98	0.43	30	0
Methyl Ethyl Ketone	3.85 E-04	0.01	99.98	1.93	36	0
1,1,1-Trichloroethane	3.38 E-04	0.01	99.99	0.34	8	0
Methyl Isobutyl Ketone	2.14 E-04	<0.01	99.99	0.64	21	0
Methyl tert-Butyl Ether	2.10 E-04	<0.01	100.00	0.63	1	0
1,2-Dichloroethane	1.18 E-04	<0.01	100.00	0.28	1	0
Chloroethane	2.64 E-05	<0.01	100.00	0.26	1	0

Table 11-3. Summary of the Toxic Noncancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
Houghton Lake, Michigan - HOMI						
Acetonitrile	1.54 E+00	86.35	86.35	92.17	2	2
Formaldehyde	7.52 E-02	4.23	90.58	0.74	3	0
Acetaldehyde	7.50 E-02	4.22	94.80	0.68	3	0
Tetrachloroethylene	2.46 E-02	1.38	96.18	6.65	2	0
Benzene	2.08 E-02	1.17	97.35	0.62	2	0
Carbon Tetrachloride	1.57 E-02	0.88	98.23	0.63	1	0
Chloromethane	1.37 E-02	0.77	99.00	1.23	2	0
Xylenes	9.12 E-03	0.51	99.51	0.91	1	0
Chloroform	5.78 E-03	0.32	99.84	0.57	2	0
Toluene	2.68 E-03	0.15	99.99	1.07	2	0
Methyl Ethyl Ketone	2.21 E-04	0.01	100.00	1.11	2	0
Sault Ste. Marie, Michigan - ITCMI						
Acrylonitrile	1.71 E+00	81.60	81.60	3.43	1	1
1,3-Butadiene	1.33 E-01	6.32	87.92	0.27	1	0
Acetonitrile	6.98 E-02	3.32	91.24	4.19	15	0
Benzene	5.17 E-02	2.46	93.71	1.55	60	0
Bromomethane	4.66 E-02	2.22	95.92	0.23	1	0
Carbon Tetrachloride	2.00 E-02	0.95	96.88	0.80	55	0
<i>trans</i> -1,3-Dichloropropene	1.93 E-02	0.92	97.79	0.39	2	0
Xylenes	1.87 E-02	0.89	98.68	1.87	57	0
Chloromethane	1.59 E-02	0.76	99.44	1.43	58	0
Toluene	4.59 E-03	0.22	99.66	1.83	60	0
Chloroform	2.61 E-03	0.12	99.78	0.26	5	0
Naphthalene	9.60 E-04	0.05	99.83	<0.01	52	0
<i>p</i> -Dichlorobenzene	5.26 E-04	0.03	99.85	0.42	1	0
Methyl Ethyl Ketone	4.93 E-04	0.02	99.88	2.47	44	0

Table 11-3. Summary of the Toxic Noncancer Compounds at the Allen Park, Dearborn, Houghton Lake, Sault Ste. Marie, and Yellow Freight, Detroit, Michigan Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
Methyl Isobutyl Ketone	4.60 E-04	0.02	99.90	1.38	3	0
Dichloromethane	3.63 E-04	0.02	99.91	0.36	13	0
Ethylbenzene	3.52 E-04	0.02	99.93	0.35	39	0
1,1,1-Trichloroethane	3.49 E-04	0.02	99.95	0.35	10	0
Styrene	3.38 E-04	0.02	99.96	0.34	17	0
Chlorobenzene	3.22 E-04	0.02	99.98	0.32	1	0
Methyl <i>tert</i> -Butyl Ether	3.12 E-04	0.01	99.99	0.94	1	0
Chloroethane	1.15 E-04	0.01	100.00	1.15	4	0
Yellow Freight, Detroit, Michigan - YFMI						
Benzene	2.06 E-01	42.90	42.90	6.18	14	0
1,3-Butadiene	1.37 E-01	28.61	71.51	0.27	7	0
Xylenes	6.41 E-02	13.34	84.85	6.41	14	0
Carbon Tetrachloride	2.90 E-02	6.04	90.89	1.16	13	0
Chloromethane	1.94 E-02	4.04	94.93	1.75	14	0
Toluene	1.47 E-02	3.05	97.98	5.86	14	0
Tetrachloroethylene	2.91 E-03	0.61	98.59	0.79	10	0
Chloroform	2.81 E-03	0.59	99.18	0.28	5	0
Naphthalene	1.01 E-03	0.21	99.38	<0.01	9	0
Ethylbenzene	9.37 E-04	0.19	99.58	0.94	14	0
Dichloromethane	7.33 E-04	0.15	99.73	0.73	10	0
Styrene	4.00 E-04	0.08	99.82	0.40	10	0
1,1,1-Trichloroethane	3.41 E-04	0.07	99.89	0.34	4	0
Methyl Ethyl Ketone	3.00 E-04	0.06	99.95	1.50	10	0
Methyl Isobutyl Ketone	2.00 E-04	0.04	99.99	0.60	6	0
Chloroethane	4.75 E-05	0.01	100.00	0.47	1	0

Table 11-4. SVOC Concentrations for Michigan Monitoring Sites

Monitoring Station	Average SVOC Concentration (ng/m³)	SVOC Compound with the Highest Concentration (ng/m³)
ITCMI	27.80	Phenanthrene (56.2)
YFMI	52.83	Phenanthrene (59.4)

Table 11-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Allen Park, Dearborn, Sault Ste. Marie, and Yellow Freight Sites in Detroit, Michigan

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	u-component of wind	v-component of wind
Allen Park, Michigan - APMI								
1,3-Butadiene	-0.43	-0.68	-0.86	-0.82	0.10	0.71	0.29	0.25
Acetaldehyde	0.28	0.22	0.17	0.19	-0.05	0.37	-0.13	0.25
Acetonitrile	0.04	-0.09	-0.12	-0.11	-0.09	0.11	-0.52	-0.86
Benzene	0.15	0.04	0.06	0.05	0.11	0.54	-0.31	0.24
Bromomethane	NA							
Carbon Tetrachloride	0.76	0.82	0.82	0.84	0.01	-0.31	0.03	0.58
Formaldehyde	0.44	0.31	0.16	0.24	-0.29	0.41	0.02	0.43
Tetrachloroethylene	0.39	0.34	0.35	0.35	0.02	-0.12	-0.19	-0.06
Xylenes	0.47	0.40	0.41	0.41	0.09	0.19	-0.21	0.48
Dearborn, Michigan - DEMI								
1,3-Butadiene	-0.10	-0.07	-0.05	-0.07	0.07	0.04	-0.36	-0.20
Acetaldehyde	0.26	0.24	0.22	0.23	-0.05	0.01	-0.08	0.22
Acrylonitrile	NA							
Benzene	0.35	0.33	0.36	0.34	0.17	0.15	-0.30	0.21
Carbon Tetrachloride	0.31	0.31	0.33	0.32	0.17	0.03	-0.07	0.20
Formaldehyde	0.26	0.25	0.23	0.24	-0.05	0.00	-0.08	0.23
Tetrachloroethylene	-0.12	-0.13	-0.16	-0.15	-0.10	0.22	-0.17	-0.02
Sault Ste. Marie, Michigan - ITCMI								
1,3-Butadiene	NA							
Acetonitrile	-0.21	-0.15	-0.13	-0.14	0.00	0.15	-0.11	-0.07
Acrylonitrile	NA							
Benzene	-0.07	0.09	-0.07	-0.08	0.08	0.13	-0.12	-0.01
Bromomethane	NA							
Carbon Tetrachloride	0.23	0.23	0.24	0.24	0.12	0.13	0.12	0.08
Yellow Freight, Detroit, Michigan - YFMI								
1,3-Butadiene	-0.32	-0.26	0.12	-0.13	0.58	0.27	-0.50	0.28
Benzene	0.39	0.52	0.71	0.62	0.52	-0.15	0.14	0.58

Table 11-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Allen Park, Dearborn, Sault Ste. Marie, and Yellow Freight Sites in Detroit, Michigan (Continued)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
Carbon Tetrachloride	0.68	0.72	0.70	0.73	0.00	-0.48	0.12	0.33
Chloromethane	0.76	0.74	0.63	0.71	-0.19	-0.20	0.48	0.59
Tetrachloroethylene	0.34	0.28	0.24	0.27	0.01	0.33	-0.21	0.13
Toluene	0.50	0.49	0.54	0.53	0.18	0.15	-0.02	0.39
Xylenes	0.43	0.43	0.52	0.48	0.28	0.19	-0.14	0.30

Table 11-6. Motor Vehicle Information vs. Daily Concentration for Michigan Monitoring Sites

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Population: Registration)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
APMI	2,028,778	1,430,965	0.71	964,194	684,578	60,000	75.93 \pm 33.62
DEMI	2,028,778	1,430,965	0.71	1,201,847	853,311	12,791	62.16 \pm 24.26
HOMI	15,189	15,827	1.04	10,187	10,594	7,000	76.75 \pm 58.31
ITCMI	38,822	33,504	0.86	22,188	19,082	100,000	19.38 \pm 4.75
YFMI	2,028,778	1,430,965	0.71	1,154,934	820,003	500	41.67 \pm 10.00

12.0 Sites in Mississippi

This section presents meteorological, concentration, and spatial trends for the five UATMP sites in Mississippi (GPMS, GRMS, JAMS, PGMS, and TUMS). All five of these sites are located in different cities in Mississippi: Gulfport, Grenada, Jackson, Pascagoula, and Tupelo. Figures 12-1 through 12-5 are topographical maps showing the monitoring sites in their urban and rural locations. Figures 12-6 through 12-10 identify facilities within 10 miles of the sites that reported to the 2002 NEI. The GPMS and PGMS sites are the farthest south, with both locations along the Gulf Coast. Farther east is PGMS, where the majority of the sources are located to the north and east of the monitoring site, and are mostly surface coating or chemical products facilities. GPMS is farther west along the Mississippi shoreline, and the few nearby sources, which are mainly involved in surface coating, are also mainly to the north. Very few facilities are located near the GRMS site, which is located in central Mississippi. Most of the facilities are located to the south of the monitor and the majority are involved in surface coating processes or fuel combustion industries. JAMS is located in the state capital of Jackson, and all but two facilities are located to the south of the monitor. These sources are primarily surface coating facilities. The industrial facilities within a ten mile radius of TUMS, which is located in northeast Mississippi, are mainly to the southwest of the site. A large number of the sources near the TUMS site are involved in polymer and resin production, surface coating processes, and chemical and allied products.

Hourly meteorological data were retrieved for all of 2004 at five weather stations near these sites for calculating correlations of meteorological data with ambient air concentration measurements. The weather observations were reported from Gulfport-Biloxi Regional Airport, Greenwood-Leflore Airport, Hawkins Field Airport, Pascagoula-Lott International Airport, and Tupelo Municipal Airport (WBAN 93874, 3978, 13927, 53858, and 93862, respectively).

Table 12-1 highlights the average UATMP concentration at each site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average u - and v - components of the wind) for the entire year and on days

samples were taken. Climatologically, all five of the Mississippi cities can be considered warm and humid, especially Gulfport and Pascagoula, the two sites nearest the coast. Table 12-1 reflects this coastal location, as GPMS and PGMS have the highest maximum, average, dew point, and wet bulb temperatures. High temperatures and humidity, due to proximity to the Gulf of Mexico, can make the climate in this region very oppressive. Annual average wind direction tends to be from the east, southeast, and south. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

12.1 Prevalent Compounds at the Mississippi Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 12-2 summarizes the cancer weighting scores, while Table 12-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

Table 12-2 shows that most of the detected cancer compounds reflect the nationwide prevalent cancer compound list, discussed in Section 3 of this report. *Trans*-1,3-dichloropropene (detected at GPMS, GRMS, and JAMS), dichloromethane (detected at all of the Mississippi sites), formaldehyde (detected at all five sites), and trichloroethylene (detected at GRMS) were not listed among the nationwide prevalent cancer compounds. Acrylonitrile, benzene, carbon tetrachloride, and acetaldehyde were the only prevalent cancer compounds across all five sites. For the noncancer compounds summarized in Table 12-3, many of the detected compounds were not listed among the nationwide noncancer prevalent list. However, all of the prevalent noncancer compounds at all of the Mississippi sites are also on the nationwide noncancer prevalent list, with the exception of *trans*-1,3-dichloropropene (GPMS and JAMS). Acrylonitrile, acetonitrile, acetaldehyde, formaldehyde, and xylenes were the only noncancer compounds to be considered prevalent across all five sites.

Nationwide prevalent compounds not detected at the Mississippi sites were: 1, 2-Dichloroethane, bromomethane, chloroprene, *cis*-1,3-dichloropropene, and 1,2-dichloropropane.

12.2 Toxicity Analysis

Acrylonitrile contributed the most in cancer toxicity weighting at each Mississippi site. Although acrylonitrile's toxicity is consistently the highest of all cancer compounds across the Mississippi sites, the number of detects is lower than most of the other prevalent compounds. Benzene had the largest number of detects across all of the sites. Acrylonitrile, acetonitrile, acetaldehyde, and formaldehyde contributed most to the average noncancer toxicity at four of the five sites. Of these four compounds, acrylonitrile had the lowest number of detects.

The acrylonitrile cancer risk at GRMS was the highest among the five sites at 31.54 in a million, while the GPMS, JAMS, TUMS, and PGMS risk ranged from 16.97 to 27.15 in a million. For the compounds that may lead to adverse noncancer health effects, the average acetonitrile toxicity at GRMS was 1.40 (over 1 indicates a significant chance of a noncancer health effect). Of the thirty-one acetonitrile detects at GRMS, fifteen concentrations were above the adverse health concentrations.

12.3 Meteorological and Concentration Averages at the Mississippi Sites

Carbonyl compounds and VOC were measured at all of the sites, as indicated in Tables 3-3 and 3-4. Table 12-1 lists the average UATMP concentrations for each of the sites that sampled in Mississippi. The GRMS site had the highest average UATMP concentration while TUMS had the lowest. Table 12-1 also lists the averages for selected meteorological parameters from January 2004 to December 2004, and for days on which sampling occurred.

The PGMS site also opted to have total and speciated nonmethane organic compounds (TNMOC/SNMOC) sampled during air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on

SNMOC/NMOC trends and concentrations. The average total NMOC value of the PGMS was 28.90 ppbC, of which nearly 36% could be identified through speciation. Of the speciated compounds, isopentane measured the highest concentration at the PGMS site (28.90 ppbC).

Table 12-5 presents the summary of calculated Pearson Correlation coefficients for each of the site-specific prevalent compounds and selected meteorological parameters by site. Identification of the site-specific prevalent compounds is discussed in Section 3 of this report. Several correlations could not be computed or were removed due to the low number of detects (fewer than four).

The strongest correlations at GPMS occurred with 1,3-butadiene and the temperature and moisture parameters, although this compound was only detected four times. Acetaldehyde and formaldehyde, both carbonyls, had moderately strong negative correlations with the temperature and moisture parameters. These compounds also exhibited strong correlations with the *u*-component of the wind.

Several compounds at GRMS exhibited moderately strong correlations with the temperature and moisture parameters. Benzene had the strongest negative correlations, while formaldehyde had the strongest positive correlations. Acetonitrile had the strongest wind correlation, 0.43 with the *v*-component of the wind.

Tetrachloroethylene, 1,3-butadiene, and *p*-dichlorobenzene all had strong negative correlations with the temperature and moisture parameters at JAMS, and strong positive correlations with sea level pressure. Acrylonitrile had strong positive correlations with the moisture parameters, and also had strong positive correlations with the wind parameters.

Xylenes exhibited the strongest correlations at PGMS, with maximum and average temperature (0.64 and 0.63), dew point and wet bulb temperatures (0.63 and 0.63), and the

v-component of the wind (0.62). In fact, all compounds at PGMS exhibited at least one moderately strong correlation and most had several moderately strong correlations, indicating meteorology has a large influence on concentration levels at PGMS.

Formaldehyde had the strongest correlations with the temperature and moisture parameters at TUMS, although acetaldehyde and acrylonitrile also had strong correlations with these parameters. Similar to PGMS, most compounds at TUMS had at least one, if not more, moderately strong correlation with the meteorological parameters.

Figures 12-11 through 12-15 show the composite back trajectories for the Mississippi sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in these figures, the back trajectories generally originated from a southerly or northerly direction. Each circle around the sites in Figure 12-11 through 12-15 represents 100 miles; between 58% (GRMS) and 74% (TUMS) of the trajectories originated within 300 miles, and between 87% (GRMS) and 96% (GPMS and JAMS) within 500 miles from the Mississippi sites. The 24-hour airshed domain is large. Back trajectories originated over 500-600 miles away.

12.4 Spatial Analysis

County-level vehicle registration and population information for Grenada County, Harrison County, Hinds County, Jackson County, and Lee County, MS, were obtained from the Mississippi State Tax Commission and the U.S. Census Bureau, and is summarized in Table 12-5. Table 12-5 also contains a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 12-5 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the Mississippi sites in Table 12-5. The JAMS site has the largest estimated vehicle ownership within a 10 mile radius, while GPMS has the highest traffic volume passing

by the site on a daily basis. However, GRMS has approximately twice the concentration of the these sites.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. All of the five sites' ratios looked relatively similar to those of the roadside study, although JAMS and PGMS resemble it the most. At GPMS, the benzene-ethylbenzene ratio and the xylenes-ethylbenzene ratio are much closer together than the roadside study. At GRMS, the benzene-ethylbenzene ratio is much lower than the other ratios. At TUMS, the toluene-ethylbenzene ratio is much larger than the others.

PGMS sampled for SNMOC in addition to VOC and carbonyl compounds. Acetylene and ethylene are SNMOCs that are primarily emitted from mobile sources. Tunnel studies conducted on mobile source emissions have found that ethylene and acetylene are typically detected in a 1.7 to 1 ratio. For more information, please refer to Section 3.4.4. Listed in Table 12-4 is the ethylene-acetylene ratio for PGMS and what percent of the expected 1.7 ratio it represents. As shown, PGMS's ethylene-acetylene ratio is only within 64% of the expected 1.7 ratio (1.08). This would indicate that the concentrations near SFSD are influenced by mobile source emissions.

12.5 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

12.5.1 Site-Specific Trends Analyses

GPMS, JAMS, PGMS, and TUMS have been participants in the UATMP since 2001. GRMS began sampling in 2003. Formaldehyde concentrations have decreased at all the sites from year to year since 2001, except at PGMS, where the 2004 concentration increased. Each site shows a slow decrease in benzene concentrations over the period. Concentrations of 1,3-butadiene had little change, except at PGMS, where a significant decrease occurred after 2001. Please refer to Figures 3-37, 3-39, 3-42, and 3-49.

12.5.2 MSA-Specific Trends Analyses

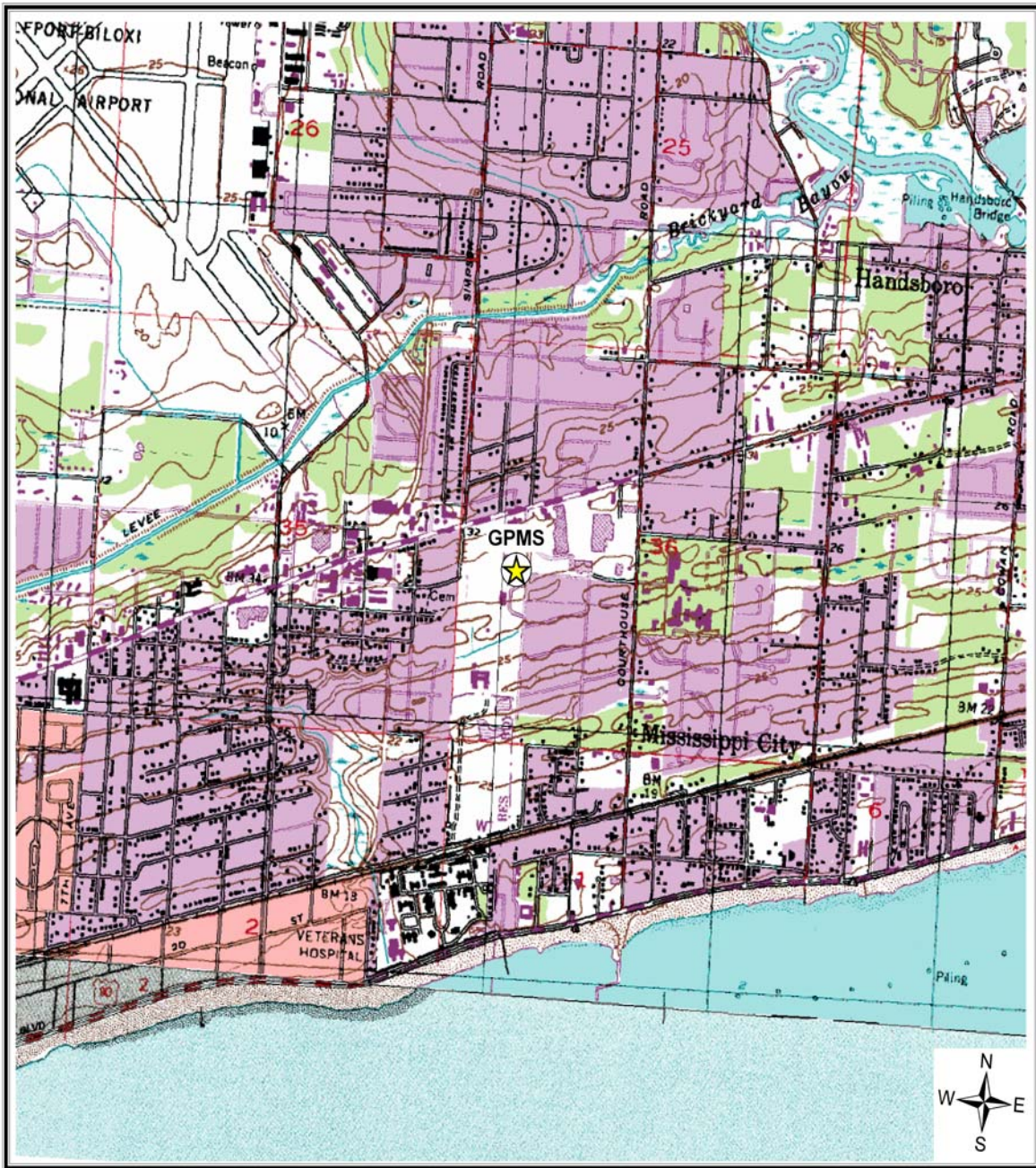
Three Mississippi sites reside in MSAs, GPMS in the Gulfport-Biloxi, MS MSA; JAMS in the Jackson, MS MSA; and PGMS in the Pascagoula, MS MSA. Trends for carbonyl and VOC compounds can be found in Table 3-13. None of these MSAs participate in either the winter oxygenated program or the reformulated gasoline program. A comparison of the 2002-2003 average concentrations to the 2004 average concentrations of the UATMP sites representing the Gulfport MSA (GPMS) shows decreasing concentrations for all of the pollutants except acetaldehyde, where concentration is holding steady.

The Gulfport MSA has experienced a 19.8% increase in population and a 52.1% increase in vehicle miles traveled (VMT) from 1990 to 2003. Carbonyl and VOC emissions generally seem to be on the decrease at this MSA, although ethylbenzene emissions have increased. A comparison of the 2002-2003 average concentrations to the 2004 average concentrations of the UATMP site representing this MSA (GPMS), shows decreasing concentrations for all of the pollutants except acetaldehyde, which has changed little.

The Jackson, MS MSA has experienced a 14.1% increase in population and a 71.6% increase in vehicle miles traveled (VMT) from 1990 to 2003. Emissions and measured concentrations of carbonyl and VOC have generally decreased or held steady over the time period.

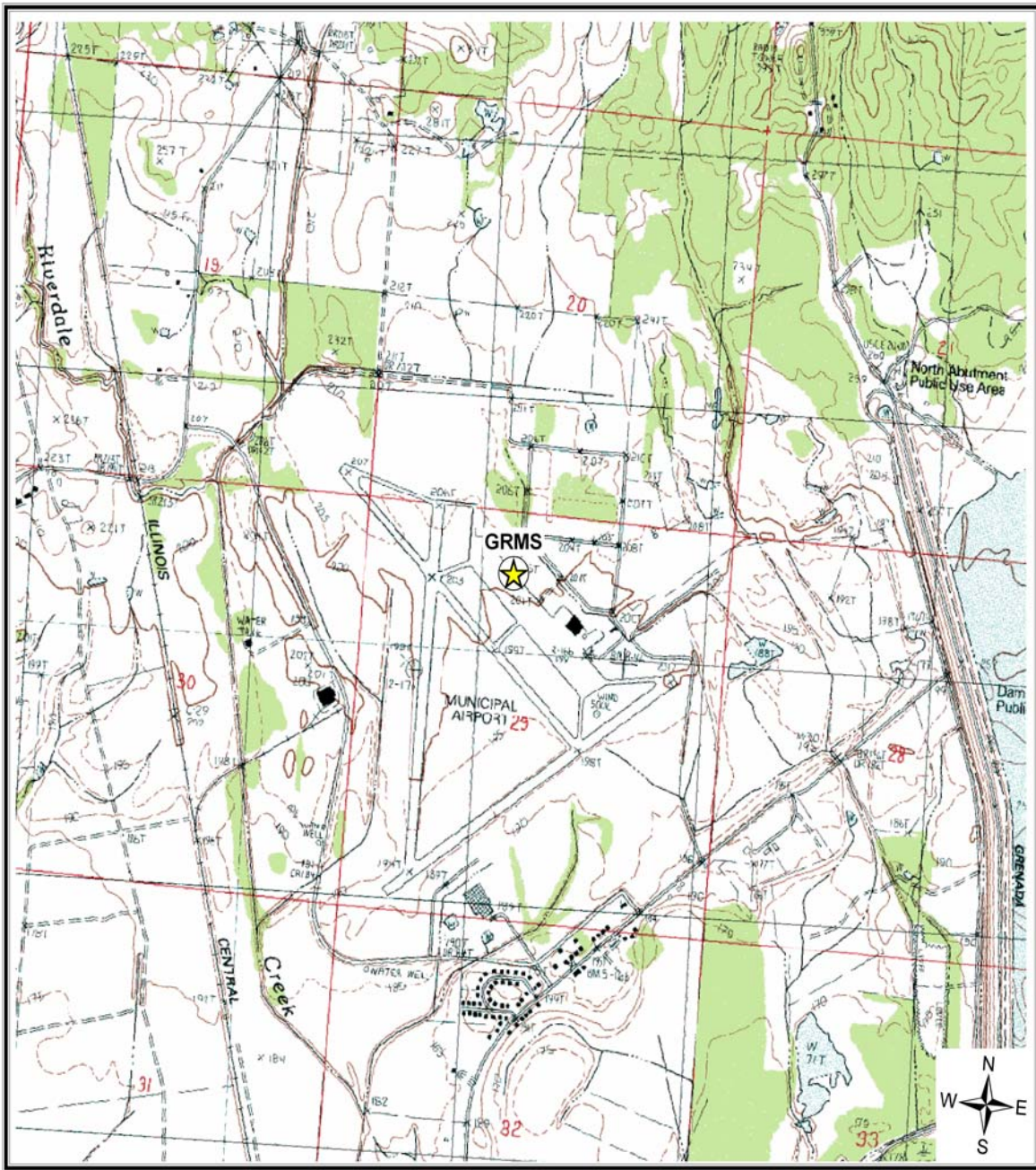
The Pascagoula, MS MSA has experienced a 17.0% increase in population and estimated VMT. Both emissions and concentrations have decreased over the time frame, with the exception of formaldehyde, as concentrations appear to have little change this year from the 2002-2003 average, based on UATMP sites representing the Pascagoula MSA (PGMS).

Figure 12-1. Gulfport, Mississippi (GPMS) Monitoring Site



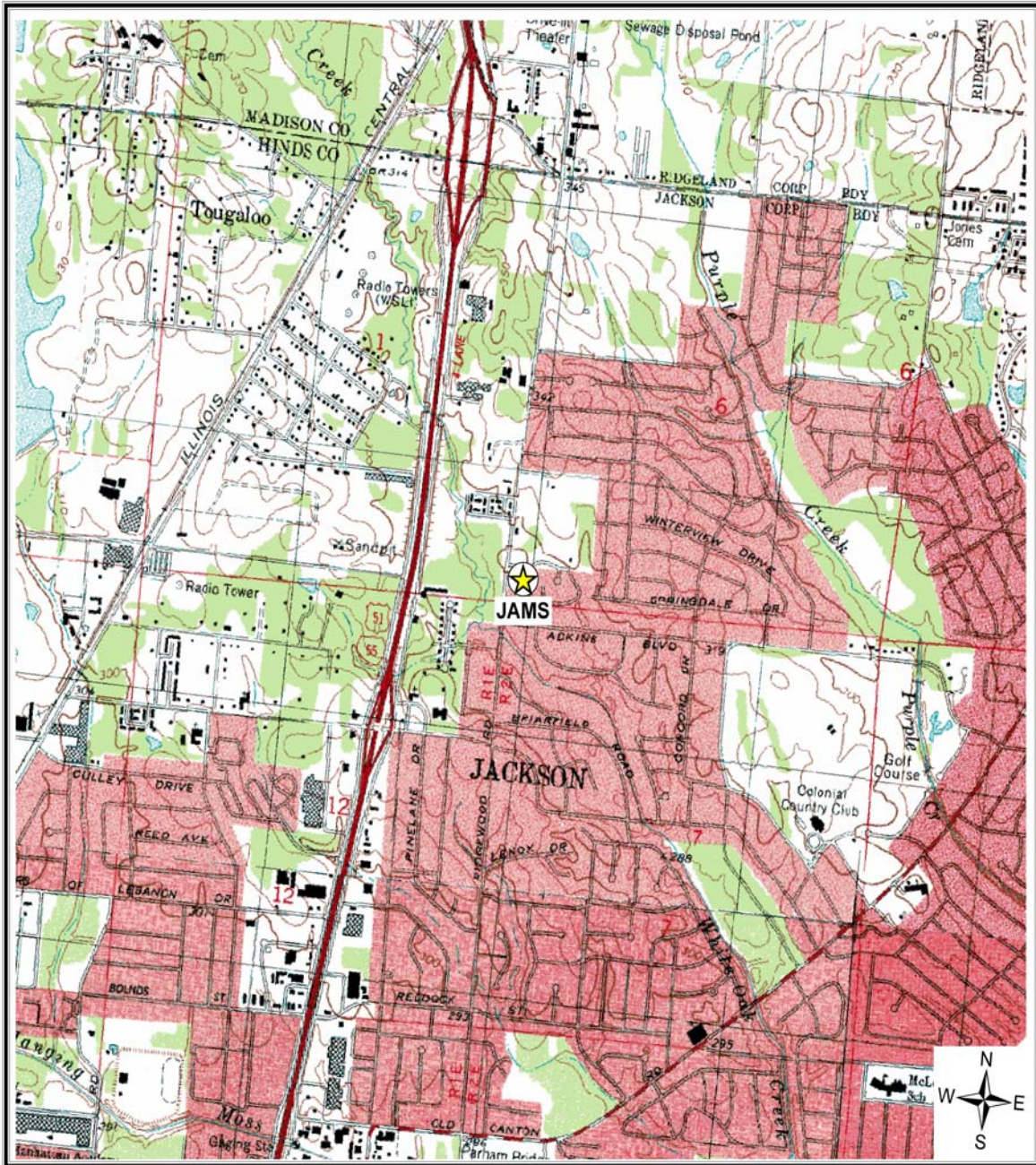
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 12-2. Grenada, Mississippi (GRMS) Monitoring Site



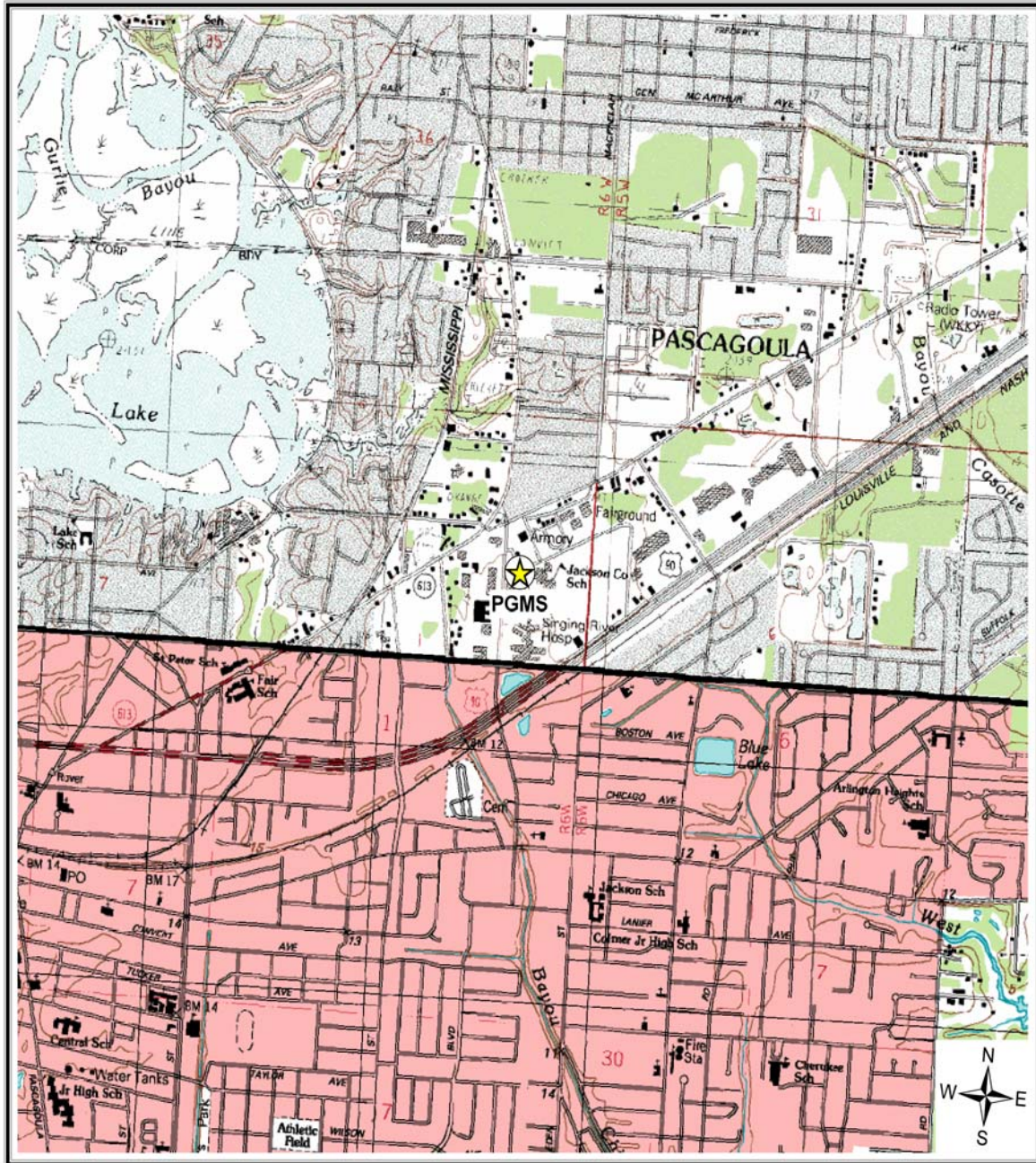
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 12-3. Jackson, Mississippi (JAMS) Monitoring Site



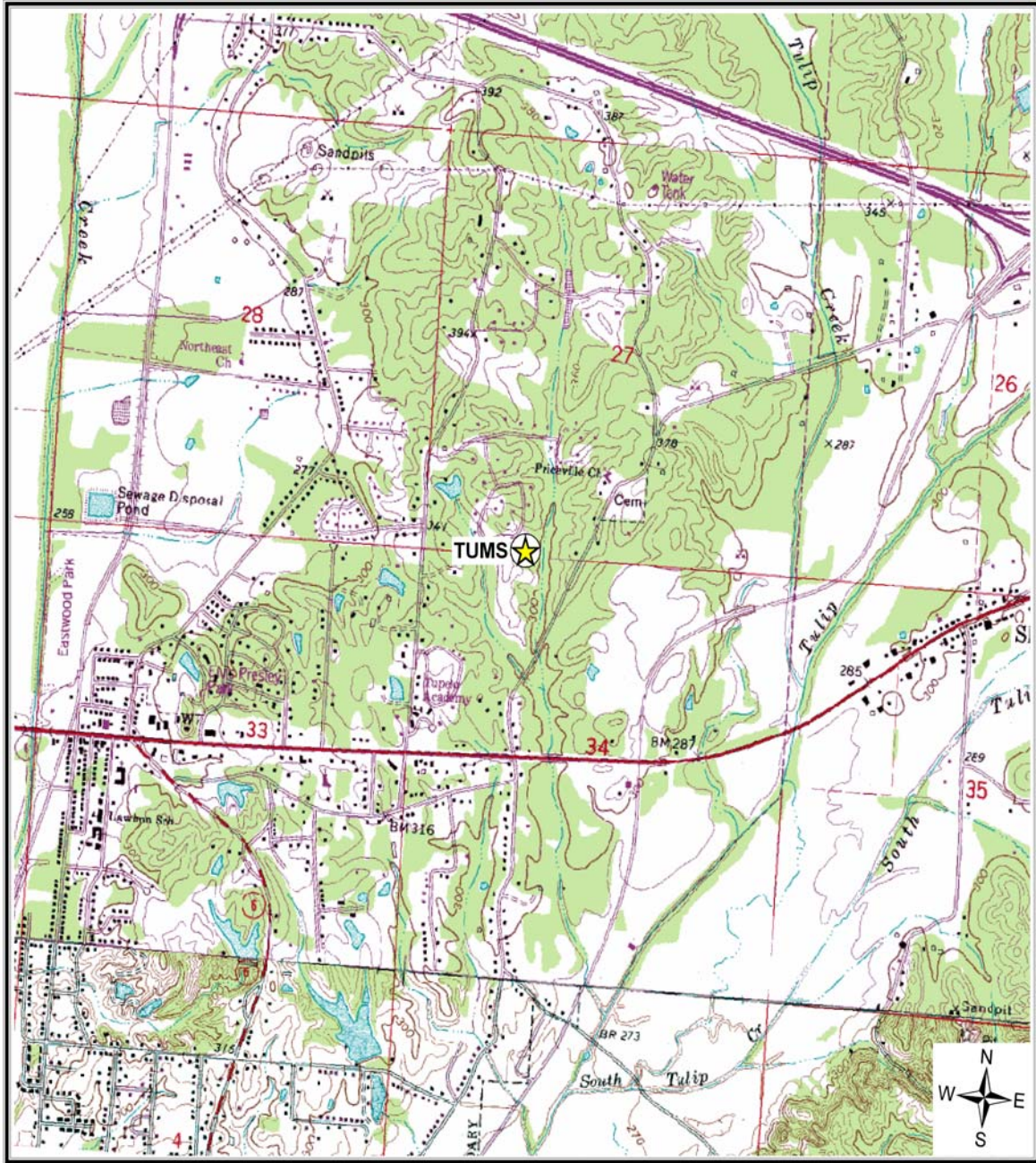
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 12-4. Pascagoula, Mississippi (PGMS) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 12-5. Tupelo, Mississippi (TUMS) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 12-6. Facilities Located Within 10 Miles of GPMS

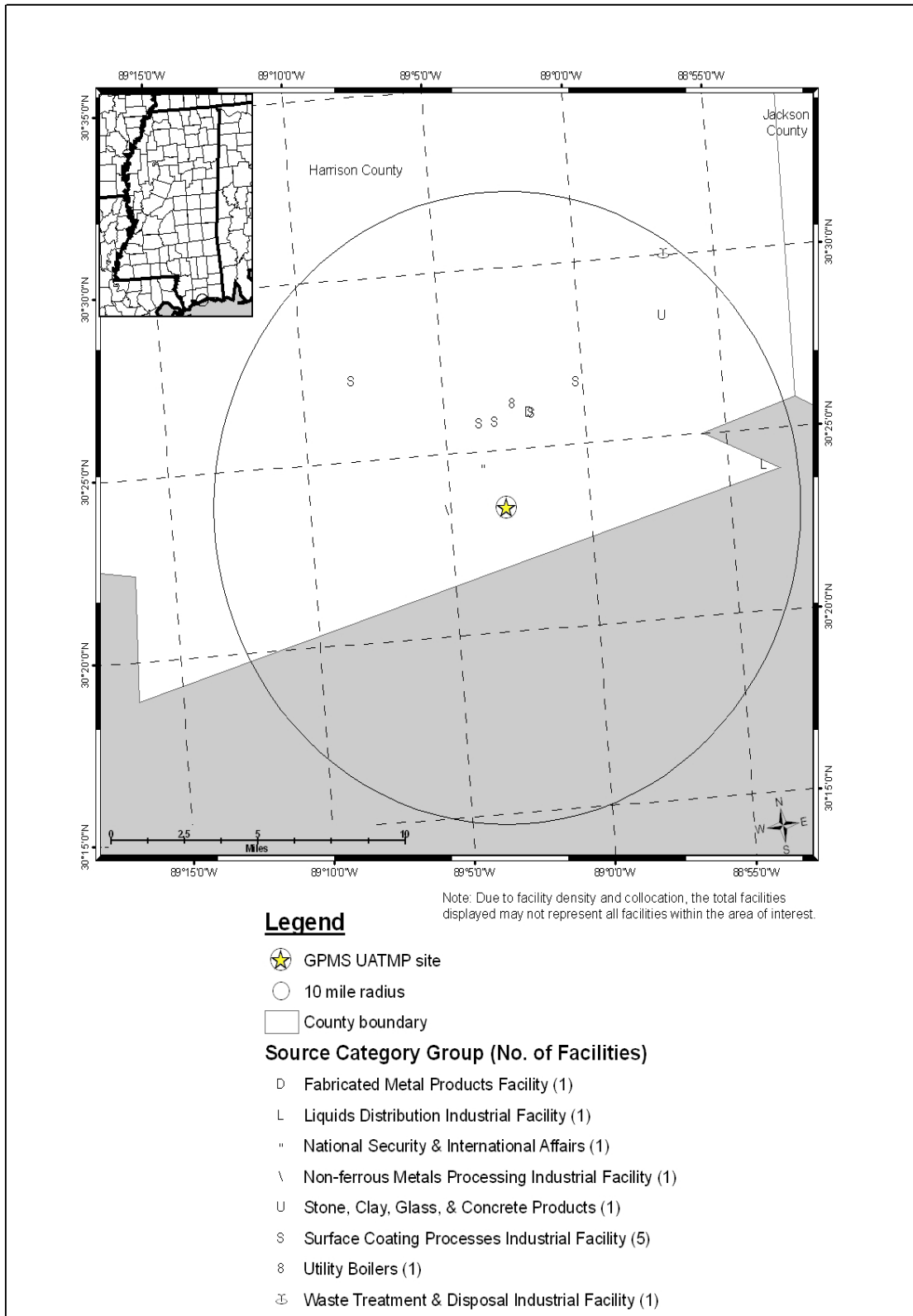


Figure 12-7. Facilities Located Within 10 Miles of GRMS

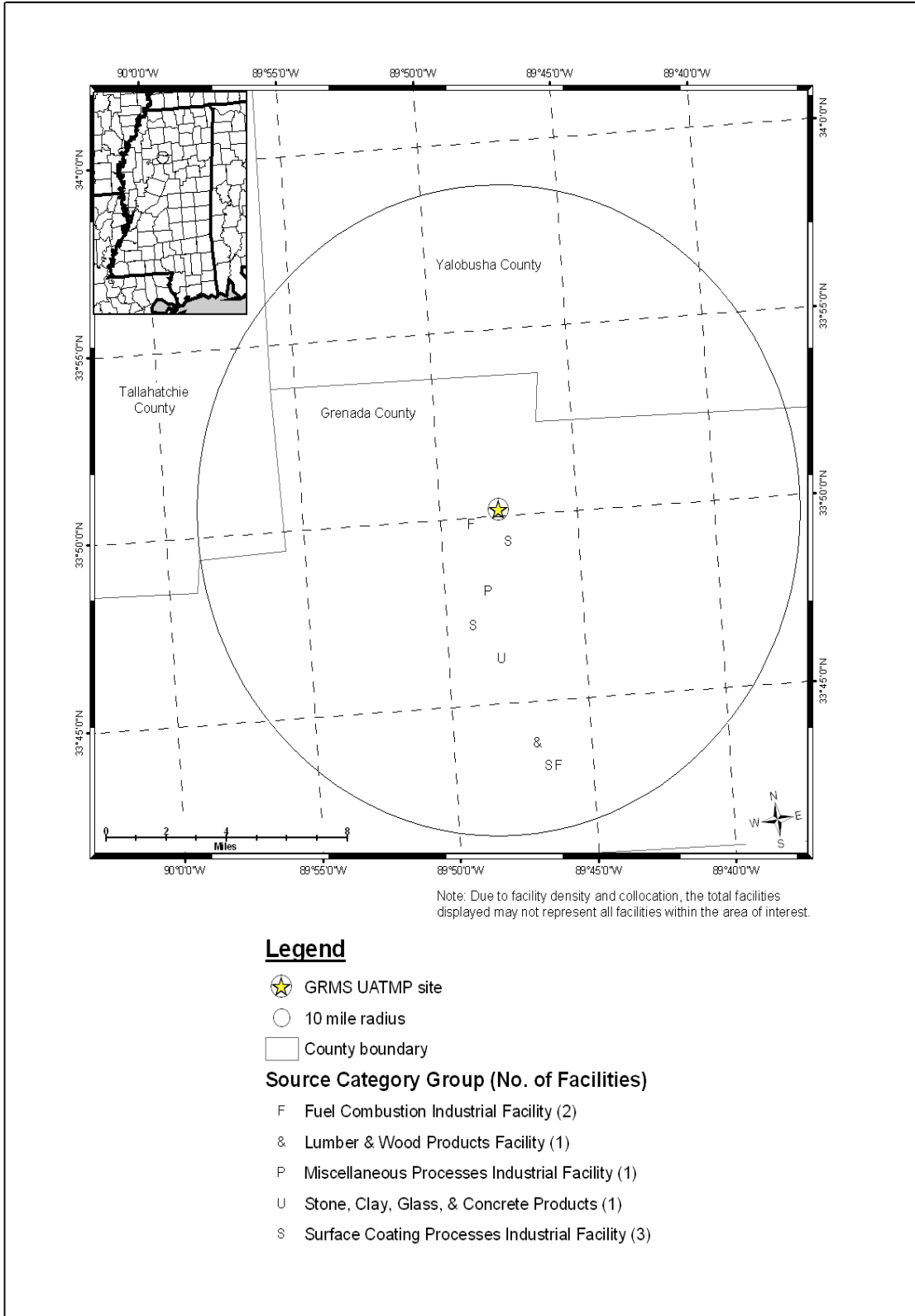


Figure 12-9. Facilities Located Within 10 Miles of PGMS

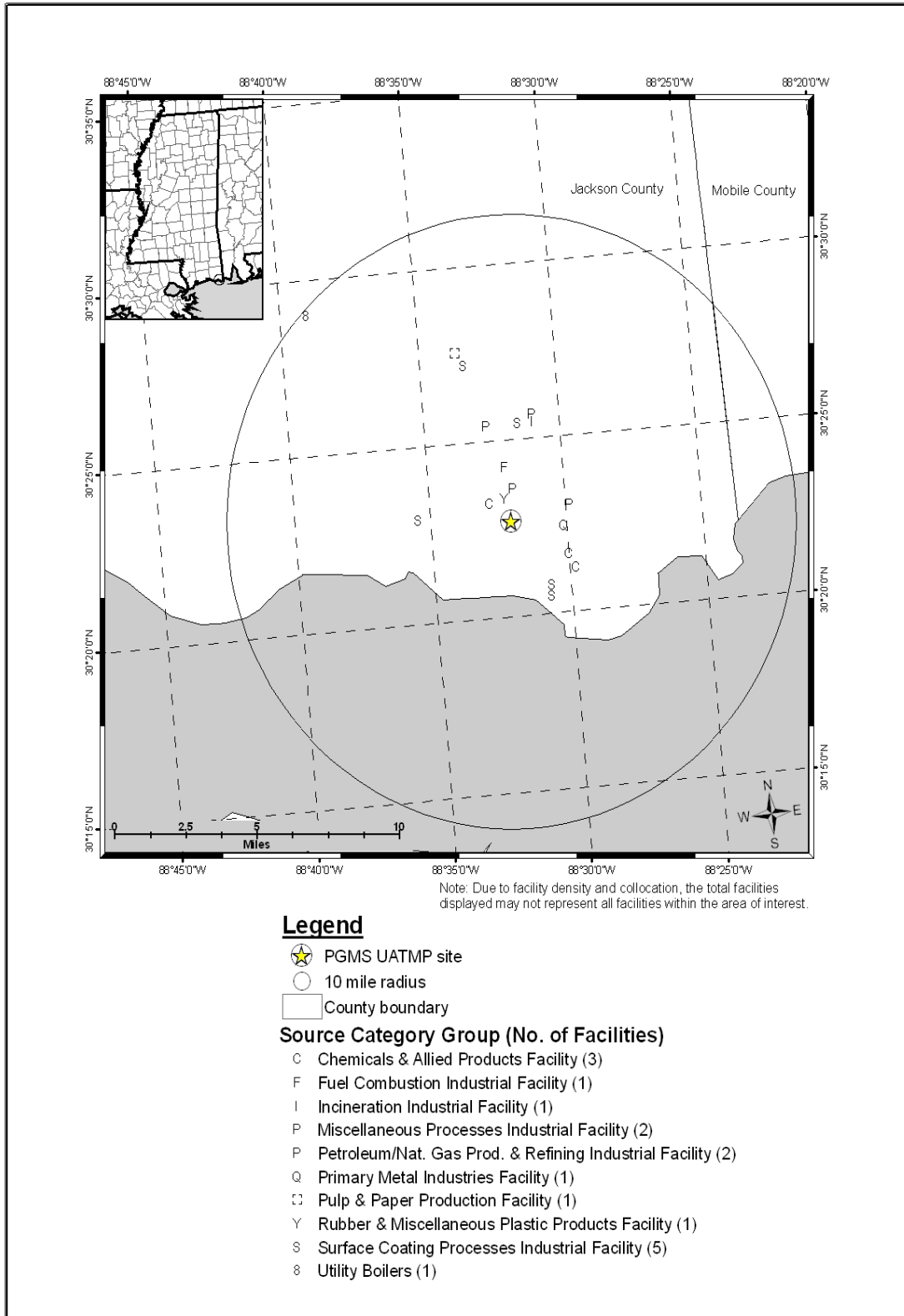


Figure 12-10. Facilities Located Within 10 Miles of TUMS

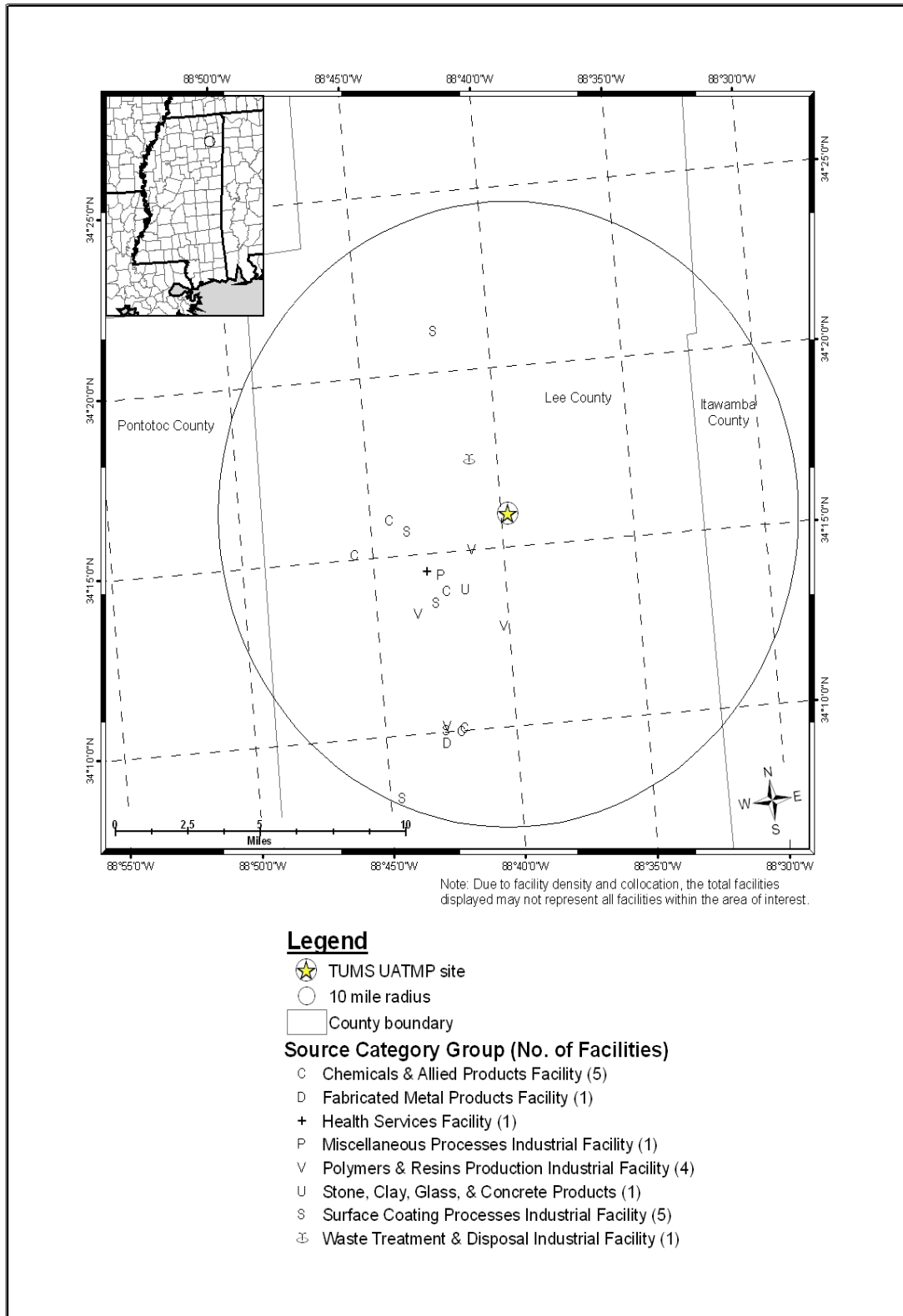


Figure 12-11. Composite Back Trajectory Map for GPMS

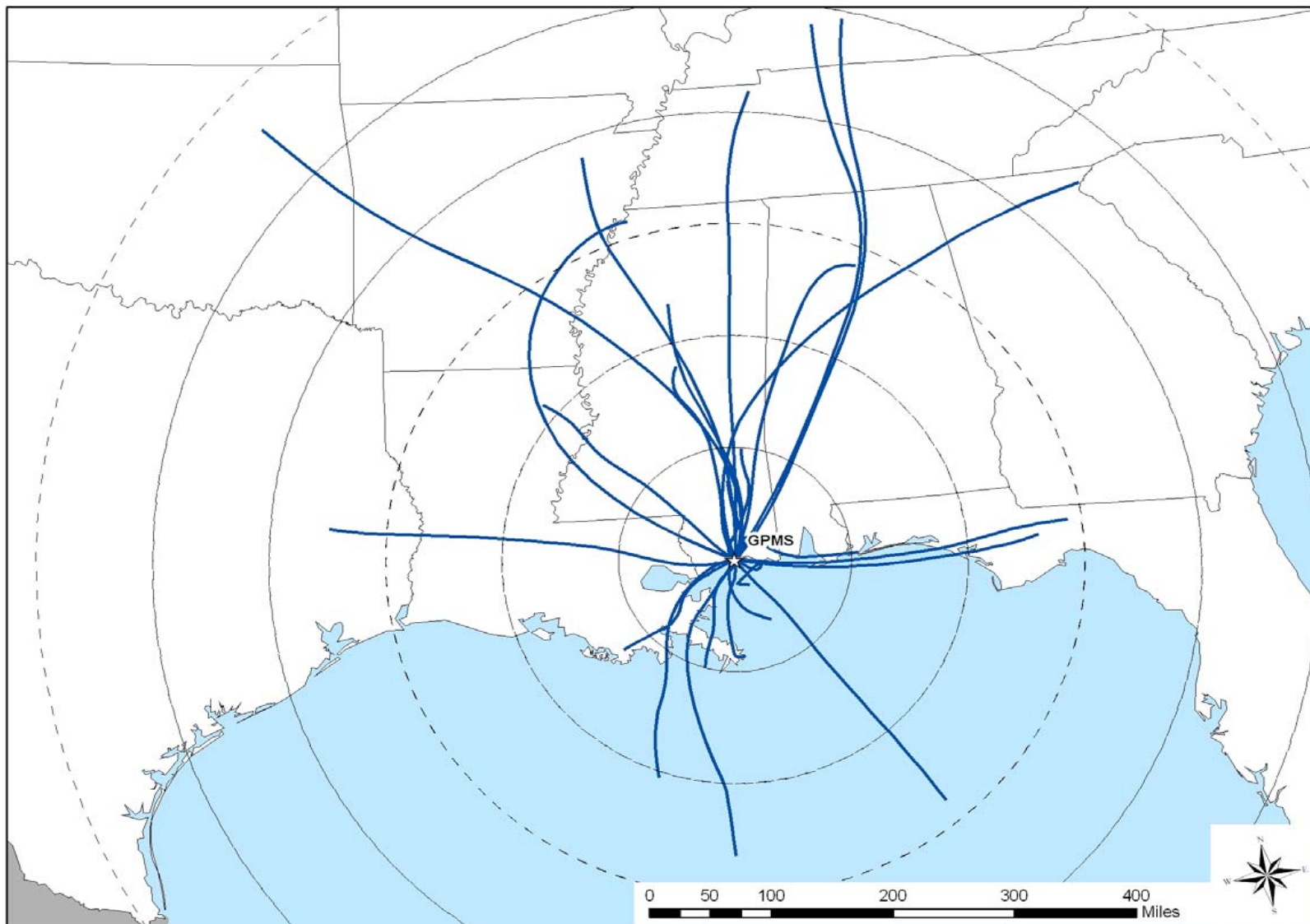


Figure 12-12. Composite Back Trajectory Map for GRMS

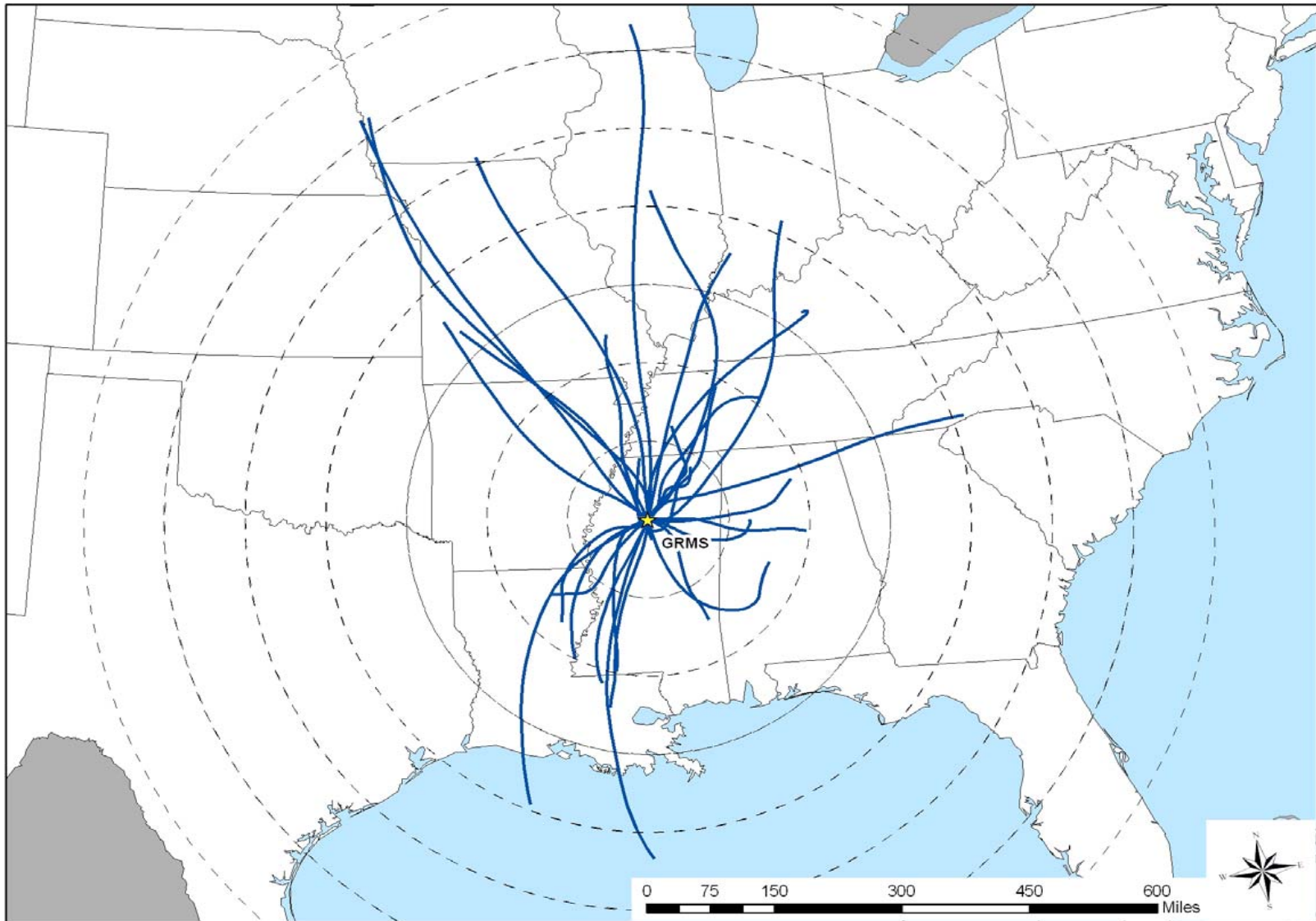


Figure 12-13. Composite Back Trajectory Map for JAMS

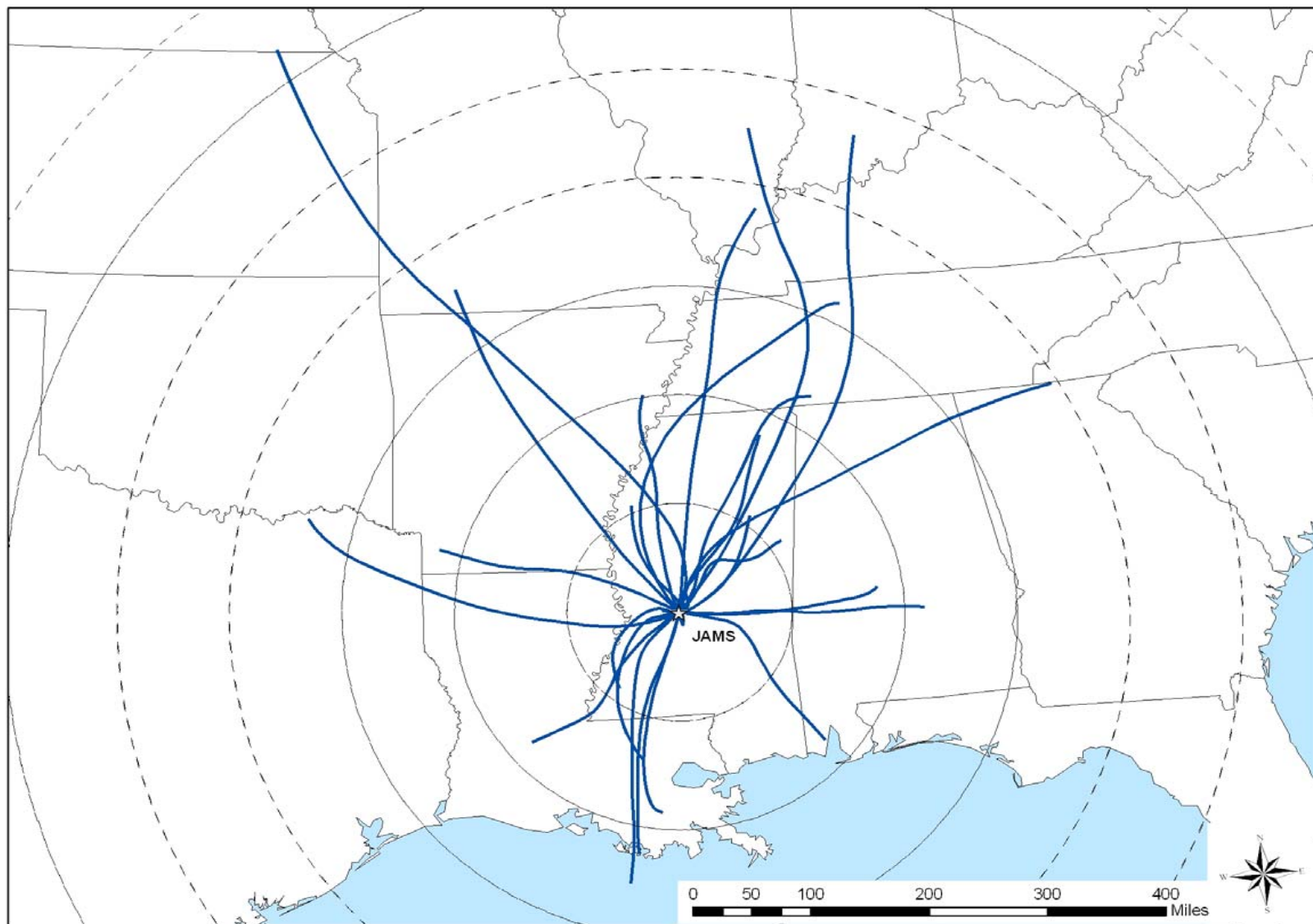


Figure 12-14. Composite Back Trajectory Map for PGMS

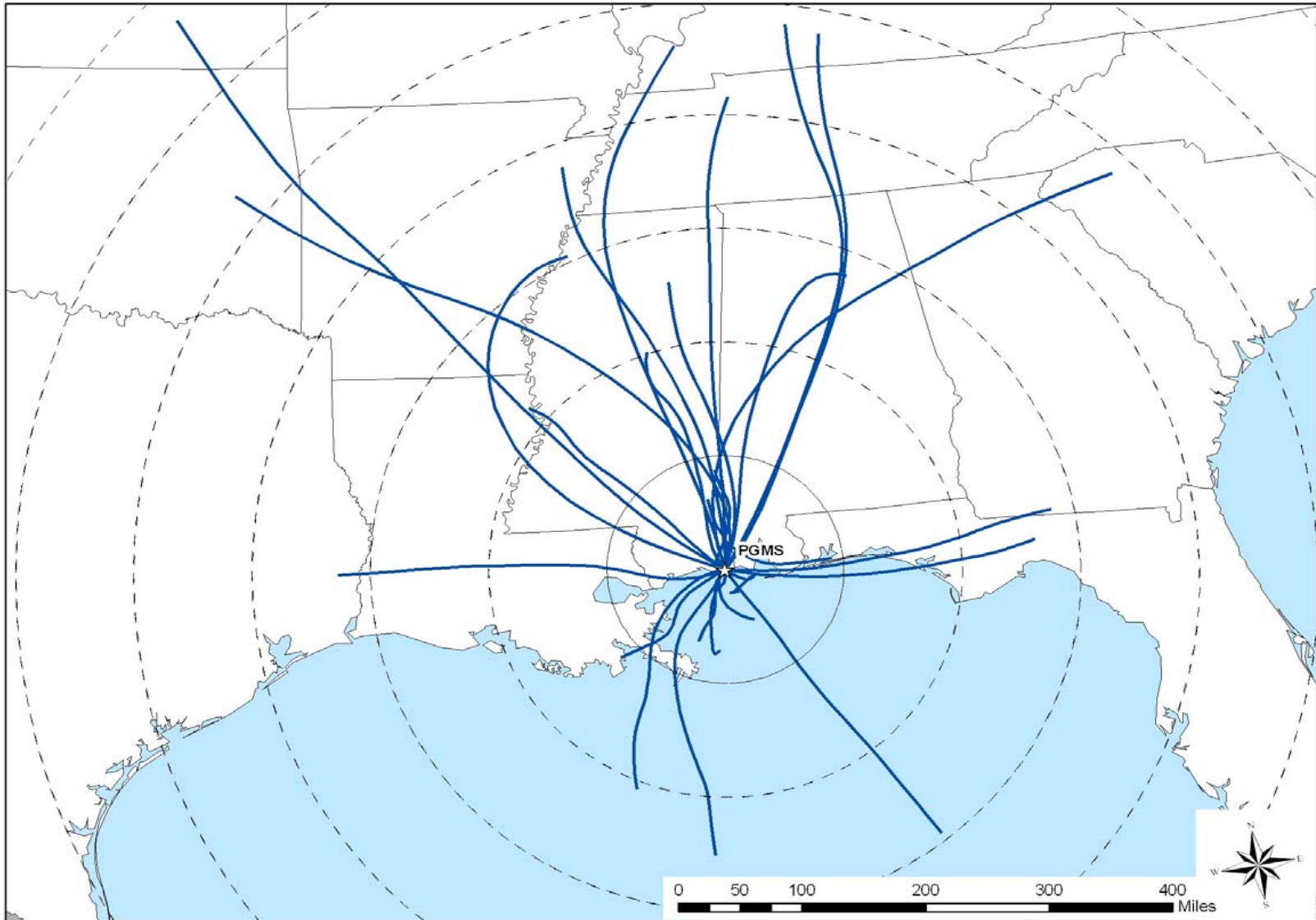


Figure 12-15. Composite Back Trajectory Map for TUMS

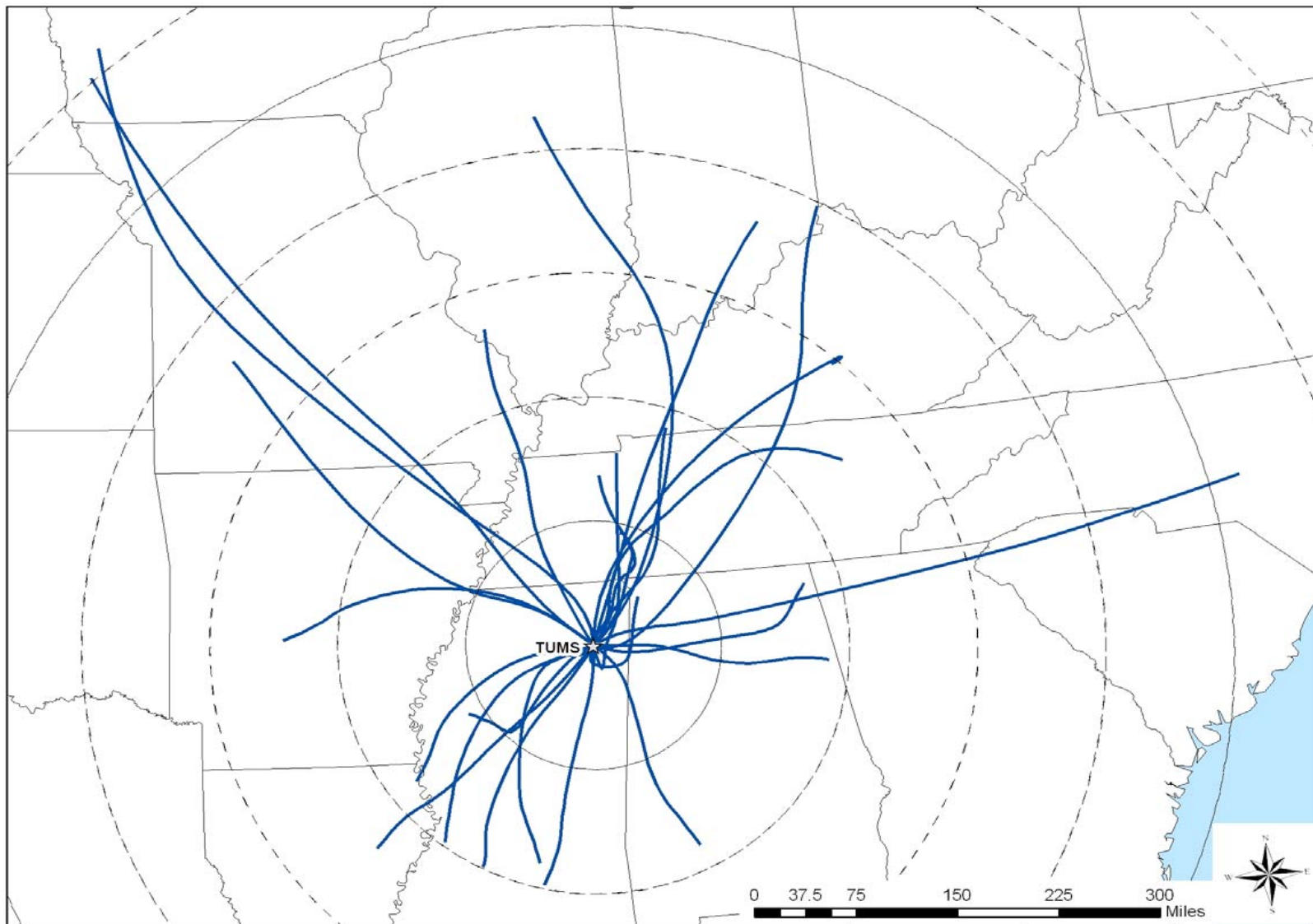


Table 12-1. Average Concentration and Meteorological Parameters for Sites in Mississippi

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
GPMS	All 2004		76.11 (± 1.28)	67.90 (± 1.33)	59.27 (± 1.50)	62.90 (± 1.31)	76.40 (± 1.13)	1018.09 (± 0.55)	-1.15 (± 0.37)	0.24 (± 0.45)
	sample day	56.31 (± 46.56)	76.88 (± 5.18)	67.42 (± 5.49)	55.95 (± 6.83)	61.11 (± 5.66)	69.78 (± 4.86)	1018.82 (± 1.87)	0.20 (± 1.03)	-1.39 (1.74)
GRMS	All 2004		73.67 (± 1.53)	63.46 (± 1.50)	54.92 (± 1.58)	58.64 (± 1.44)	76.46 (± 1.06)	1018.39 (± 0.58)	-0.38 (± 0.28)	0.90 (± 0.49)
	sample day	115.00 (± 19.17)	72.39 (± 6.36)	60.91 (± 6.01)	51.02 (± 6.11)	55.48 (± 5.68)	73.48 (± 3.09)	1020.04 (± 1.80)	-0.24 (0.82)	-0.13 (± 1.47)
JAMS	All 2004		74.37 (± 1.42)	64.80 (± 1.40)	55.46 (± 1.57)	59.56 (± 1.37)	74.63 (± 1.24)	1018.03 (± 0.56)	-0.35 (± 0.33)	0.92 (± 0.40)
	sample day	45.48 (± 7.24)	75.48 (± 5.81)	64.92 (± 5.91)	53.44 (± 6.60)	58.58 (± 5.77)	70.03 (± 4.55)	1019.10 (± 1.94)	-0.03 (± 1.12)	(-0.50) (± 1.14)
PGMS	All 2004		77.32 (± 1.25)	66.77 (± 1.30)	59.07 (± 1.47)	62.28 (± 1.30)	78.95 (± 0.95)	1018.53 (± 0.55)	-1.04 (± 0.27)	-0.47 (± 0.37)
	sample day	37.93 (± 8.59)	75.41 (± 5.44)	64.13 (± 5.57)	54.58 (± 6.41)	58.88 (± 5.61)	74.40 (± 3.60)	1019.09 (± 1.77)	0.21 (± 0.80)	-2.33 (1.42)
TUMS	All 2004		71.60 (± 1.54)	61.84 (± 1.51)	52.81 (± 1.68)	56.95 (± 1.48)	72.02 (± 1.15)	1018.59 (± 0.58)	-0.14 (± 0.24)	0.13 (± 0.47)
	sample day	33.01 (± 8.22)	70.67 (± 7.02)	59.97 (± 6.50)	49.97 (± 6.94)	54.66 (± 6.28)	72.94 (± 3.79)	1019.64 (± 1.92)	0.18 (± 0.77)	-1.92 (± 1.54)

Table 12-2. Summary of the Toxic Cancer Compounds at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo, Mississippi Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Gulfport, Mississippi - GPMS						
Acrylonitrile	1.70 E-05	28.76	28.76	0.25	2	16.97
Carbon Tetrachloride	8.78 E-06	14.88	43.64	0.59	23	8.78
Benzene	6.81 E-06	11.54	55.18	0.87	25	6.81
1,3-Butadiene	6.10 E-06	10.33	65.51	0.20	4	6.10
<i>p</i> -Dichlorobenzene	5.29 E-06	8.97	74.48	0.48	1	5.29
Acetaldehyde	4.56 E-06	7.73	82.20	2.07	23	4.56
Tetrachloroethylene	4.40 E-06	7.46	89.67	0.75	1	4.40
Ethyl Acrylate	4.01 E-06	6.80	96.47	0.29	1	4.01
<i>trans</i> -1,3-Dichloropropene	1.82 E-06	3.08	99.54	0.45	1	1.82
Dichloromethane	2.64 E-07	0.45	99.99	0.56	3	0.26
Formaldehyde	6.02 E-09	0.01	100.00	1.09	23	<0.01
Grenada, Mississippi - GRMS						
Acrylonitrile	3.15 E-05	61.13	61.13	0.46	8	31.54
Carbon Tetrachloride	8.13 E-06	15.77	76.89	0.54	27	8.13
Acetaldehyde	4.76 E-06	9.22	86.12	2.16	29	4.76
Benzene	4.20 E-06	8.15	94.26	0.54	31	4.20
<i>trans</i> -1,3-Dichloropropene	1.82 E-06	3.52	97.78	0.45	1	1.82
Trichloroethylene	9.00 E-07	1.74	99.53	0.45	2	0.90
Dichloromethane	2.29 E-07	0.44	99.97	0.49	5	0.23
Formaldehyde	1.55 E-08	0.03	100.00	2.81	29	0.02
Jackson, Mississippi - JAMS						
Acrylonitrile	27.2 E-05	32.35	32.35	0.40	5	27.15
Benzene	1.33 E-05	15.88	48.22	1.71	25	13.33

Table 12-2. Summary of the Toxic Cancer Compounds at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo, Mississippi Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
1,3-Butadiene	9.94 E-06	11.84	60.07	0.33	13	9.94
Acetaldehyde	9.69 E-06	11.55	71.61	4.41	23	9.69
Carbon Tetrachloride	8.95 E-06	10.67	82.28	0.60	22	8.95
Tetrachloroethylene	6.66 E-06	7.94	90.22	1.13	5	6.66
<i>p</i> -Dichlorobenzene	6.19 E-06	7.38	97.59	0.56	9	6.19
<i>trans</i> -1,3-Dichloropropene	1.82 E-06	2.16	99.76	0.45	1	1.82
Dichloromethane	1.99 E-07	0.24	99.99	0.42	9	0.20
Formaldehyde	4.40 E-09	0.01	100.00	0.80	23	<0.00
Pascagoula, Mississippi - PGMS						
Acrylonitrile	1.92 E-05	35.99	35.99	0.28	2	19.18
Carbon Tetrachloride	9.05 E-06	16.98	52.97	0.60	24	9.05
Benzene	8.49 E-06	15.93	68.90	1.09	27	8.49
<i>p</i> -Dichlorobenzene	6.61 E-06	12.41	81.31	0.60	1	6.61
1,3-Butadiene	5.53 E-06	10.38	91.69	0.18	7	5.53
Acetaldehyde	4.20 E-06	7.88	99.57	1.91	21	4.20
Dichloromethane	1.96 E-07	0.37	99.94	0.42	4	0.20
Formaldehyde	3.07 E-08	0.06	100.00	5.58	20	0.03
Tupelo, Mississippi - TUMS						
Acrylonitrile	1.71 E-05	37.42	37.42	0.25	5	17.12
Carbon Tetrachloride	8.62 E-06	18.84	56.26	0.57	24	8.62
Benzene	6.35 E-06	13.89	70.15	0.81	26	6.35
Acetaldehyde	4.75 E-06	10.38	80.53	2.16	25	4.75
1,3-Butadiene	4.42 E-06	9.67	90.20	0.15	3	4.42
Vinyl Chloride	4.20 E-06	9.18	99.38	0.48	3	4.20
Dichloromethane	2.76 E-07	0.60	99.98	0.59	6	0.28
Formaldehyde	8.40 E-09	0.02	100.00	1.53	25	0.01

Table 12-3. Summary of the Toxic Noncancer Compounds at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo, Mississippi Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Gulfport, Mississippi - GPMS						
Acetonitrile	6.25 E-01	47.47	47.47	37.49	22	2
Acetaldehyde	2.30 E-01	17.50	64.96	2.07	23	1
Acrylonitrile	1.25 E-01	9.48	74.44	0.25	2	0
Formaldehyde	1.12 E-01	8.49	82.93	1.09	23	0
1,3-Butadiene	1.02 E-01	7.72	90.65	0.20	4	0
Benzene	2.91 E-02	2.21	92.86	0.87	25	0
<i>trans</i> -1,3-Dichloropropene	2.27 E-02	1.72	94.58	0.45	1	0
Xylenes	2.12 E-02	1.61	96.19	2.12	24	0
Chloromethane	1.52 E-02	1.15	97.35	1.37	25	0
Carbon Tetrachloride	1.46 E-02	1.11	98.46	0.59	23	0
1,1-Dichloroethene	6.54 E-03	0.50	98.96	1.31	1	0
Toluene	5.67 E-03	0.43	99.39	2.27	25	0
Tetrachloroethylene	2.76 E-03	0.21	99.60	0.75	1	0
Chloroform	2.01 E-03	0.15	99.75	0.20	4	0
Styrene	1.28 E-03	0.10	99.85	1.28	16	0
<i>p</i> -Dichlorobenzene	6.01 E-04	0.05	99.89	0.48	1	0
Dichloromethane	5.62 E-04	0.04	99.94	0.56	3	0
Ethylbenzene	3.84 E-04	0.03	99.97	0.38	21	0
Methyl Ethyl Ketone	3.75 E-04	0.03	99.99	1.87	20	0
Methyl tert-Butyl Ether	8.41 E-05	0.01	100.00	0.25	2	0
Grenada, Mississippi - GRMS						
Acetonitrile	1.40 E+00	60.64	60.64	83.80	31	15
Formaldehyde	2.87 E-01	12.45	73.09	2.81	29	0
Acetaldehyde	2.40 E-01	10.43	83.52	2.16	29	0
Acrylonitrile	2.32 E-01	10.07	93.59	0.46	8	0
Xylenes	6.54 E-02	2.84	96.43	6.54	31	0

Table 12-3. Summary of the Toxic Noncancer Compounds at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo, Mississippi Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
<i>trans</i> -1,3-Dichloropropene	2.27 E-02	0.99	97.41	0.45	1	0
Benzene	1.80 E-02	0.78	98.19	0.54	31	0
Chloromethane	1.39 E-02	0.60	98.80	1.25	31	0
Carbon Tetrachloride	1.36 E-02	0.59	99.38	0.54	27	0
Toluene	1.11 E-02	0.48	99.87	4.45	31	0
Ethylbenzene	9.12 E-04	0.04	99.91	0.91	30	0
Trichloroethylene	7.50 E-04	0.03	99.94	0.45	2	0
Dichloromethane	4.86 E-04	0.02	99.96	0.49	5	0
Styrene	4.57 E-04	0.02	99.98	0.46	18	0
Methyl Ethyl Ketone	3.78 E-04	0.02	100.00	1.89	29	0
Chloroethane	5.54 E-05	0.00	100.00	0.55	2	0
Jackson, Mississippi - JAMS						
Acetaldehyde	4.89 E-01	38.21	38.21	4.41	23	0
Acrylonitrile	2.00 E-01	15.59	53.80	0.40	5	0
1,3-Butadiene	1.66 E-01	12.94	66.74	0.33	13	0
Acetonitrile	1.61 E-01	12.58	79.31	9.66	23	0
Formaldehyde	8.16 E-02	6.37	85.68	0.80	23	0
Benzene	5.70 E-02	4.45	90.13	1.71	25	0
Xylenes	5.38 E-02	4.20	94.33	5.38	25	0
<i>trans</i> -1,3-Dichloropropene	2.27 E-02	1.77	96.10	0.45	1	0
Carbon Tetrachloride	1.49 E-02	1.17	97.27	0.60	22	0
Chloromethane	1.48 E-02	1.15	98.42	1.33	25	0
Toluene	1.04 E-02	0.81	99.23	4.16	25	0
Tetrachloroethylene	4.18 E-03	0.33	99.56	1.13	5	0
Chloroform	2.51 E-03	0.20	99.75	0.25	6	0
Ethylbenzene	8.02 E-04	0.06	99.82	0.80	25	0
<i>p</i> -Dichlorobenzene	7.04 E-04	0.05	99.87	0.56	9	0

Table 12-3. Summary of the Toxic Noncancer Compounds at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo, Mississippi Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Dichloromethane	4.24 E-04	0.03	99.90	0.42	9	0
Methyl Ethyl Ketone	3.64 E-04	0.03	99.93	1.82	22	0
Styrene	3.39 E-04	0.03	99.96	0.34	19	0
Methyl tert-Butyl Ether	3.11 E-04	0.02	99.98	0.93	20	0
Methyl Isobutyl Ketone	1.78 E-04	0.01	100.00	0.53	2	0
Chloroethane	2.90 E-05	0.00	100.00	0.29	1	0
Pascagoula, Mississippi - PGMS						
Formaldehyde	5.69 E-01	44.28	44.28	5.58	20	2
Acetaldehyde	2.12 E-01	16.52	60.80	1.91	21	0
Acetonitrile	1.62 E-01	12.63	73.43	9.73	16	1
Acrylonitrile	1.41 E-01	10.98	84.40	0.28	2	0
1,3-Butadiene	8.27 E-02	6.44	90.84	0.17	7	0
Benzene	3.56 E-02	2.77	93.61	1.07	27	0
Xylenes	3.31 E-02	2.57	96.19	3.31	27	0
Chloromethane	1.75 E-02	1.36	97.55	1.57	27	0
Carbon Tetrachloride	1.51 E-02	1.17	98.72	0.60	24	0
Toluene	8.78 E-03	0.68	99.41	3.51	27	0
<i>n</i> -Hexane	2.70 E-03	0.21	99.62	0.54	15	0
Chloroform	2.01 E-03	0.16	99.77	0.20	3	0
Ethylbenzene	7.75 E-04	0.06	99.83	0.77	27	0
<i>p</i> -Dichlorobenzene	7.52 E-04	0.06	99.89	0.60	1	0
Styrene	4.90 E-04	0.04	99.93	0.49	19	0
Dichloromethane	4.17 E-04	0.03	99.96	0.42	4	0
Methyl Ethyl Ketone	3.60 E-04	0.03	99.99	1.80	23	0
Methyl tert-Butyl Ether	1.20 E-04	0.01	100.00	0.36	1	0

Table 12-3. Summary of the Toxic Noncancer Compounds at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo, Mississippi Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Tupelo, Mississippi - TUMS						
Acetaldehyde	2.40 E-01	27.01	27.01	2.16	25	0
Acetonitrile	2.00 E-01	22.49	49.50	11.98	22	1
Formaldehyde	1.56 E-01	17.54	67.05	1.53	25	0
Acrylonitrile	1.26 E-01	14.17	81.22	0.25	5	0
1,3-Butadiene	7.37 E-02	8.30	89.53	0.15	3	0
Benzene	2.72 E-02	3.06	92.58	0.81	26	0
Xylenes	2.16 E-02	2.43	95.02	2.16	26	0
Carbon Tetrachloride	1.44 E-02	1.62	96.63	0.57	24	0
Chloromethane	1.40 E-02	1.58	96.63	0.57	24	0
Toluene	7.40 E-03	0.83	99.05	2.96	26	0
Vinyl Chloride	4.77 E-03	0.54	99.59	0.48	3	0
Chloroform	2.01 E-03	0.23	99.81	0.20	1	0
Dichloromethane	5.88 E-04	0.07	99.88	0.59	6	0
Ethylbenzene	3.53 E-04	0.04	99.92	0.35	26	0
Methyl Ethyl Ketone	3.33 E-04	0.04	99.96	1.66	22	0
Styrene	2.77 E-04	0.03	99.99	0.28	15	0
Methyl Isobutyl Ketone	1.09 E-04	0.01	100.00	0.33	2	0

Table 12-4. TNMOC Measured by the Pascagoula, Mississippi (PGMS) Monitoring Site

Monitoring Site	Average TNMOC Speciated (ppbC)	Average TNMOC w/ Unknowns (ppbC)	% TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)	Ethylene to Acetylene Ratio	% of Expected Ratio
PGMS	98.51	158.04	62	Isopentane (28.9)	1.08	64%

Table 12-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo Mississippi Sites

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Gulfport, Mississippi - GPMS								
1,3-Butadiene	-0.95	-0.98	-0.99	-0.99	-0.85	0.83	0.29	-0.59
Acetaldehyde	-0.45	-0.42	-0.32	-0.38	0.01	-0.08	0.52	-0.29
Acetonitrile	0.20	0.17	0.17	0.17	0.12	-0.13	-0.24	0.10
Acrylonitrile	NA							
Benzene	-0.21	-0.29	-0.25	-0.28	-0.05	0.26	0.09	0.18
Carbon Tetrachloride	0.17	0.19	0.23	0.21	0.22	-0.43	-0.08	-0.05
Ethyl Acrylate	NA							
Formaldehyde	-0.44	-0.35	-0.24	-0.31	0.10	-0.10	0.53	-0.31
<i>p</i> -Dichlorobenzene	NA							
Tetrachloroethylene	NA							
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	0.02	-0.10	-0.05	-0.08	0.11	0.18	0.00	0.24
Grenada, Mississippi - GRMS								
Acetaldehyde	0.38	0.34	0.30	0.32	-0.14	-0.07	-0.15	-0.10
Acetonitrile	0.37	0.34	0.31	0.32	-0.12	-0.34	-0.38	0.43
Acrylonitrile	0.09	0.11	0.16	0.14	0.37	-0.12	-0.26	-0.38
Benzene	-0.49	-0.48	-0.46	-0.48	-0.03	0.33	0.32	-0.29
Carbon Tetrachloride	-0.06	0.01	-0.01	0.00	-0.12	-0.06	-0.10	0.23
Formaldehyde	0.40	0.41	0.43	0.42	0.13	-0.18	0.05	0.02
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	-0.18	-0.24	-0.27	-0.25	-0.14	0.19	0.10	-0.25
Jackson, Mississippi - JAMS								
1,3-Butadiene	-0.62	-0.70	-0.65	-0.69	-0.23	0.58	0.23	-0.08
Acetaldehyde	0.10	0.04	-0.04	-0.01	-0.26	-0.02	-0.17	0.17
Acetonitrile	0.27	0.25	0.22	0.23	0.01	-0.13	-0.20	0.32
Acrylonitrile	0.19	0.45	0.72	0.70	0.61	0.19	0.36	0.57
Benzene	-0.28	-0.34	-0.33	-0.34	-0.11	0.24	0.16	0.05

Table 12-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Gulfport, Grenada, Jackson, Pascagoula, and Tupelo Mississippi Sites (Cont.)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Carbon Tetrachloride	0.45	0.45	0.42	0.42	0.11	-0.37	-0.11	0.40
Formaldehyde	0.39	0.36	0.26	0.30	-0.21	-0.18	-0.46	0.26
<i>p</i> -Dichlorobenzene	-0.48	-0.60	-0.60	-0.62	-0.33	0.72	0.04	0.26
Tetrachloroethylene	-0.62	-0.63	-0.63	-0.63	-0.10	0.58	0.58	-0.16
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	-0.19	-0.27	-0.30	-0.30	-0.19	0.21	0.14	0.13
Pascagoula, Mississippi - PGMS								
1,3-Butadiene	0.15	0.17	0.20	0.18	0.39	-0.07	-0.22	0.53
Acetaldehyde	-0.35	-0.33	-0.41	-0.37	-0.45	0.37	0.06	-0.30
Acetonitrile	0.16	0.01	-0.05	-0.03	-0.09	-0.34	0.12	0.04
Acrylonitrile	NA							
Benzene	0.53	0.52	0.53	0.53	0.41	-0.21	-0.35	0.60
Carbon Tetrachloride	0.45	0.47	0.50	0.48	0.38	-0.55	-0.08	0.31
Formaldehyde	-0.44	-0.37	-0.43	-0.40	-0.42	0.19	0.33	-0.29
<i>p</i> -Dichlorobenzene	NA							
Xylenes	0.64	0.63	0.63	0.63	0.42	-0.27	-0.32	0.62
Tupelo, Mississippi - TUMS								
1,3-Butadiene	NA							
Acetaldehyde	0.64	0.60	0.57	0.58	0.07	0.09	-0.23	0.44
Acetonitrile	0.17	0.15	0.11	0.12	-0.08	0.04	0.03	0.12
Acrylonitrile	0.59	0.61	0.49	0.53	-0.06	-0.17	0.47	0.41
Benzene	-0.21	-0.24	-0.31	-0.29	-0.39	0.45	0.15	0.11
Carbon Tetrachloride	0.00	0.08	0.14	0.11	0.21	-0.39	0.19	-0.18
Formaldehyde	0.78	0.77	0.75	0.76	0.22	-0.34	-0.38	0.43
Vinyl Chloride	NA							
Xylenes	0.26	0.24	0.22	0.22	0.05	-0.03	-0.12	0.38

Table 12-6. Motor Vehicle Information vs. Daily Concentration for Mississippi Monitoring Sites

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Car Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
GPMS	189,614	163,972	0.86	172,653	148,482	17,000	56.31 (\pm 46.56)
GRMS	22,809	19,564	0.86	21,446	18,444	1,100	115.00 (\pm 19.17)
JAMS	249,087	177,642	0.71	266,182	188,989	12,500	45.48 (\pm 7.24)
PGMS	133,928	116,592	0.87	56,235	48,924	8,600	37.93 (\pm 8.59)
TUMS	77,690	68,191	0.88	70,215	61,789	4,900	33.01 (\pm 8.22)

13.0 Sites in Missouri

This section presents meteorological, concentration, and spatial trends for the three UATMP sites in Missouri (S4MO, SLMO, and BTMO). Two of these sites are located in the St. Louis metropolitan statistical area (MSA), while the third (BTMO) is located to the south of the city. Figures 13-1 through 13-3 are topographical maps showing the monitoring sites in their urban locations. Figures 13-4 and 13-5 identify facilities within 10 miles of the sites that reported to the 2002 NEI. Numerous sources are located near the St. Louis sites, most of which are surface coating and miscellaneous industries, while BTMO has very few nearby sources. Hourly meteorological data were retrieved for all of 2004 at two weather stations near these sites for calculating correlations of meteorological data with ambient air concentration measurements. The weather stations are Cahokia-St. Louis and Farmington (WBAN 3960 and 93996, respectively).

Table 13-1 highlights the average UATMP concentration at each of these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*-components of the wind) for the entire year and on days samples were taken. St. Louis has a climate that is continental in nature, with cold, rather dry winters, warm, somewhat wetter summers, and a significant seasonal variability. Wind speeds are generally light and wind flows from the southeast on average, as indicated in Table 13-1. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987). BTMO sampled only in January and SLMO sampled through the beginning of February. This explains the large discrepancies between the 2004 and sample day averages.

13.1 Prevalent Compounds at the Missouri Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 13-2 summarizes the cancer weighting scores, and Table 13-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for

each site. It is important to note which types of compounds each site sampled in 2003. The BTMO and SLMO sites sampled carbonyl compounds and SNMOC; the S4MO site sampled all compound types except SVOC.

As can be shown in Table 13-2, two of the three detected cancer compounds at BTMO and SLMO are considered prevalent and reflect the nationwide cancer prevalent list, as listed in Section 3 of this report. Only formaldehyde is not a prevalent nationwide cancer compound. At S4MO, seven of the nine prevalent cancer compounds are also considered prevalent nationwide. Only arsenic and cadmium compounds are not on the nationwide cancer list. A similar pattern is exhibited for the noncancer compounds summarized in Table 13-3. At BTMO, the same three cancer compounds are also noncancer compounds. At SLMO, total xylenes are considered prevalent in addition to acetaldehyde, formaldehyde, and benzene. With the exception of several metal compounds and *n*-hexane, the noncancer prevalent compounds at S4MO reflect the nationwide noncancer list. Only formaldehyde, acetaldehyde, and benzene are prevalent across all three sites.

Prevalent toxic compounds not detected at the Missouri sites were: 1,2-dichloroethane; 1,2-dichloropropane; vinyl chloride; chloroprene; *cis*-1,3-dichloropropene; and ethyl acrylate.

13.2 Toxicity Analysis

Benzene and acetaldehyde contributed to over 99% of the total cancer toxicity at both BTMO and SLMO, while only contributing to about 20% at S4MO. The cancer risk from benzene at BTMO was roughly half of that at SLMO and S4MO (5.68, 12.14, and 10.72 in a million, respectively). At S4MO, acrylonitrile contributed to 31% of the total cancer toxicity, and has a cancer risk of 25.41 in a million. Prevalent metal compounds contributed to 12% of the total cancer toxicity.

Formaldehyde, acetaldehyde, and benzene contribute to 92% or more of the total noncancer toxicity at BTMO and SLMO. The highest average toxicity between these two sites was 0.436 for acetaldehyde at SLMO (over 1 indicates a significant chance of a noncancer health

effect). No adverse health concentrations were measured at these sites. Metal compounds at S4MO contributed to nearly 22% of the total noncancer toxicity, with manganese compounds contributing over 16%. Six adverse health concentrations were measured at this site, with one for manganese compounds, four for formaldehyde, and one for acetaldehyde.

13.3 Meteorological and Concentration Averages at the Missouri Sites

Carbonyl compounds and SNMOC were measured at all three Missouri sites, and VOC and metal compounds were measured at S4MO, as indicated in Tables 3-3 and 3-4. The average daily UATMP concentration for each site is listed in Table 13-1. Also listed in Table 13-1 are the averages for selected meteorological parameters from January 2004 to December 2004.

SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for SLMO was 203.40 ppbC, of which nearly 52% could be identified through speciation. Of the speciated compounds, *n*-hexane measured the highest concentration at the SLMO site (30.40 ppbC). The average total NMOC value for S4MO was 160.74 ppbC, of which nearly 76% could be identified through speciation. Of the speciated compounds, *n*-hexane measured the highest concentration at the S4MO site (83.20 ppbC). The average total NMOC value for BTMO was 92.35 ppbC, of which nearly 43% could be identified through speciation. Of the speciated compounds at BTMO, propane measured the highest concentration (6.55 ppbC). This information is given in Table 13-4. Also included in Table 13-4 is the average metals concentration at S4MO.

Table 13-5 is the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. Many of the Pearson correlations for BTMO and SLMO appear to be very strong. However, the number of detects of each

compound at BTMO was four and at SLMO was five. This small sample size may drastically skew the correlations, making them appear stronger than they really are.

At S4MO, benzene and total xylenes exhibited moderately strong to strong negative correlations with maximum, average, dew point, and wet bulb temperatures, while acetaldehyde, acetonitrile, acrylonitrile, formaldehyde, and tetrachloroethylene exhibited moderately strong to strong positive correlations with these same parameters. Strong positive correlations were also computed between *n*-hexane and the moisture parameters. Acrylonitrile and *n*-hexane exhibited strong negative correlations with sea level pressure. Most of the correlations between the prevalent compounds and the wind components were weak or moderate.

Figures 13-6 through 13-8 show the composite back trajectories for the Missouri sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in these figures, SLMO and BTMO sampled very few days in 2004. There are too few trajectories to determine where back trajectories predominantly originated from for these two sites. Back trajectories at S4MO originated from nearly all directions, although there is a lower number of them from the east or the west. Each circle around the site in Figures 13-6 through 13-8 represents 100 miles; between 40% (SLMO) and 57% (S4MO) of the trajectories originated within 300 miles, and between 75% (BTMO) and 96% (SLMO) within 700 miles from the Missouri sites. The 24-hour airshed domain for the sites appears large. Back trajectories originated as far away as 700-800 miles.

13.4 Spatial Analysis

County-level vehicle registration and population in St. Francois and St. Louis Counties were obtained from the Missouri Department of Revenue and the US Census Bureau, and are summarized in Table 13-6. Table 13-6 also contains a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 13-6 also contains traffic

information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the sites listed in the Table 13-6. The St. Louis sites had higher traffic volume and vehicle ownership than BTMO, and S4MO had the highest traffic volume and vehicle ownership.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. BTMO and SLMO did not measure VOCs and are therefore not represented in Figure 3-1. S4MO's concentration ratios resemble those of the roadside study, although all of its xylene-ethylbenzene ratio is somewhat lower than that of the roadside study.

All three Missouri sites sampled for SNMOC in addition to carbonyl compounds. Acetylene and ethylene are SNMOCs that are primarily emitted from mobile sources. Tunnel studies conducted on mobile source emissions have found that ethylene and acetylene are typically detected in a 1.7 to 1 ratio. For more information, please refer to Section 3.4.4. Listed in Table 13-4 is the ethylene-acetylene ratio for these sites and what percent of the expected 1.7 ratio it represents. As shown, BTMO's ethylene-acetylene ratio is within 54% of the expected 1.7 ratio (0.91); S4MO's ethylene-acetylene ratio is within 52% of the expected 1.7 ratio (0.88); SLMO's ethylene-acetylene ratio is only within 43% of the expected 1.7 ratio (0.73). This would indicate that the emissions near these sites may not be primarily from mobile sources.

13.5 RFG Analysis

The St. Louis, MO-IL MSA voluntarily participates in the federal reformulated fuel program (EPA, 1999c). Throughout the year, the oxygen content in gasoline must be at least 2% by weight, boosting the octane quality, increasing combustion, and reducing exhaust emissions. Additionally, the benzene content must not be greater than 1% by volume (EPA, 1994). The oxygenates used as RFG additives in the St. Louis MSA are MTBE, ethanol, and TAME (EPA, 2003b).

A survey at 3 service stations during the summer of 2002 in St. Louis, MO showed the oxygen content of fuels at 3.05% by weight and the benzene content at 0.468% by volume. MTBE and ethanol averaged 0.22% and 8.65% by weight, respectively, from the summer survey (EPA, 2003b). A survey at 2 service stations during the winter of 2002 in St. Louis, MO, showed the oxygen content at 2.84% by weight and the benzene content at 0.576% by volume. Ethanol, MTBE, and TAME averaged 6.54%, 2.91%, and 0.28% by weight, respectively, from the winter survey (EPA, 2003b). Figure 13-9 is the VOC profile at the S4MO site. SLMO did not sample for VOCs; thus, an RFG analysis was not performed for this site.

The total VOC concentrations at S4MO varied year-round, with the highest concentration occurring on August 31, 2004. On August 31, the non-HAP VOC and BTEX concentrations were higher than other sampling days. The non-HAP BTEX mobile concentrations were typically low or nonexistent. The sampling at S4MO ran from January 4 - December 29. Total VOC concentrations appear to be lower in the late spring and early summer months compared to the rest of the year.

The S4MO BTEX concentration was compared to the GPMS BTEX concentration. GPMS is located in a non-RFG requirement area, but the two sites have similar traffic volumes (S4MO = 22,840; GPMS = 17,000). The BTEX concentrations at S4MO are higher than GPMS (9.51 $\mu\text{g}/\text{m}^3$ vs. 5.50 $\mu\text{g}/\text{m}^3$, respectively), suggesting that the RFG requirements may not be effective.

13.6 NATTS Site Analysis

One of the St. Louis sites, S4MO, is an EPA-designated NATTS site. A description of the NATTS program is provided in Section 3.6. A regulation analysis and an emission tracer analysis for each of the NATTS sites was conducted. Details on each type of analysis are also provided in Section 3.6.

13.6.1 Regulation Analysis

Table 3-10 summarizes the reduction of emissions that is expected from the promulgation of regulations applicable to facilities located within 10 miles of the monitoring site. This analysis includes only regulations implemented after 2002 (regulations implemented prior to 2003 would already be in effect at the time of the 2002 National Emissions Inventory and no further reduction would be expected). As indicated in Table 3-10, twenty-six future regulations would be applicable to the facilities located within 10 miles of S4MO. Based on analysis, the regulations shown are expected to achieve a 4% reduction in emissions of carbonyl compounds, an 8% reduction of metal compounds, and a 5% reduction of VOC. Individual pollutant emissions are expected to be reduced between 1% (mercury compounds, tetrachloroethylene, methyl methacrylate, and methyl tert-butyl ether) and 24% (styrene). These reductions are expected to occur over the next several years as the last compliance date for the applicable regulations is January 2010.

13.6.2 Emission Tracer Analysis

The highest acetaldehyde and formaldehyde noncancer toxicity scores were further examined. Figures 13-10 through 13-11 are the pollution roses for acetaldehyde and formaldehyde at S4MO. The highest concentration of acetaldehyde and formaldehyde occurred on August 31, 2004 and winds on that day point to possible emission sources north of the monitor. Figures 13-12 and 13-13 are back trajectory maps for this date, which shows air originating to the north and northwest of the monitor. Also plotted in Figure 13-12 and 13-13 are acetaldehyde and formaldehyde sources near the monitor. These figures show many sources to the north and northwest of the monitor. Air likely passed nearby these sources prior to being sampled.

The highest manganese noncancer toxicity score was further examined. Figure 13-14 is the pollution rose for manganese compounds at S4MO. The highest concentration of manganese compounds also occurred on August 31, 2004 and winds on that day point to possible emission sources north of the monitor. Figure 13-15 is a back trajectory map for this date, which shows air originating to the north and northwest of the monitor. Also plotted in Figure 13-15 are

manganese compound sources near the monitor. These figures show many sources to the north and northwest of the monitor. Air likely passed nearby these sources prior to being sampled.

13.7 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e, minimum 3 years), an site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

13.7.1 Site-Specific Trends Analyses

BTMO and S4MO have been participants in the UATMP since 2002, and SLMO has participated since 2001. BTMO has not sampled for VOC as part of the UATMP, so only formaldehyde concentration data is available. BTMO's formaldehyde concentration for 2004 appears to be down considerably from 2003, although it is important to note that BTMO sampled only in January. For the last two years, SLMO has sampled only for carbonyl compounds. It appears that formaldehyde concentrations have decreased significantly since 2001. However, it is important to note that, like BTMO, SLMO sampled only through the beginning of February in 2004.

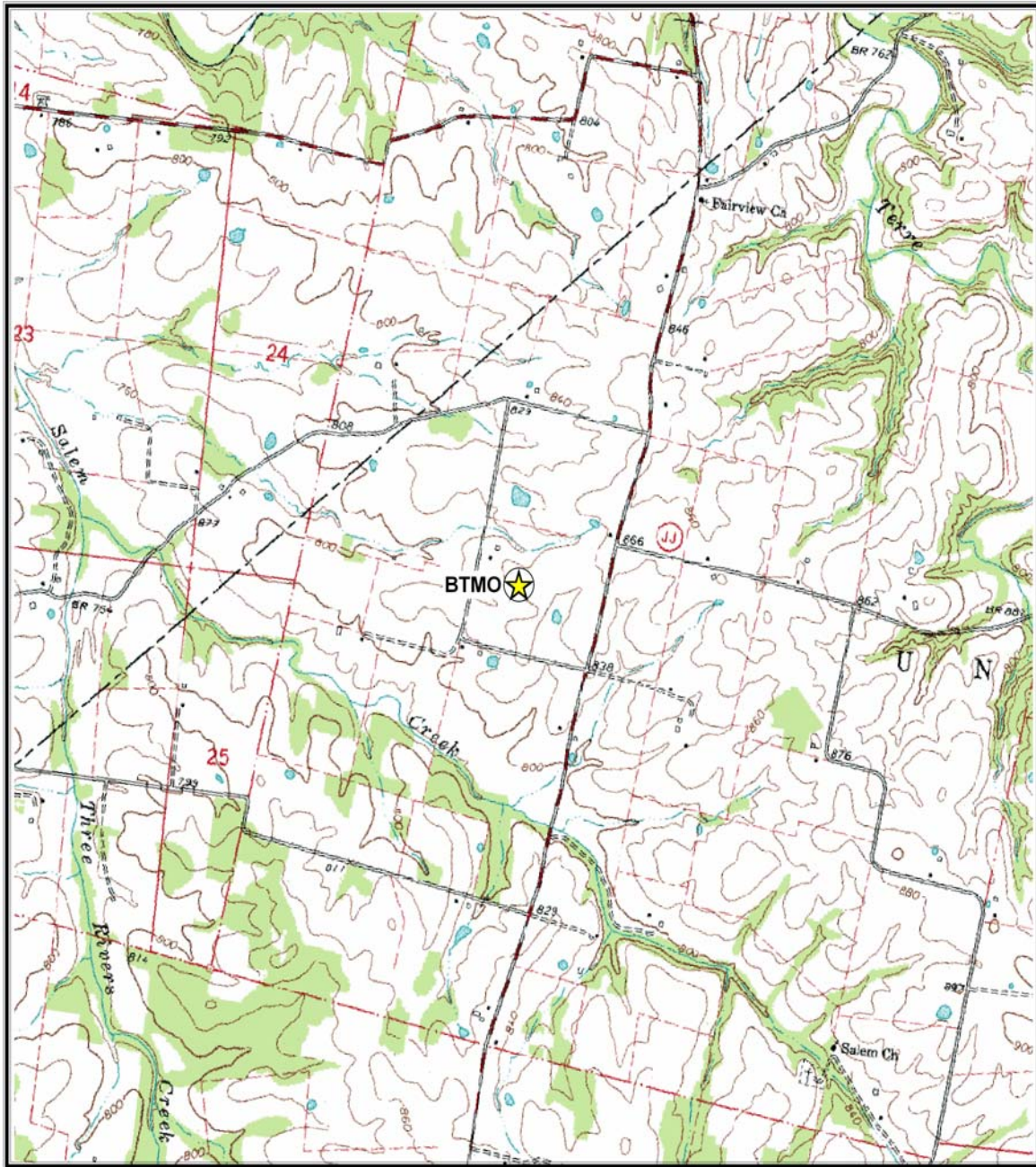
S4MO's formaldehyde, benzene, and 1,3-butadiene concentrations have changed little from their 2003 values. As S4MO did not sample for VOC until 2003, only formaldehyde concentrations were available in 2002. Formaldehyde concentrations were lower in 2002 than in 2003 and 2004. Please refer to Figures 3-29, 3-45, and 3-47.

13.7.2 MSA-Specific Trends Analyses

S4MO and SLMO reside in the St. Louis, MO-IL MSA. The St. Louis MSA has experienced a 6.1% increase in population and a 37.9% increase in vehicle miles traveled (VMT) from 1990 to 2003. VOC, carbonyl and metal compound emissions have decreased between 46% and 89% respectively, between 1990 and 2002. However, formaldehyde concentrations

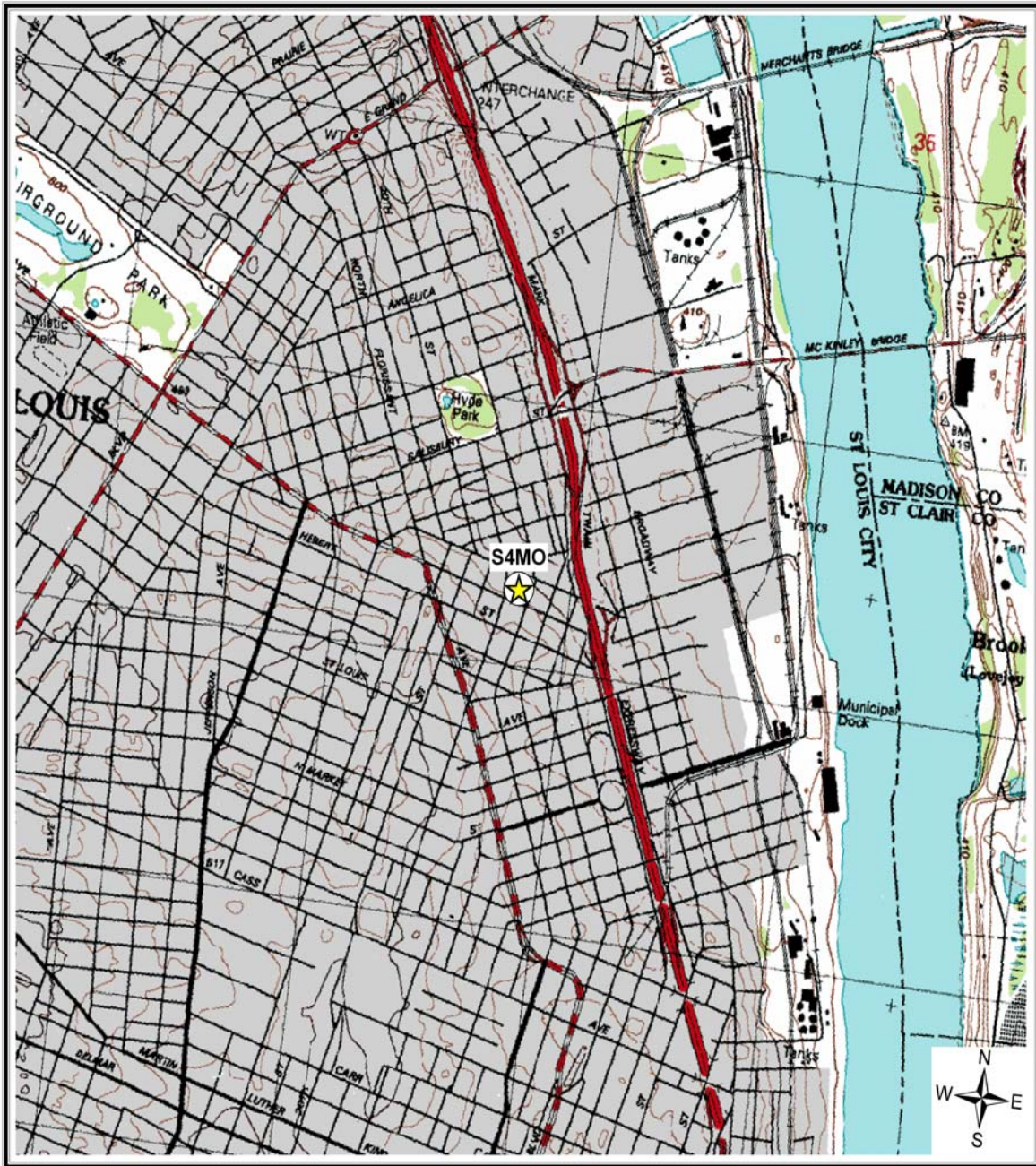
increased significantly (+198) during the time period. Research has shown that formaldehyde compounds tend to increase when fuels containing ethanol are combusted. The 2004 concentrations, as calculated from the UATMP sites representing this MSA (SLMO and S4MO), have decreased significantly from the 2002-2003 time period. Trends for these and other compounds of interest can be found in Table 3-13. This MSA has opted to participate in the reformulated gasoline program.

Figure 13-1. Bonne Terre, Missouri (BTMO) Monitoring Site



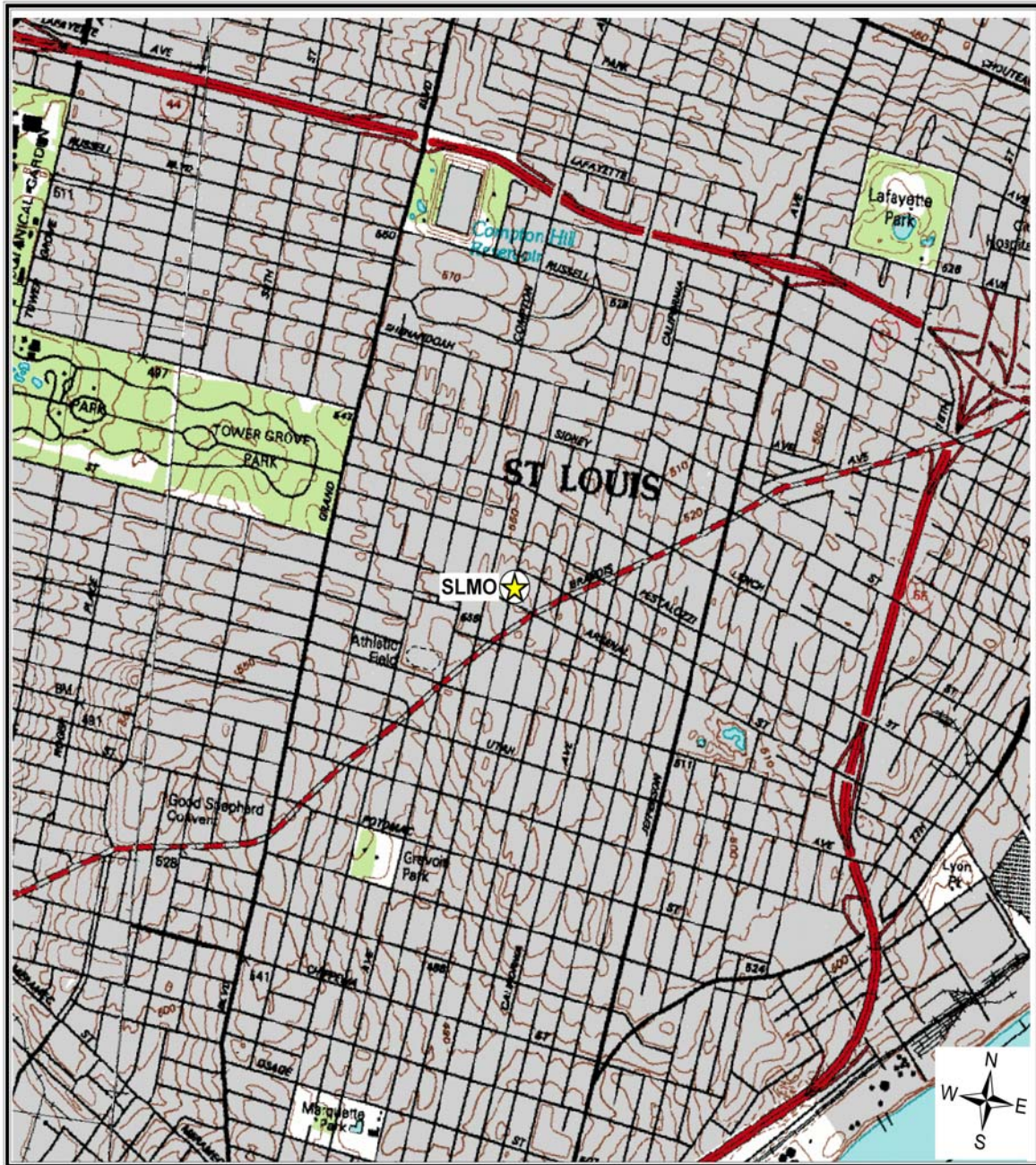
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 13-2. St. Louis, Missouri Site 1 (S4MO) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 13-3. St. Louis, Missouri Site 2 (SLMO) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 13-4. Facilities Located Within 10 Miles of BTMO

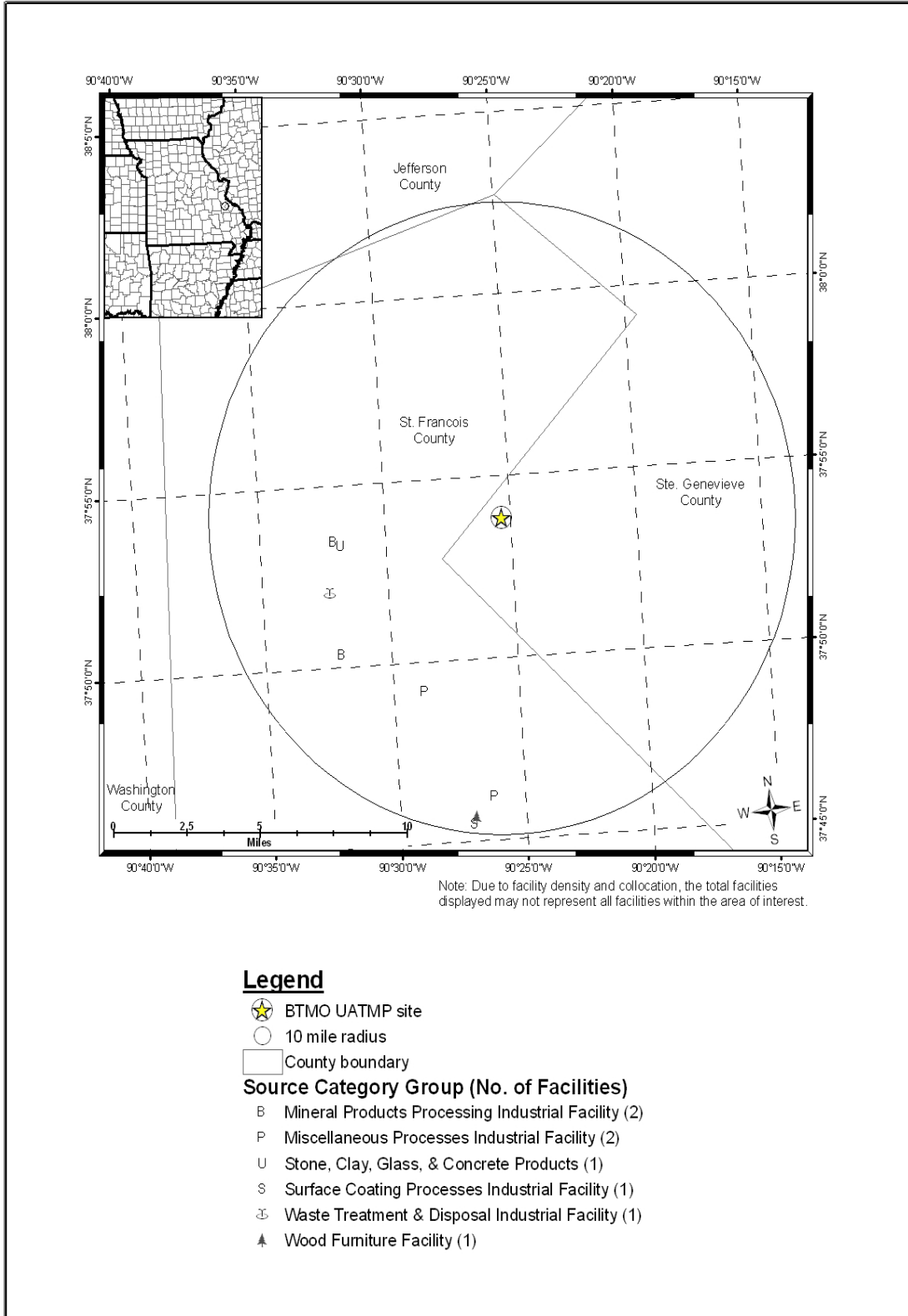


Figure 13-5. Facilities Located Within 10 Miles of S4MO and SLMO

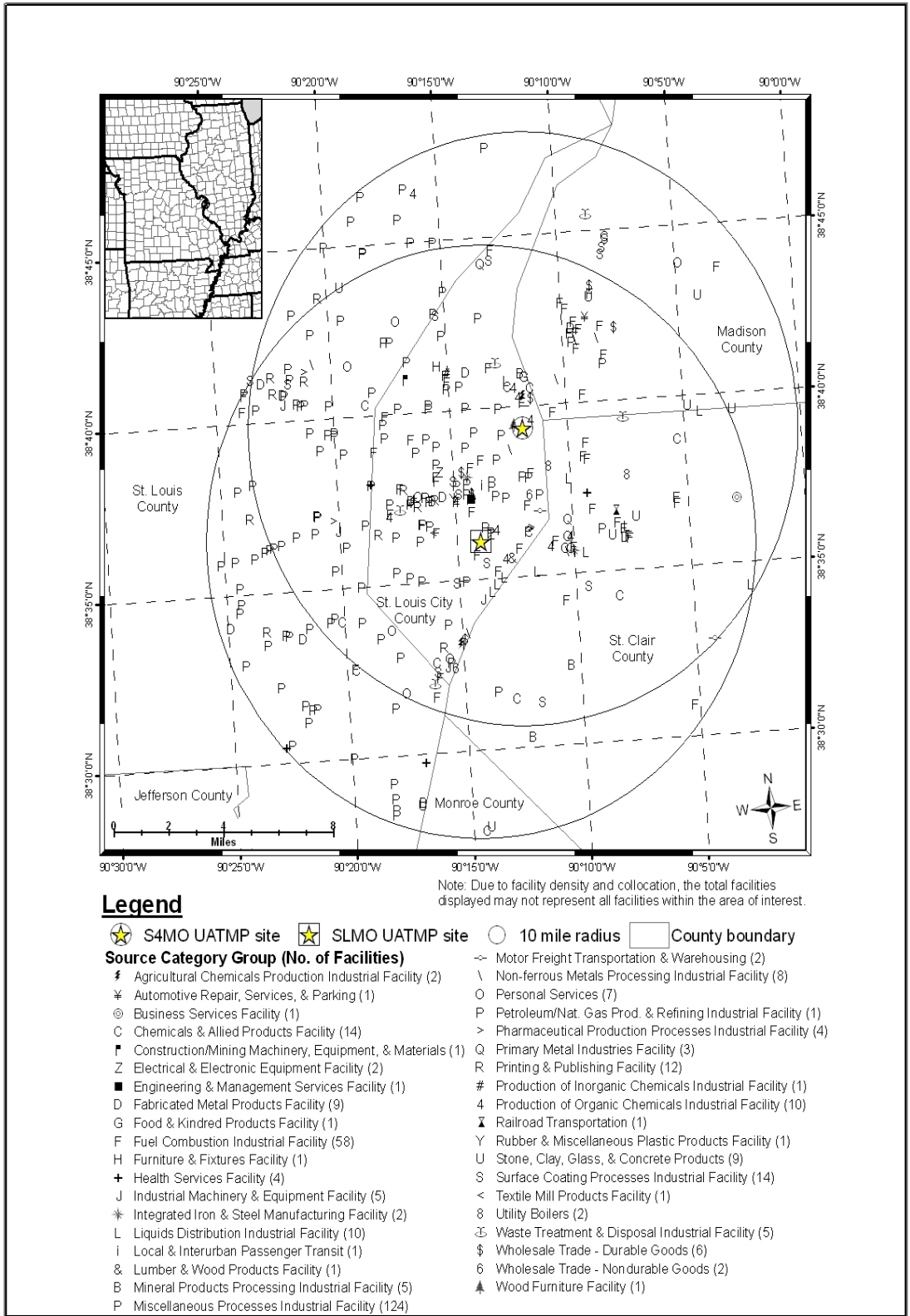


Figure 13-6. Composite Back Trajectory Map for BTMO

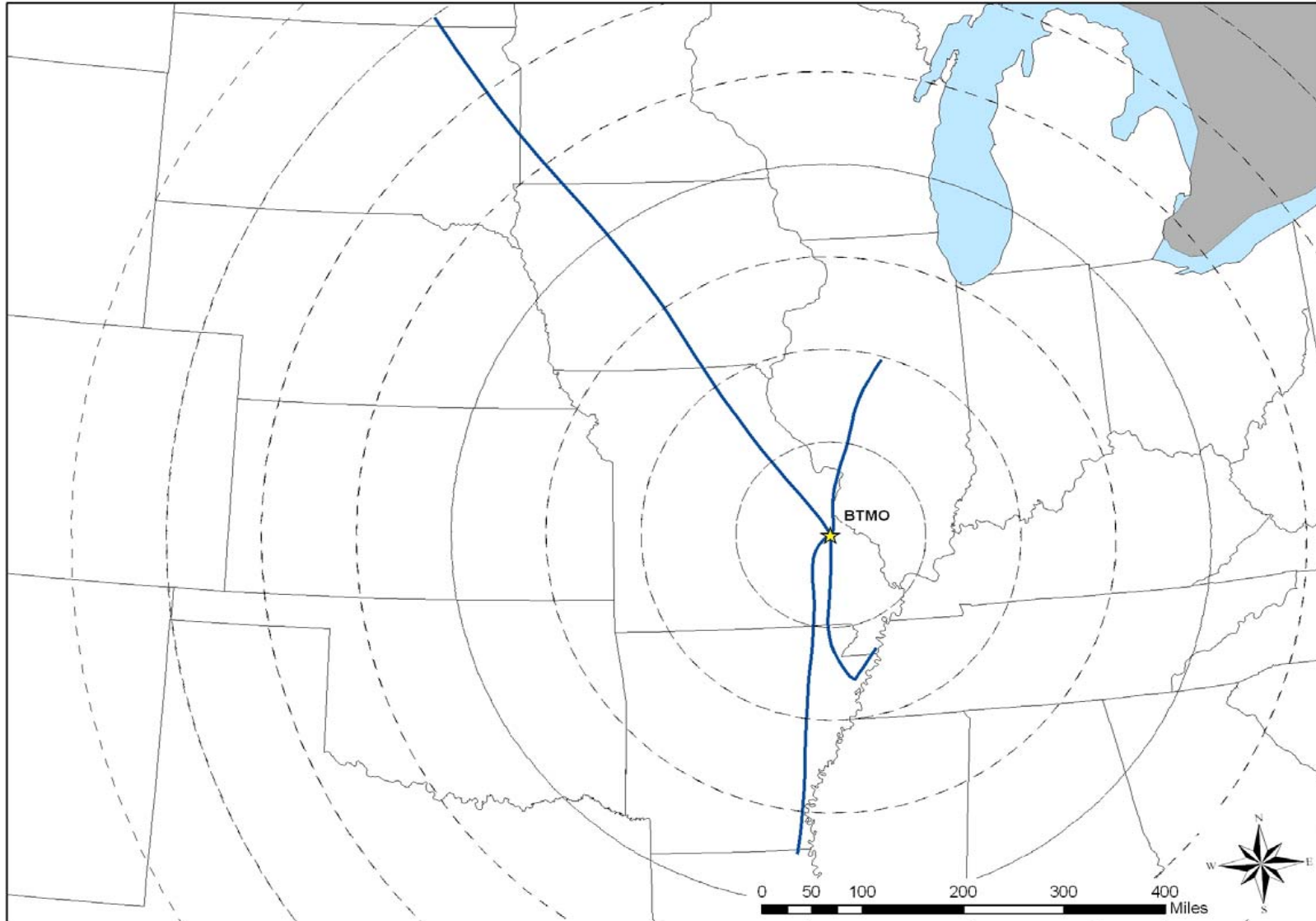


Figure 13-7. Composite Back Trajectory Map for S4MO

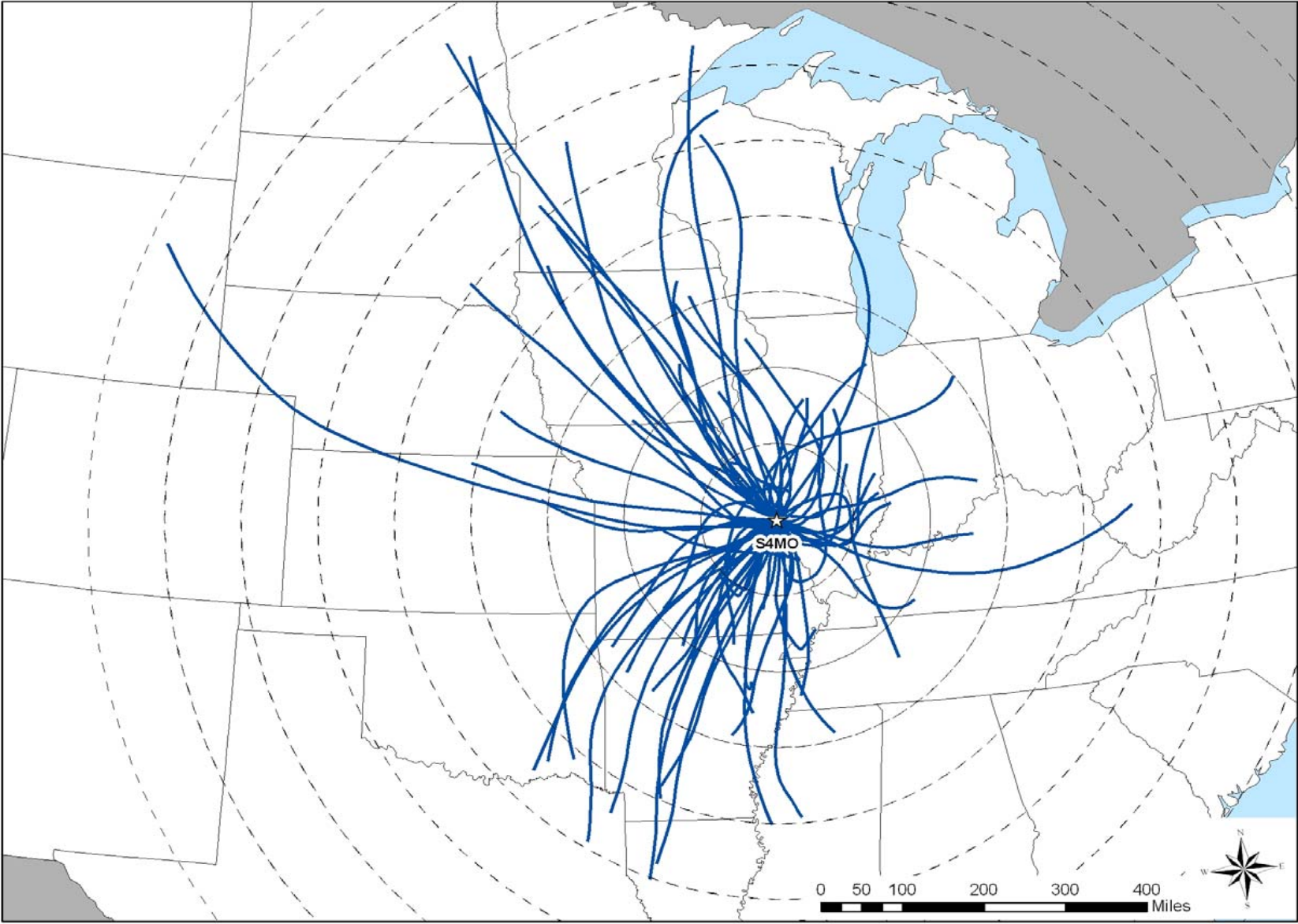


Figure 13-8. Composite Back Trajectory Map for SLMO

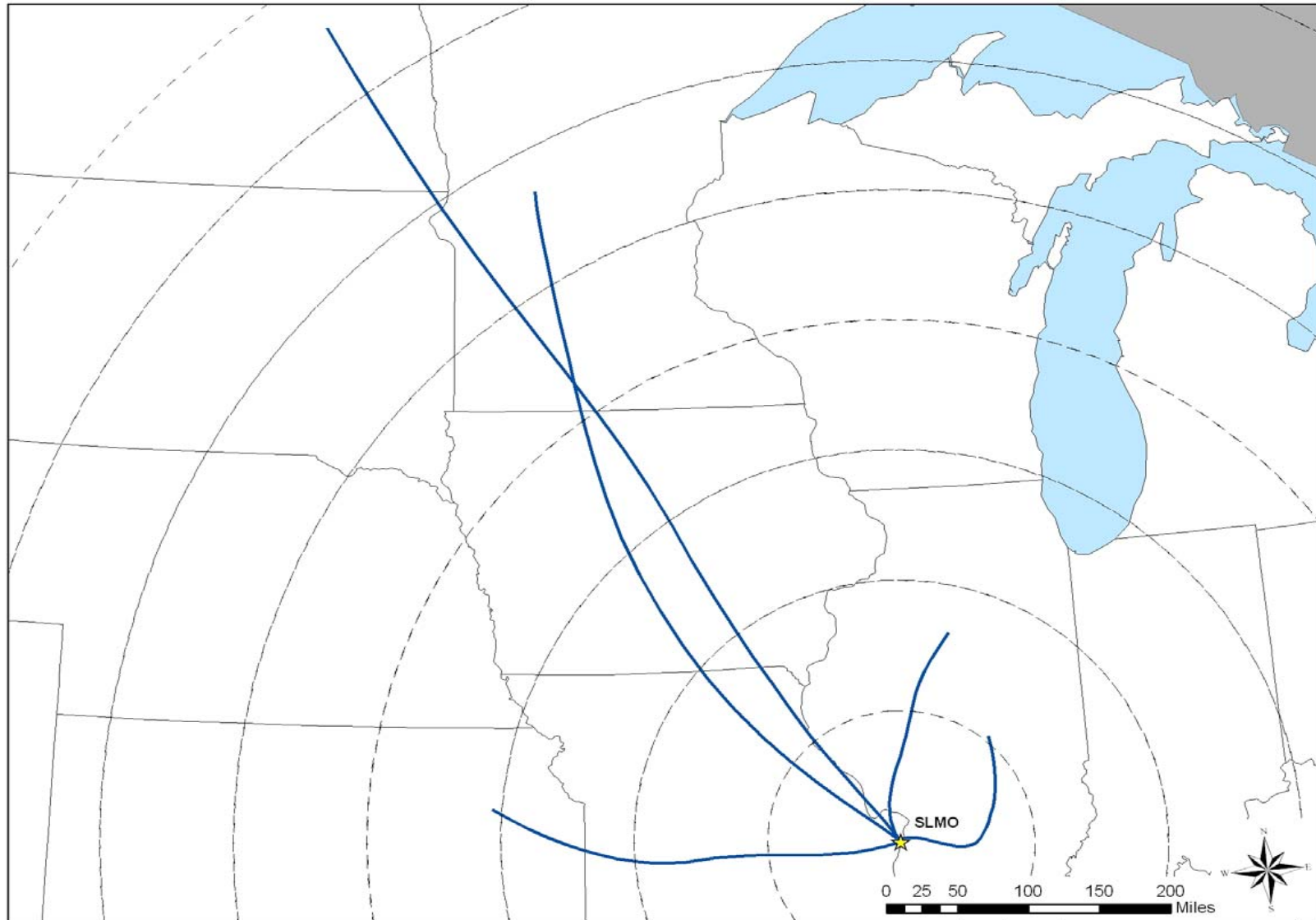


Figure 13-9. 2004 Total VOC Profile at S4MO

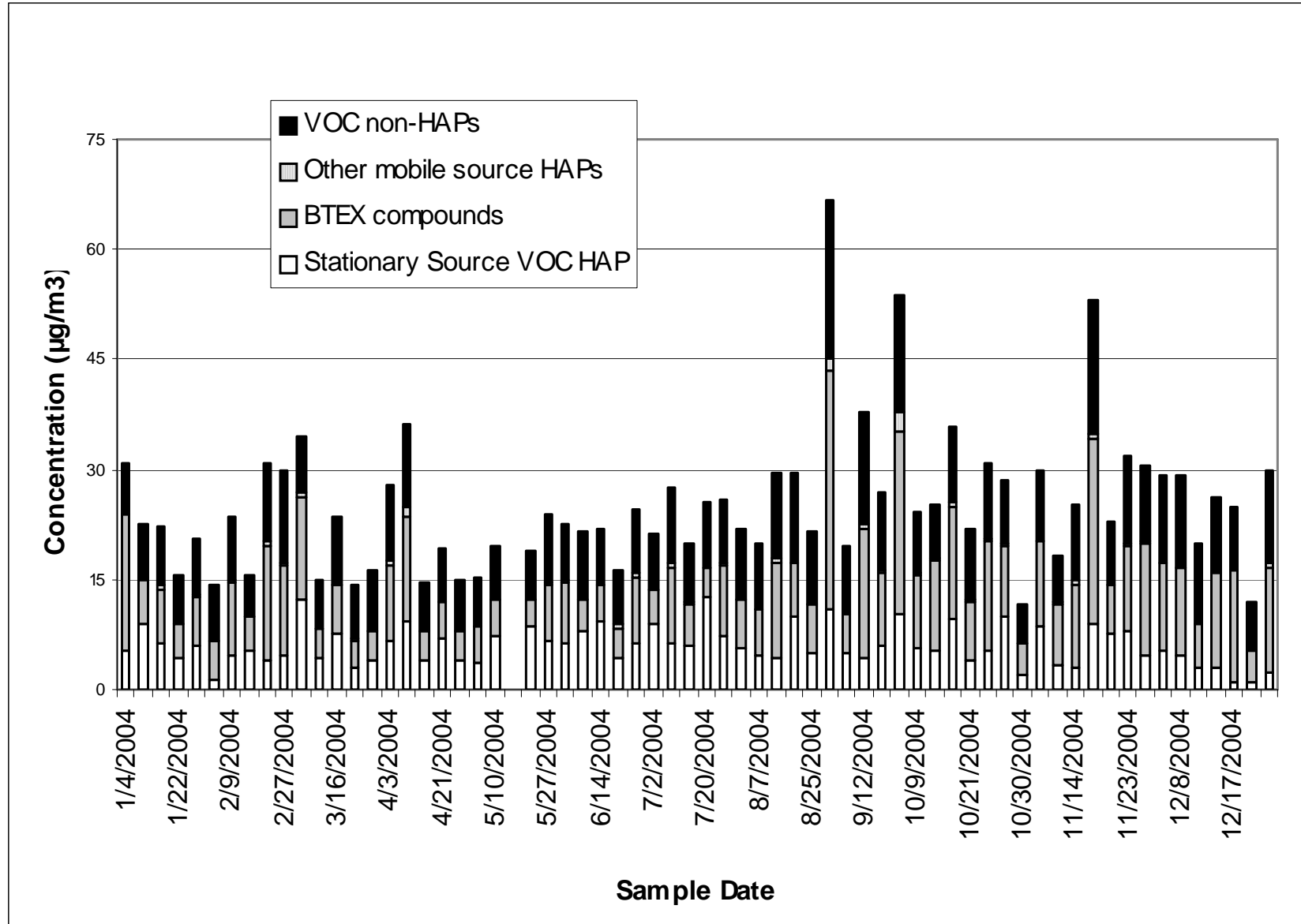


Figure 13-10. Acetaldehyde Pollution Rose for S4MO

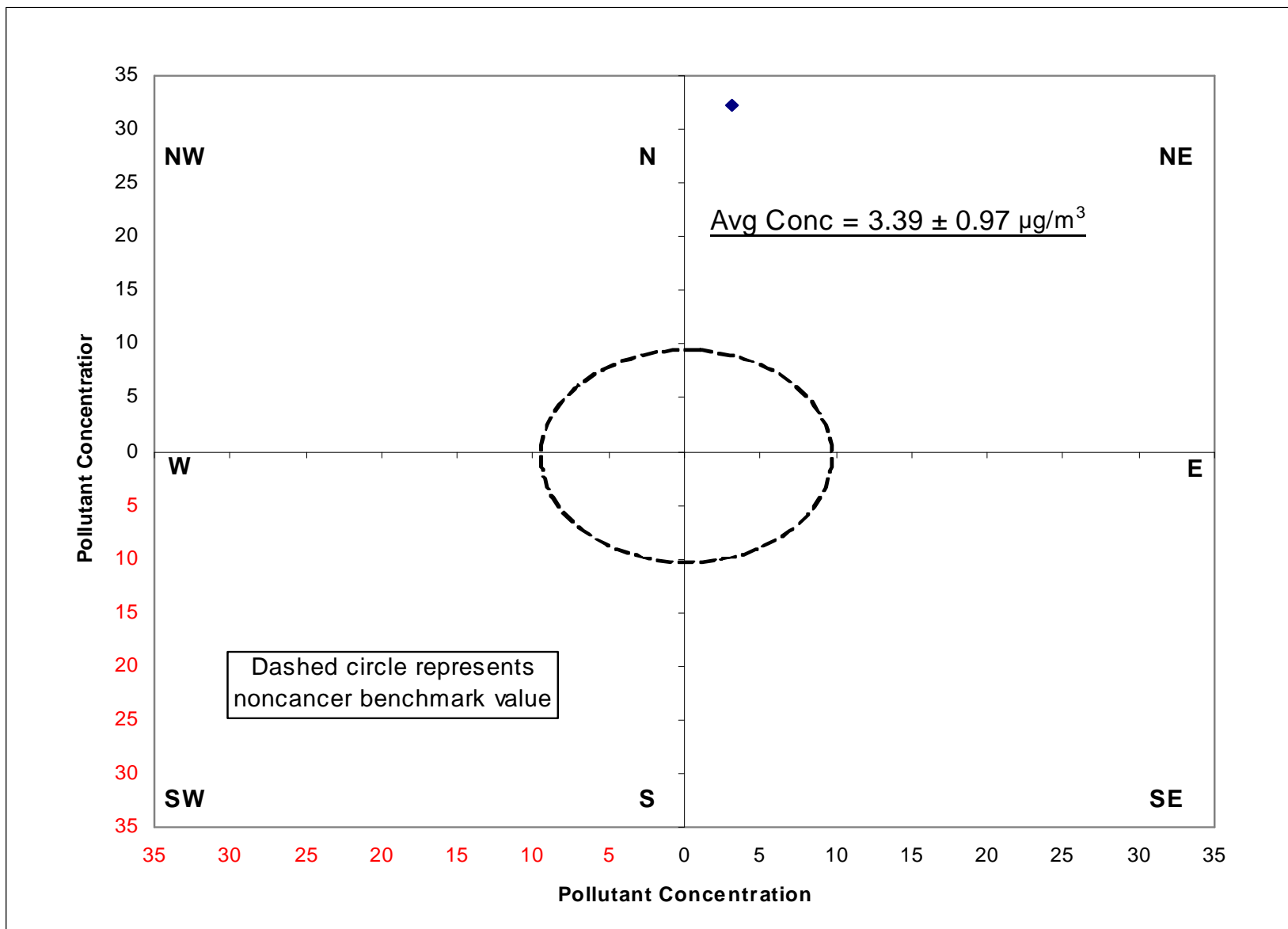


Figure 13-11. Formaldehyde Pollution Rose for S4MO

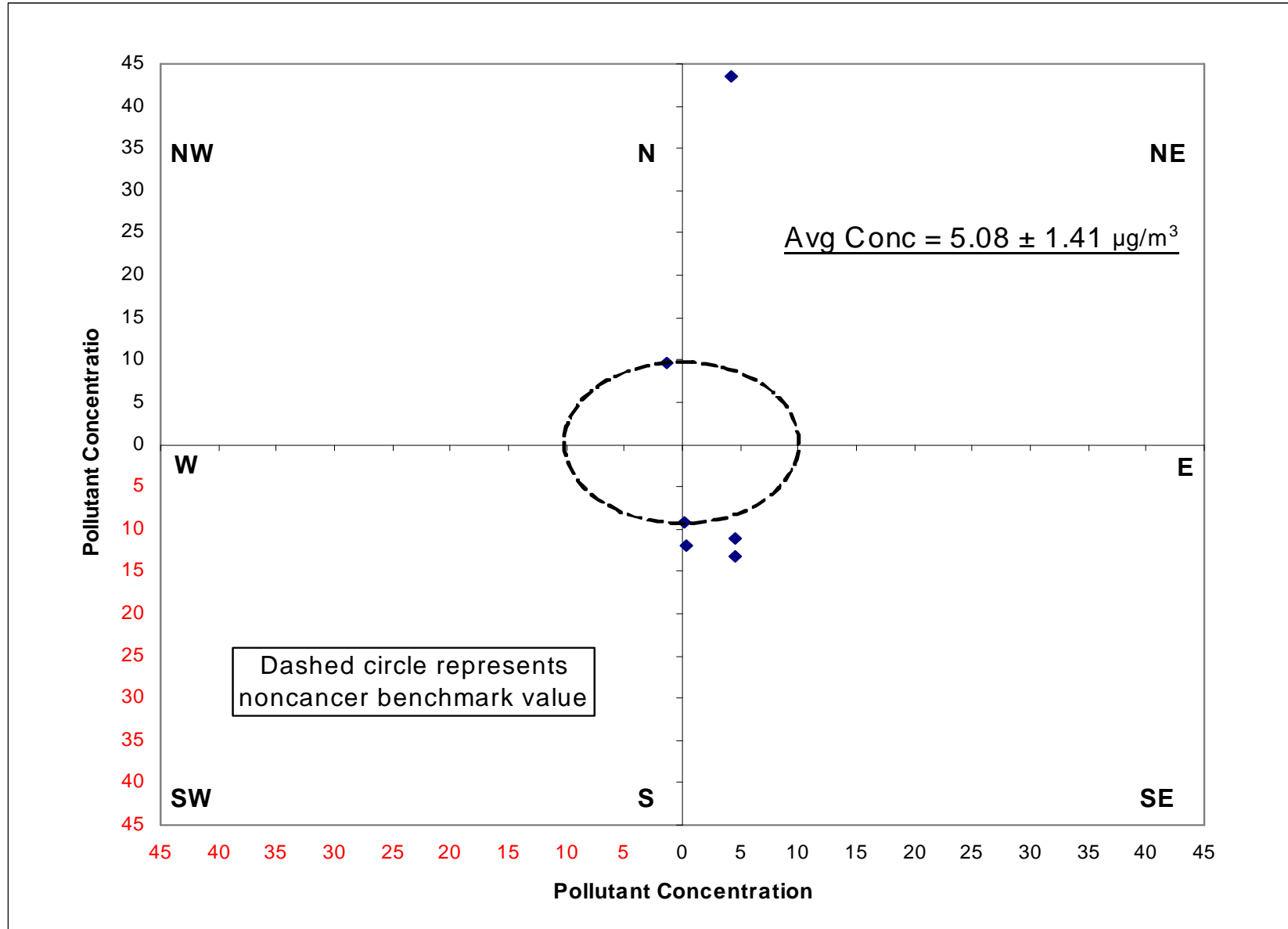


Figure 13-12. Acetaldehyde Sources Along the August 31, 2004 Back Trajectory at S4MO

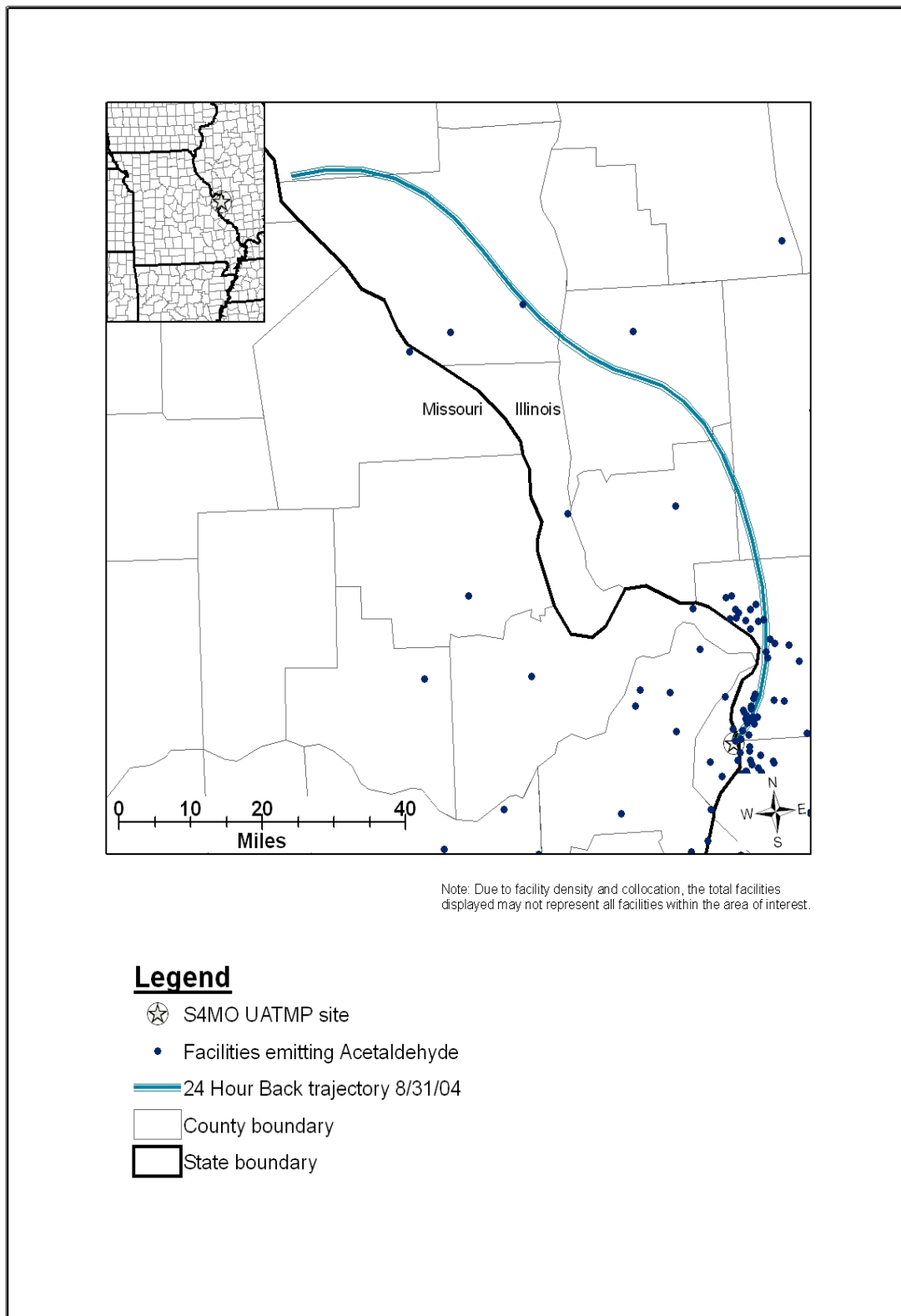
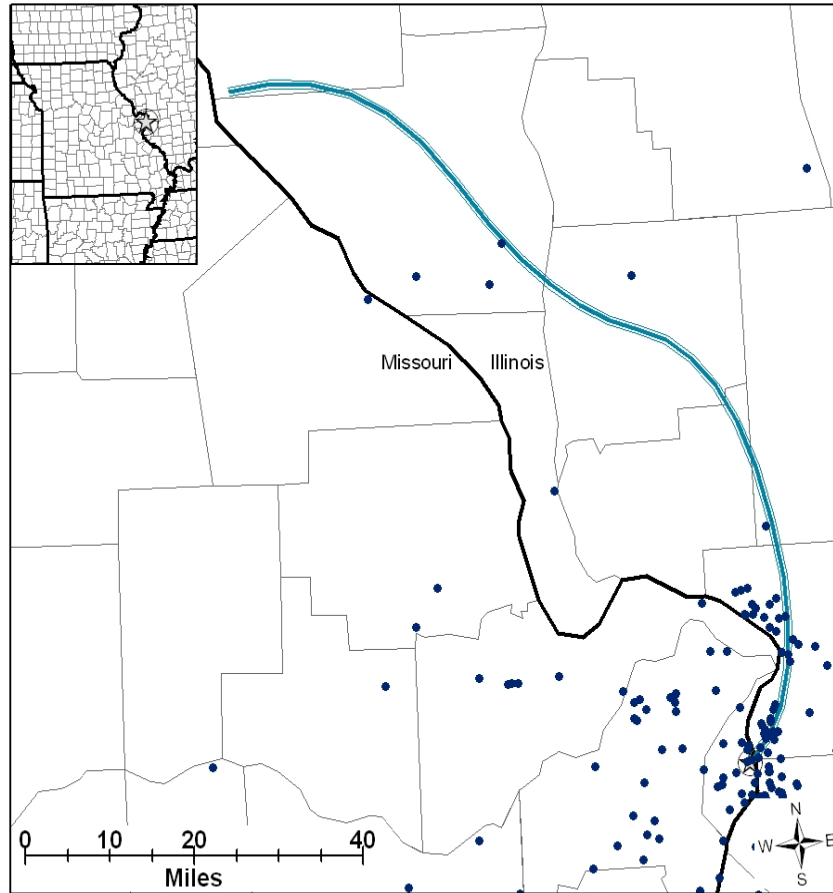


Figure 13-13. Formaldehyde Source Along the August 31, 2004 Back Trajectory at S4MO



Note: Due to facility density and collocation, the total facilities displayed may not represent all facilities within the area of interest.

Legend

- ☆ S4MO UATMP site
- Facilities emitting Formaldehyde
- 24 Hour Back trajectory 8/31/04
- County boundary
- State boundary

Figure 13-14. Manganese Compound Pollution Rose for S4MO

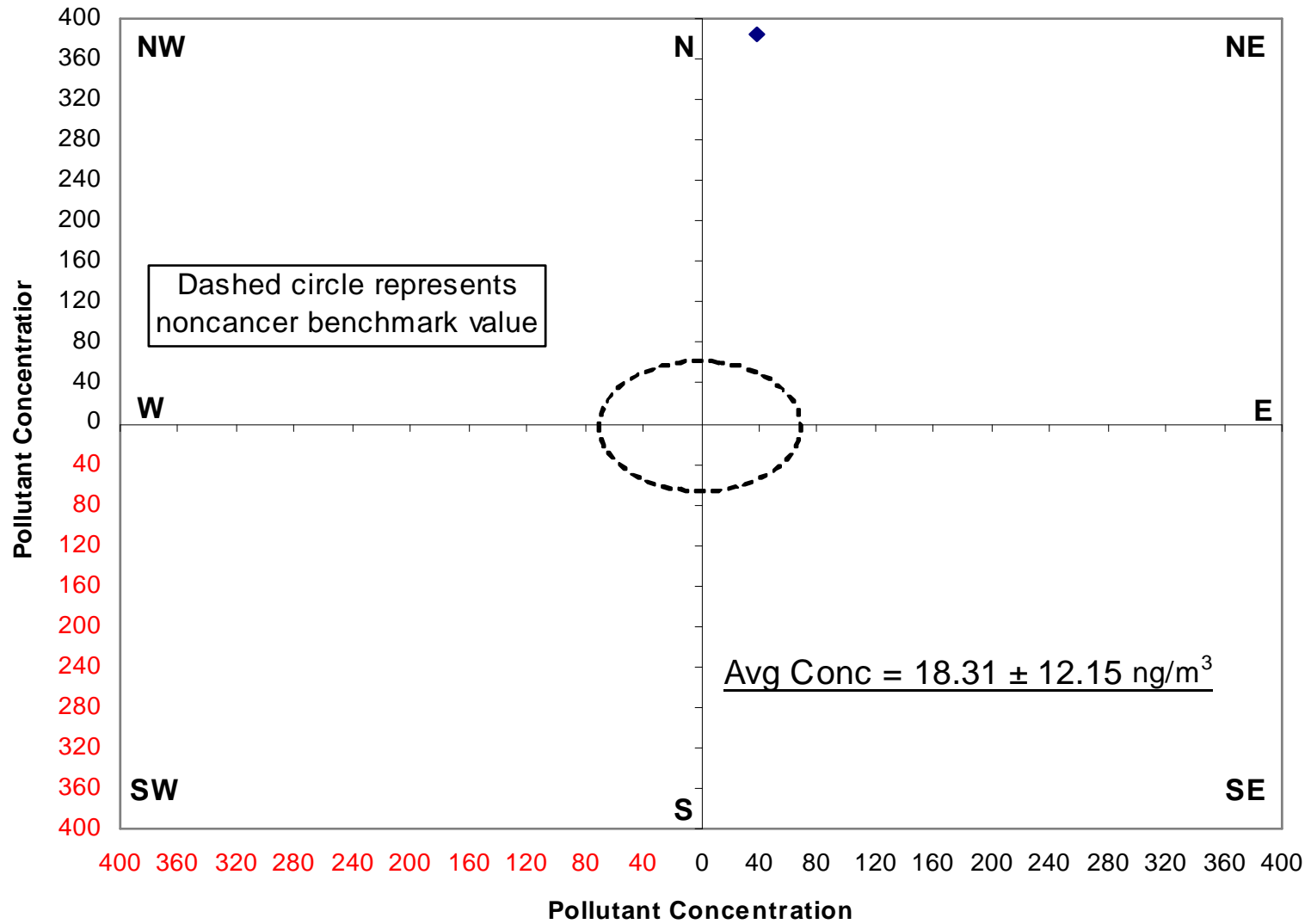


Figure 13-15. Manganese Compound Sources Along the August 31, 2004 Back Trajectory at S4MO

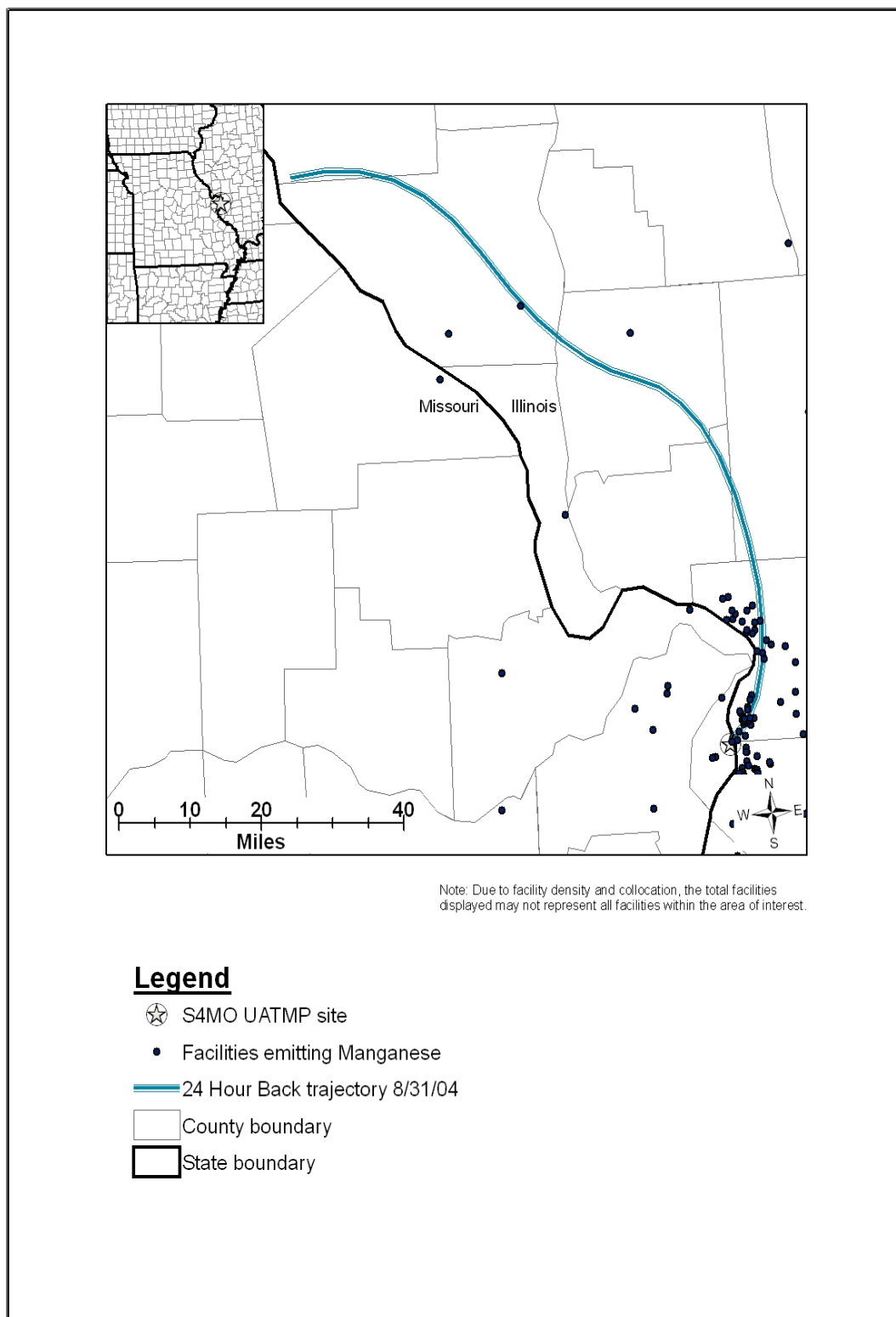


Table 13-1. Average Concentration and Meteorological Parameters for Sites in Missouri

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
BTMO	All 2004	/ / / / / / / /	65.31 (± 1.84)	55.84 (± 1.74)	46.04 (± 1.95)	51.06 (± 1.70)	72.77 (± 1.51)	1017.87 (± 5.80) ¹	0.75 (± 0.28)	1.00 (± 0.46)
	sample day	5.31 (± 1.29)	40.50 (± 4.41)	33.04 (± 4.79)	21.63 (± 8.65)	29.20 (± 5.05)	65.97 (± 14.93)	1019.94 (± 6.99)	1.05 (± 1.53)	-0.56 (± 4.87)
S4MO	All 2004	/ / / / / / / /	65.68 (± 1.87)	55.95 (± 1.77)	47.18 (± 1.90)	51.53 (± 1.70)	75.08 (± 1.29)	1018.32 (± 0.65)	0.36 (± 0.37)	0.16 (± 0.48)
	sample day	36.60 (± 4.92)	64.64 (± 4.32)	55.07 (± 4.01)	46.13 (± 4.24)	50.58 (± 3.81)	74.93 (± 3.14)	1019.07 (± 1.58)	0.19 (± 0.78)	-0.05 (± 0.96)
SLMO	All 2004	/ / / / / / / /	65.68 (± 1.87)	55.95 (± 1.77)	47.18 (± 1.90)	51.53 (± 1.70)	75.08 (± 1.29)	1018.32 (± 0.65)	0.36 (± 0.37)	0.16 (± 0.48)
	sample day	10.51 (± 3.01)	35.60 (± 3.49)	26.58 (± 4.87)	17.15 (± 8.17)	23.81 (± 5.59)	69.80 (± 13.36)	1024.36 (± 5.53)	3.66 (± 3.30)	-3.22 (± 2.95)

¹ Sea level pressure was not recorded at this station. Station pressure in inches of Mercury was converted to mb to yield an “uncorrected sea level pressure.”

Table 13-2. Summary of the Toxic Cancer Compounds at the Bonne Terre, St. Louis Site 4, and St. Louis 1, Missouri Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Cancer Risk (Out of 1 Million)
Bonne Terre, Missouri - BTMO						
Benzene	5.68 E-06	67.24	67.24	0.73	4	5.68
Acetaldehyde	2.75 E-06	32.63	99.87	1.25	4	2.75
Formaldehyde	1.13 E-08	0.13	100.00	2.05	4	0.01
St. Louis Site 4, Missouri - S4MO						
Acrylonitrile	2.54 E-05	30.51	30.51	0.37	16	25.41
Benzene	1.07 E-05	12.87	43.39	1.37	65	10.72
Carbon Tetrachloride	9.08 E-06	10.90	54.29	0.61	57	9.08
1,3-Butadiene	7.51 E-06	9.02	63.30	0.25	23	7.51
Acetaldehyde	7.47 E-06	8.97	72.27	3.39	63	7.47
<i>p</i> -Dichlorobenzene	7.40 E-06	8.89	81.16	0.67	13	7.40
Arsenic Compounds	7.17 E-06	8.62	89.77	<0.00	61	7.17
Tetrachloroethylene	3.25 E-06	3.90	93.67	0.55	13	3.25
Cadmium Compounds	2.08 E-06	2.50	96.17	<0.00	61	2.08
<i>trans</i> -1,3-Dichloropropene	1.95 E-06	2.34	98.52	0.49	4	1.95
Trichloroethylene	6.63 E-07	0.80	99.31	0.33	6	0.66
Dichloromethane	5.20 E-07	0.62	99.94	1.11	49	0.52
Formaldehyde	2.80 E-08	0.03	99.97	5.09	63	0.03
Beryllium Compounds	2.58 E-08	0.03	100.00	<0.00	34	0.03
St. Louis Site 1, Missouri - SLMO						
Benzene	1.21 E-05	58.39	58.39	1.56	5	12.14
Acetaldehyde	8.64 E-06	41.56	99.94	3.93	5	8.64
Formaldehyde	1.16 E-08	0.06	100.00	2.11	5	0.01

**Table 13-3. Summary of the Toxic Noncancer Compounds at the Bonne Terre, St. Louis Site 4,
and St. Louis 1, Missouri Monitoring Sites**

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Bonne Terre, Missouri - BTMO						
Formaldehyde	2.09 E-01	54.71	54.71	2.05	4	0
Acetaldehyde	1.39 E-01	36.46	91.17	1.25	4	0
Benzene	2.43 E-02	6.36	97.52	0.73	4	0
Xylenes	4.88 E-03	1.28	98.80	0.49	4	0
<i>n</i> -Hexane	2.67 E-03	0.70	99.50	0.53	4	0
Toluene	1.73 E-03	0.45	99.95	0.69	4	0
Ethylbenzene	1.81 E-04	0.05	100.00	0.18	4	0
St. Louis Site 4, Missouri - S4MO						
Formaldehyde	5.19 E-01	23.76	23.76	5.09	63	4
Acetaldehyde	3.77 E-01	17.27	41.03	3.39	63	1
Manganese Compounds	3.66 E-01	16.76	57.79	0.02	61	1
Bromomethane	2.64 E-01	12.09	69.88	1.32	1	0
Acrylonitrile	1.87 E-01	8.55	78.43	0.37	16	0
1,3-Butadiene	1.24 E-01	5.68	84.11	0.25	23	0
Cadmium Compounds	5.78 E-02	2.64	86.76	<0.00	61	0
Arsenic Compounds	5.56 E-02	2.55	89.30	<0.00	61	0
Benzene	4.64 E-02	2.12	91.43	1.39	65	0
Xylenes	3.77 E-02	1.72	93.15	3.77	65	0
<i>n</i> -Hexane	3.27 E-02	1.50	94.65	6.54	9	0
Acetonitrile	2.50 E-02	1.14	95.79	1.50	32	0
<i>trans</i> -1,3-Dichloropropene	2.44 E-02	1.12	96.91	0.49	4	0
Carbon Tetrachloride	1.51 E-02	0.69	97.60	0.61	57	0
Chloromethane	1.43 E-02	0.65	98.25	1.28	63	0
Toluene	9.13 E-03	0.42	98.67	3.65	65	0
Lead Compounds	7.83 E-03	0.36	99.03	0.01	61	0
Nickel Compounds	6.70 E-03	0.31	99.34	<0.00	61	0

Table 13-3. Summary of the Toxic Noncancer Compounds at the Bonne Terre, St. Louis Site 4, St. Louis 1, Missouri Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
Chloroform	4.68 E-03	0.21	99.55	0.46	9	0
Tetrachloroethylene	2.04 E-03	0.09	99.64	0.55	13	0
Cobalt Compounds	1.80 E-03	0.08	99.73	<0.00	61	0
Dichloromethane	1.11 E-03	0.05	99.78	1.11	49	0
<i>p</i> -Dichlorobenzene	8.41 E-04	0.04	99.81	0.67	13	0
Ethylbenzene	6.59 E-04	0.03	99.84	0.66	65	0
Trichloroethylene	5.52 E-04	0.03	99.87	0.33	6	0
Beryllium Compounds	5.37 E-04	0.02	99.89	<0.00	34	0
1,1,1-Trichloroethane	5.18 E-04	0.02	99.92	0.52	2	0
Methyl Ethyl Ketone	4.60 E-04	0.02	99.94	2.30	51	0
Styrene	3.49 E-04	0.02	99.96	0.35	42	0
Chlorobenzene	3.38 E-04	0.02	99.97	0.34	3	0
Methyl Isobutyl Ketone	3.13 E-04	0.01	99.99	0.94	20	0
Methyl <i>tert</i> -Butyl Ether	1.92 E-04	0.01	99.99	0.58	3	0
Mercury Compounds	8.83 E-05	0.00	100.00	<0.00	31	0
Selenium Compounds	4.23 E-05	0.00	100.00	<0.00	61	0
St. Louis Site 1, Missouri - SLMO						
Acetaldehyde	4.36 E-01	56.86	56.86	3.93	5	0
Formaldehyde	2.16 E-01	28.11	84.97	2.11	5	0
Benzene	5.19 E-02	6.76	91.73	1.56	5	0
Xylenes	3.04 E-02	3.96	95.69	3.04	5	0
<i>n</i> -Hexane	2.15 E-02	2.80	98.49	4.30	5	0
Toluene	1.03 E-02	1.34	99.83	4.10	5	0
Ethylbenzene	8.84 E-04	0.12	99.94	0.88	5	0
Styrene	4.50 E-04	0.06	100.00	0.45	1	0

Table 13-4. Metals and Compounds, and SNMOC Measured by the Missouri Monitoring Sites

Site	Average Metals Concentration (ng/m³)	TNMOC Speciated (ppbC)	TNMOC with Unknowns (ppbC)	% of TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)	Ethylene to Acetylene Ratio	% of Expected Ratio
BTMO	---	39.70	92.35	43%	Propane (6.55)	0.91	54%
S4MO	38.47	121.42	160.74	76%	n-Hexane (83.20)	0.88	52%
SLMO	---	105.52	203.40	52%	n-Hexane (30.40)	0.73	43%

Table 13-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Bonne Terre, St. Louis Site 4, and St. Louis Site 1, Missouri Sites

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Bonne Terre, Missouri - BTMO								
Acetaldehyde	0.62	0.27	-0.12	0.00	-0.45	0.31	-0.84	0.99
Benzene	0.38	0.08	-0.18	-0.13	-0.37	0.45	-0.86	0.93
Formaldehyde	-0.04	-0.52	-0.91	-0.76	-1.00	0.80	0.18	0.25
St. Louis Site 4, Missouri - S4MO								
1,3-Butadiene	0.03	-0.06	-0.10	-0.09	-0.14	0.17	0.37	-0.12
Acetaldehyde	0.35	0.30	0.27	0.29	-0.03	0.01	0.00	0.07
Acetonitrile	0.53	0.57	0.59	0.59	0.24	-0.33	-0.24	0.23
Acrylonitrile	0.44	0.49	0.54	0.51	0.36	-0.63	0.13	0.05
Arsenic Compounds	0.00	-0.06	-0.08	-0.07	-0.08	0.15	-0.36	0.18
Benzene	-0.52	-0.55	-0.48	-0.52	0.07	0.27	0.02	-0.15
Bromomethane	NA							
Cadmium Compounds	0.15	0.17	0.21	0.20	0.19	-0.16	-0.23	0.07
Carbon Tetrachloride	0.07	0.08	0.18	0.14	0.33	-0.08	-0.32	0.20
Formaldehyde	0.48	0.44	0.40	0.43	0.00	-0.07	-0.04	0.15
Manganese Compounds	0.13	0.10	0.11	0.11	0.06	0.07	-0.04	-0.03
<i>n</i> -Hexane	0.04	0.35	0.57	0.47	0.75	-0.71	0.03	-0.34
<i>p</i> -Dichlorobenzene	0.21	0.23	0.24	0.24	0.19	0.16	-0.08	0.27
Tetrachloroethylene	0.38	0.36	0.40	0.38	0.34	0.35	-0.08	0.00
Xylenes	-0.35	-0.41	-0.38	-0.40	-0.04	0.24	0.13	-0.05
St. Louis Site 1, Missouri - SLMO								
Acetaldehyde	-0.80	-0.80	-0.62	-0.76	-0.35	0.74	-0.38	0.91
Benzene	-0.35	-0.69	-0.75	-0.74	-0.65	0.90	-0.54	0.87
Formaldehyde	-0.04	-0.77	-0.82	-0.80	-0.71	0.45	0.43	-0.01
Xylenes	-0.61	-0.79	-0.60	-0.74	-0.32	0.68	-0.54	0.83

Table 13-6. Motor Vehicle Information vs. Daily Concentration for Missouri Monitoring Sites

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
BTMO	57,929	86,254	1.49	34,969	52,104	4,360	5.31 \pm 1.29
S4MO	332,223	244,956	0.74	822,941	608,976	22,840	36.60 \pm 4.92
SLMO	332,223	244,956	0.74	755,374	558,977	15,016	10.51 \pm 3.01

14.0 Sites in New Jersey

This section presents meteorological, concentration, and spatial trends for the four UATMP sites in New Jersey (CANJ, CHNJ, ELNJ, and NBNJ). The four sites are located in different cities (Camden, Chester, Elizabeth, and New Brunswick, respectively). Figures 14-1 through 14-4 are topographical maps showing the monitoring sites in their urban locations. Figures 14-5 through 14-7 identify facilities within 10 miles of the sites that reported to the 2002 NEI. CANJ is located on the southeast side of the state, near the PA/NJ border and east of Philadelphia. A number of sources are located mainly to its north and west, most of which are involved in fuel combustion. CHNJ is located in the north-central part of New Jersey and has only eight industrial sites nearby, most of which lie just within the ten mile radius from the site. ELNJ and NBNJ are somewhat closer to each other, with the outer portions of their ten mile radii intersecting. These two sites are near the New Jersey/New York border, just west of Staten Island, and have a number of sources in the vicinity, most of which are liquid distribution facilities, miscellaneous industries, and chemicals and allied product facilities.

Hourly meteorological data were retrieved for all of 2004 at three weather stations near these sites for calculating correlations of meteorological data with ambient air concentration measurements. The weather stations are Philadelphia International, Newark International Airport, and Somerville-Somerset Airport, NJ (WBAN 13739, 14734 and 54785, respectively).

Table 14-1 highlights the average UATMP concentration at each of these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*- components of the wind) for the entire year and on days samples were taken. New Jersey is located in a region where most storm systems track across, allowing its weather to be somewhat variable. However, its proximity to the Atlantic Ocean has a moderating effect. Hence, summers along the coast tend to be cooler than areas farther inland, while winters tend to be warmer. The location of New Jersey also tends to allow for ample annual precipitation and often high humidity. A southwesterly wind is most

common in the summer and a northwesterly wind is typical in the winter. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

14.1 Prevalent Compounds at the New Jersey Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 14-2 summarizes the cancer weighting scores and Table 14-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

Table 14-2 shows that most of the prevalent cancer compounds reflect the nationwide prevalent cancer compounds, as listed in Section 3 of this report. Only trichloroethylene, *trans*-1,3-dichloropropene, dichloromethane, and formaldehyde (each detected at all four sites) are listed in Table 14-2 and are not listed among the nationwide prevalent cancer compounds. For the noncancer compounds summarized in Table 14-3, many of the detected compounds are not listed on the nationwide prevalent noncancer compound list. However, only two sites had a prevalent noncancer compound (*trans*-1,3-dichloropropene) not on the nationwide list.

Prevalent toxic compounds not detected at the New Jersey sites were: 1,2-dichloroethane; *cis*-1,3-dichloropropene; chloroprene; and ethyl acrylate.

14.2 Toxicity Analysis

Acrylonitrile, benzene, carbon tetrachloride, tetrachloroethylene, acetaldehyde, and 1,3-butadiene were the only prevalent cancer compounds common to all four sites. Acrylonitrile contributed most to the total cancer toxicity at all of the four sites, although it consistently had a low number of detects. Benzene had the highest number of detects of the prevalent cancer compounds at all four sites. At all of the sites except CHNJ, formaldehyde and acetaldehyde

together contributed to over 65% of the total noncancer toxicity. The number of formaldehyde detects equaled the number of acetaldehyde detects at all four sites.

The acrylonitrile cancer risk at CHNJ was the highest among the four sites at 37.6 in a million, while the acrylonitrile cancer risk at CANJ, CHNJ, and ELNJ was 22.1, 22.6, and 22.6 in a million, respectively. For the compounds that may lead to adverse noncancer health effects, the average acetaldehyde toxicity at CANJ was 1.09 (over 1 indicates a significant chance of a noncancer health effect). Of the fifty-two acetaldehyde detects at CANJ, thirteen concentrations were of adverse health concentrations. Concentrations greater than the adverse health effect threshold occurred at all four sites.

14.3 Meteorological and Concentration Averages at the New Jersey Sites

Carbonyl compounds and VOC were measured at all four of the sites, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration at CANJ was the highest ($61.54 \pm 13.48 \mu\text{g}/\text{m}^3$) while CHNJ was the lowest ($31.67 \pm 8.19 \mu\text{g}/\text{m}^3$), as indicated in Table 14-1. Table 14-1 also lists the averages for selected meteorological parameters from January 2004 to December 2004, and for days on which samples were taken.

Table 14-4 presents the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters by site. Identification of the prevalent compounds is discussed in Section 3 of this report. The strongest correlation at CANJ was computed between acrylonitrile and the *v*-component of the wind. However, this compound was only detected four times, which can skew the correlations. Acetonitrile and formaldehyde exhibited strong, positive correlations with the temperature and moisture variables, except relative humidity. Moderately strong to strong positive correlations of *p*-dichlorobenzene were shown with sea level pressure and the *u*-component of wind, and a moderately strong negative correlation with relative humidity.

At CHNJ, moderately strong to strong negative correlations were computed between tetrachloroethylene and *trans*-1,3-dichloropropene and maximum, average, dewpoint, and wet bulb temperatures (ranging from -0.37 to -0.50). Very strong to strong negative correlations were also exhibited between these compounds and the *v*-component of the wind. However, it is important to note that fewer than five concentrations were detected for *trans*-1,3-dichloropropene.

At ELNJ, acetaldehyde and acetonitrile had moderately strong positive correlations with maximum, average, dewpoint and wet bulb temperature, while tetrachloroethylene had moderately strong negative correlations with these same parameters. Acetaldehyde and benzene had the strongest correlations with the *v*-component of wind (both 0.45), while acrylonitrile had the strongest correlation with the *u*-component of the wind (-0.43).

At NBNJ, 1,3-butadiene exhibited very strong correlations with average maximum temperature (-0.81). However, this compound was only detected four times, and the low number of detects could skew the correlations. The carbonyl compounds both exhibited moderately strong positive correlations with the temperature and moisture variables (except relative humidity). Moderately strong correlations also occurred between tetrachloroethylene and maximum temperature (0.32) and relative humidity (-0.45).

Figures 14-8 through 14-11 show the composite back trajectories for the New Jersey sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in these figures, the back trajectories look like pinwheels around the monitoring sites, with back trajectories originating from almost every direction. There does, however, appear to be an absence of trajectories originating from the east and southeast of most of the sites. Each circle around the sites in Figure 14-8 through 14-11 represents 100 miles; between 80% (CANJ) and 84% (ELNJ) of the trajectories originated within 600 miles, and 98% (all sites) within 1000 miles

from the New Jersey sites. The 24-hour airshed domain is extremely large. Back trajectories originated nearly 1100 miles away.

14.4 Spatial Analysis

County level vehicle registration information was not available for Camden, Middlesex, Morris, and Union Counties. Thus, state-level vehicle registration, from the Energy Information Administration (EIA), was allocated to the county level using the county-level population proportion. County-level population information in these counties was obtained from the U.S. Census Bureau, and is included in Table 14-5. Table 14-5 also includes a vehicle registration to county population ratios (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of the 10-mile vehicle registration was computed using the 10-mile population surrounding the monitor and the vehicle registration ratio. Table 14-5 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the sites listed in Table 14-5. ELNJ has both the highest nearby vehicle ownership and the highest daily traffic volume passing the monitor.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. Although all of the New Jersey sites somewhat resemble the roadside study, ELNJ resembles it the most. The benzene-ethylbenzene and xylenes-ethylbenzene concentration ratios are closer together than those of the roadside study at CHNJ. CANJ and NBNJ's toluene-ethylbenzene ratio are higher than the roadside study's and their benzene-ethylbenzene and xylenes-ethylbenzene ratios are somewhat closer together than the roadside study's. Interestingly, ELNJ is located near interchange 13 on I-95 in Elizabeth, NJ.

14.5 RFG Analysis

The Philadelphia-Camden-Wilmington, PA-NJ-MD-DE MSA participates in the federally-mandated reformulated fuel program (EPA, 1999c). Throughout the year, the oxygen content in gasoline must be at least 2% by weight, boosting the octane quality, increasing combustion, and reducing exhaust emissions. Additionally, the benzene content must not be greater than 1% by volume (EPA, 1994). The oxygenates used as RFG additives in the Philadelphia MSA are MTBE, TAME, and ethanol (EPA, 2003b). A survey at 7 service stations during the summer of 2002 in the Philadelphia MSA showed the oxygen content of the fuel at 2.26% by weight and the benzene content at 0.610% by volume. MTBE and TAME also averaged 12.06% and 0.41% by weight, respectively, from the summer survey (EPA, 2003b). A survey at 5 service stations during the winter of 2002 in this MSA showed the oxygen content at 1.90% by weight and the benzene content at 0.597% by volume. MTBE, ethanol, and TAME also averaged 9.87%, 0.12%, and 0.35% by weight, respectively from the winter survey (EPA, 2003b). Figure 14-12 presents the VOC profiles at the Philadelphia MSA site (CANJ).

The New York-Newark-Edison, NY-NJ-PA MSA also participates in the federally-mandated reformulated fuel program (EPA, 1999c). The oxygenates used as RFG additives in the New York MSA are MTBE, TAME, ethanol, and ETBE (EPA, 2003b). A survey at 7 service stations during the summer of 2002 in the New York MSA showed the oxygen content of the fuel at 1.99% by weight and the benzene content at 0.585% by volume. MTBE and TAME also averaged 10.26% and 0.76% by weight, respectively from the summer survey (EPA, 2003b). A survey at 5 service stations during the winter of 2002 in this MSA showed the oxygen content at 1.87% by weight and the benzene content at 0.625% by volume. MTBE, ethanol, TAME, and ETBE also averaged 9.68%, 0.13%, 0.34%, and 0.01% by weight, respectively, from the winter survey (EPA, 2003b). Figures 14-13 through 14-15 are the VOC profiles at the New York MSA sites (CHNJ, ELNJ, and NBNJ).

At CANJ (Figure 14-12), the total VOC concentrations varied throughout the year, although May through August saw a noticeable rise in concentrations. The highest concentration

occurred on July 14, 2004. On that day, the stationary source HAP contribution was much higher than other sampling days. The mobile source (BTEX and non-BTEX) HAP concentrations were highest in Autumn. The stationary source concentrations increased dramatically during the summer season. The sampling at CANJ ran from January 10 - December 29. The CANJ BTEX concentration was compared to the APMI BTEX concentration. APMI is located in a non-RFG requirement area, but the two sites have similar traffic volumes (CANJ = 62,000; APMI = 60,000). The BTEX concentration at CANJ is less than at APMI ($9.92 \mu\text{g}/\text{m}^3$ vs. $12.35 \mu\text{g}/\text{m}^3$, respectively), suggesting that the RFG requirement may be effective.

At CHNJ (Figure 14-13), the total VOC concentrations varied throughout the year, with the highest concentration occurring on June 2, 2004. On that day, the BTEX HAP and stationary source contribution was much higher than other sampling days. The sampling at CHNJ ran from January 1 - December 29. The stationary source HAP and BTEX concentrations were highest in the summer. The non-HAP and other mobile VOCs did not vary much throughout the year. The CHNJ BTEX concentration was compared to the JAMS BTEX concentration. JAMS is located in a non-RFG requirement area, but the two sites have similar traffic volumes (CHNJ = 12,623; JAMS = 12,500). The BTEX concentration at CHNJ is less than half of JAMS ($4.39 \mu\text{g}/\text{m}^3$ vs. $12.06 \mu\text{g}/\text{m}^3$, respectively), suggesting that the RFG requirement may be effective.

At ELNJ (Figure 14-14), the total VOC concentrations varied throughout the year, with the highest concentration occurring on August 1, 2004. On that day, the stationary, other mobile, and non-HAP contribution was much higher than other sampling days. The sampling at ELNJ ran from January 4 - December 29. The ELNJ BTEX concentration was compared to the SPIL BTEX concentration. SPIL is also located in a RFG area and these sites have the two highest traffic volumes of all the sites (ELNJ = 170,000; ITCMI = 214,900). The BTEX concentration at ELNJ is somewhat higher than the SPIL concentration ($11.43 \mu\text{g}/\text{m}^3$ vs. $9.02 \mu\text{g}/\text{m}^3$, respectively). It appears as if the RFG requirement may not be effective but there are also a high number of stationary sources emitting BTEX compounds near ELNJ.

At NBNJ (Figure 14-15), the total VOC concentrations varied throughout the year, with the highest concentration occurring on June 2, 2004. On that day, the stationary source HAP and VOC non-HAP contribution was much higher than other sampling days. The sampling at ELNJ ran from January 4 - December 29. The NBNJ BTEX concentration was compared to the APMI BTEX concentration. APMI is located in a non-RFG requirement area, but the two sites have similar traffic volumes (NBNJ = 63,000; APMI = 60,000). The BTEX concentration at NBNJ less than at APMI ($7.58 \mu\text{g}/\text{m}^3$ vs. $12.35 \mu\text{g}/\text{m}^3$, respectively), suggesting that the RFG requirements may be effective at NBNJ.

14.6 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years); a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

14.6.1 Site-Specific Trends Analysis

CANJ has participated in the UATMP since 1994; ELNJ since 1999; and CHNJ and NBNJ since 2001. A comparison of concentrations of 1,3-butadiene, benzene, and formaldehyde at CANJ shows that there has been a lot of variation of the last ten years. Formaldehyde concentrations for 2004 are the highest over the time frame; 1,3-butadiene concentrations were highest in 2000; and benzene concentrations peaked in 1996. Please refer to Figure 3-30.

1,3-Butadiene concentrations at CHNJ in 2004 are equal to these in 2001, sharing the highest concentration in CHNJ's four year UATMP sampling history. Benzene concentrations have changed little since 2001. Formaldehyde concentrations decreased steadily from 2001 to 2003, but increased slightly in 2004. Please refer to Figure 3-31.

Formaldehyde concentrations at ELNJ have been on the rise since 2003, after falling in 2001 and 2002. Benzene concentrations have been slowly decreasing since 2002, while 1,3-butadiene concentrations have shown little change since 2002. Please refer to Figure 3-35.

At NBNJ, formaldehyde concentrations have been on the rise since 2003, although concentrations nearly doubled in 2004. Concentrations of benzene and 1,3-butadiene have shown little change over the four-year period. Please refer to Figure 3-41.

14.6.2 MSA-Specific Trends Analyses

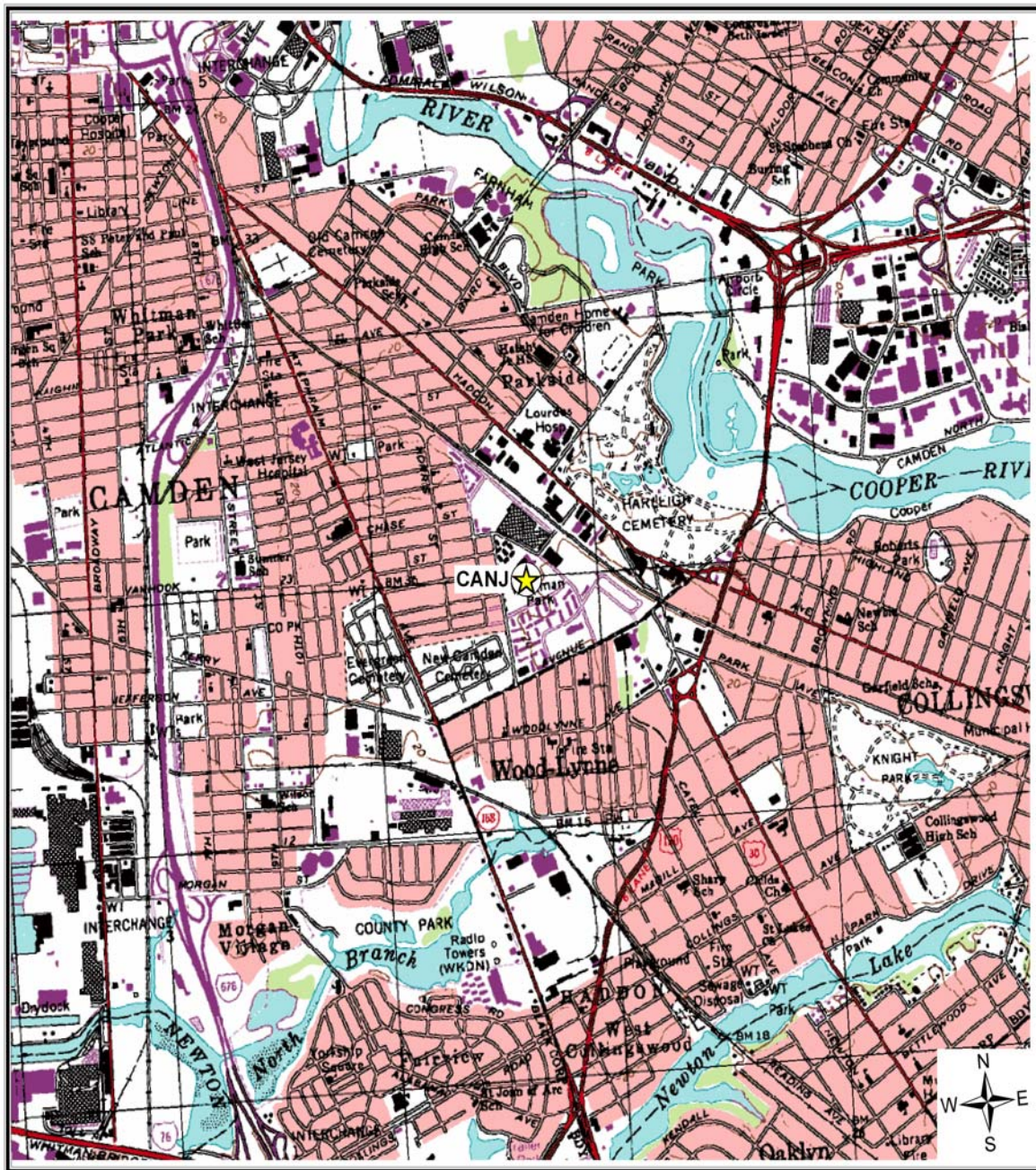
All four New Jersey sites reside in MSAs, three in the New York-Northern New Jersey-Long Island, NY-NJ-PA MSA (CHNJ, ELNJ, and NBNJ), and one in the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD MSA. The New York MSA has experienced a 10.5% increase in population and 28.9% increase in vehicle miles traveled (VMT) from 1990 to 2003. Carbonyl and VOC emissions have decreased between 29% to 84% between 1990 and 2002. Measured concentrations of these compounds have decreased as well, ranging from 43% to 66%.

Formaldehyde concentrations decreased by 43% throughout the time period, even though ethanol is used as an oxygenate. However, the ethanol blend is very low (<1%), and much lower than other MSAs (St. Louis, for example). Concentration of each of the VOC considered in this analysis appear to be decreasing, and each of the carbonyl compounds appear to be holding steady for 2004, according to the UATMP sites representing the New York MSA (CHNJ, ELNJ, and NBNJ). This MSA participates in the winter oxygenated program and the reformulated gasoline program. Trends for these and other compounds of interest can be found in Table 3-13.

The Philadelphia MSA has experienced a 6.2% increase in population and a 56.6% increase in VMT from 1990 and 2003. Emissions of VOC and carbonyl compounds have decreased substantially over the period, as have measured concentrations of these pollutants. Formaldehyde concentrations decreased by 60% throughout the time period, even though ethanol is used as an oxygenate. However, similar to the New York MSA, the ethanol blend is very low (<1%). For the UATMP site representing this MSA (CANJ), 2004 VOC concentrations continue

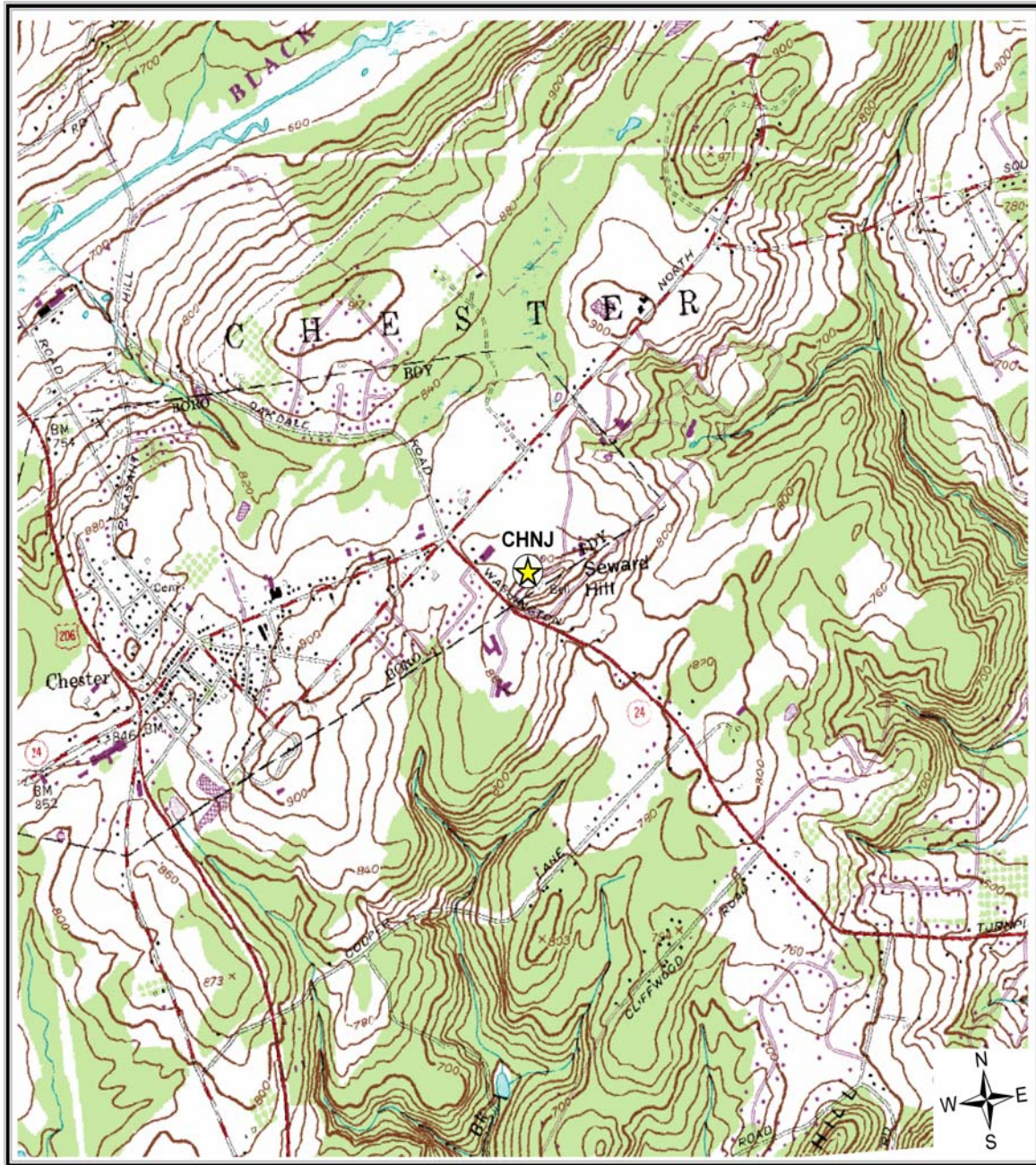
to decrease. However, both acetaldehyde and formaldehyde concentrations show an increasing trend for 2004. This MSA participates in both the winter-oxygenated program and the reformulated gasoline program. Please refer to Table 3-13 for more information.

Figure 14-1. Camden, New Jersey (CANJ) Monitoring Site



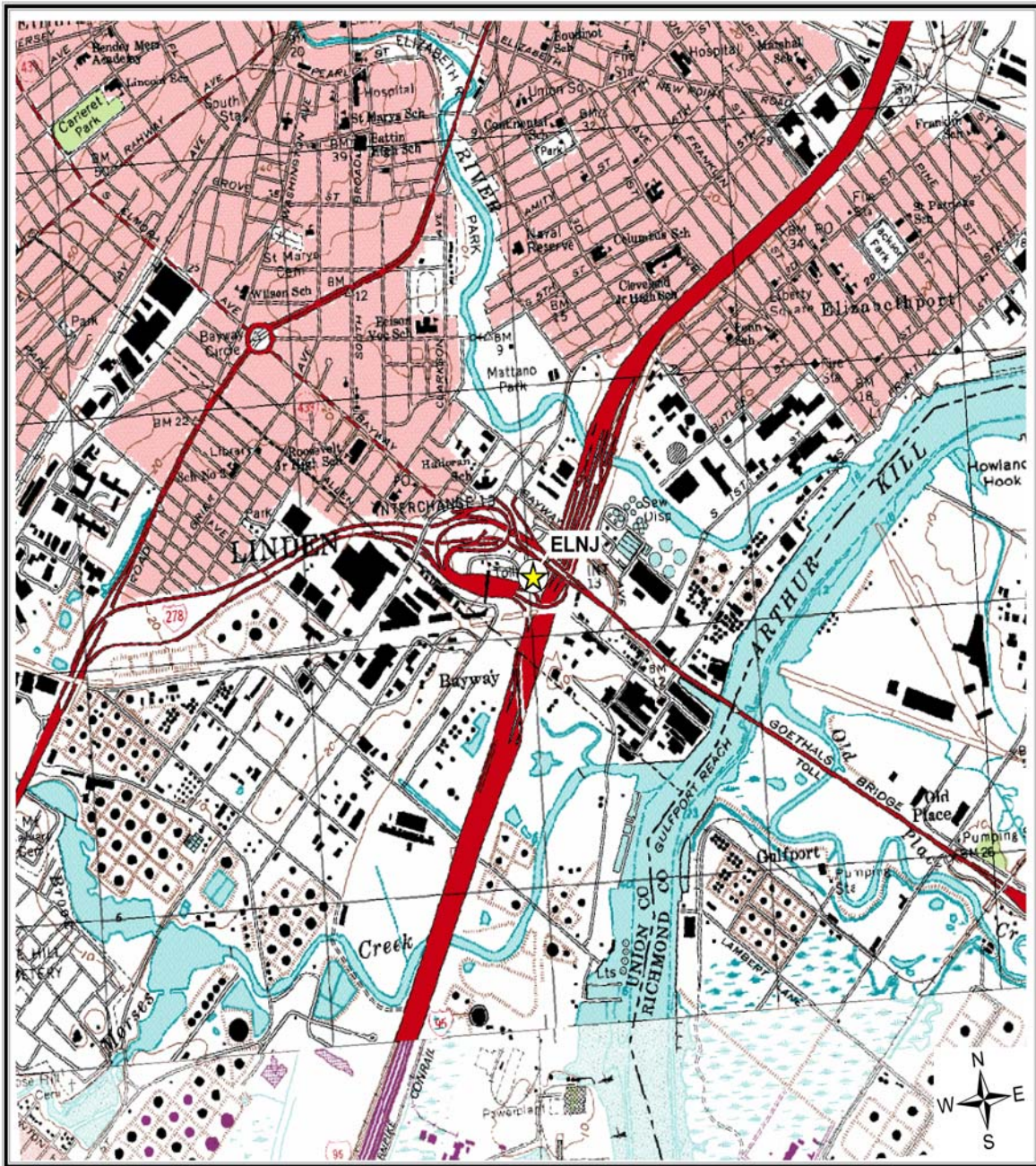
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 14-2. Chester, New Jersey (CHNJ) Monitoring Site



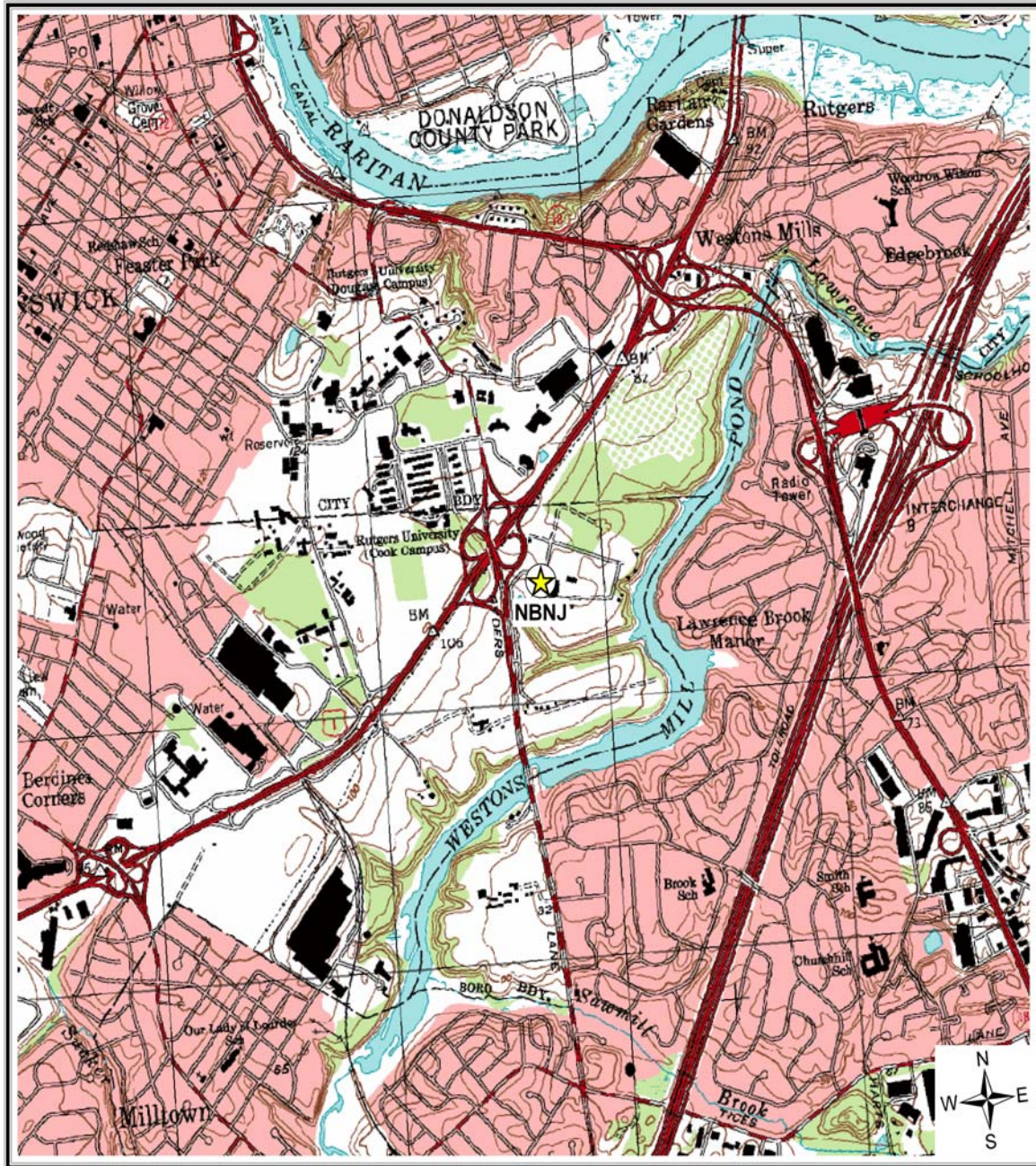
Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 14-3. Elizabeth, New Jersey (ELNJ) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 14-4. New Brunswick, New Jersey (NBNJ) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 14-5. Facilities Located Within 10 Miles of CANJ

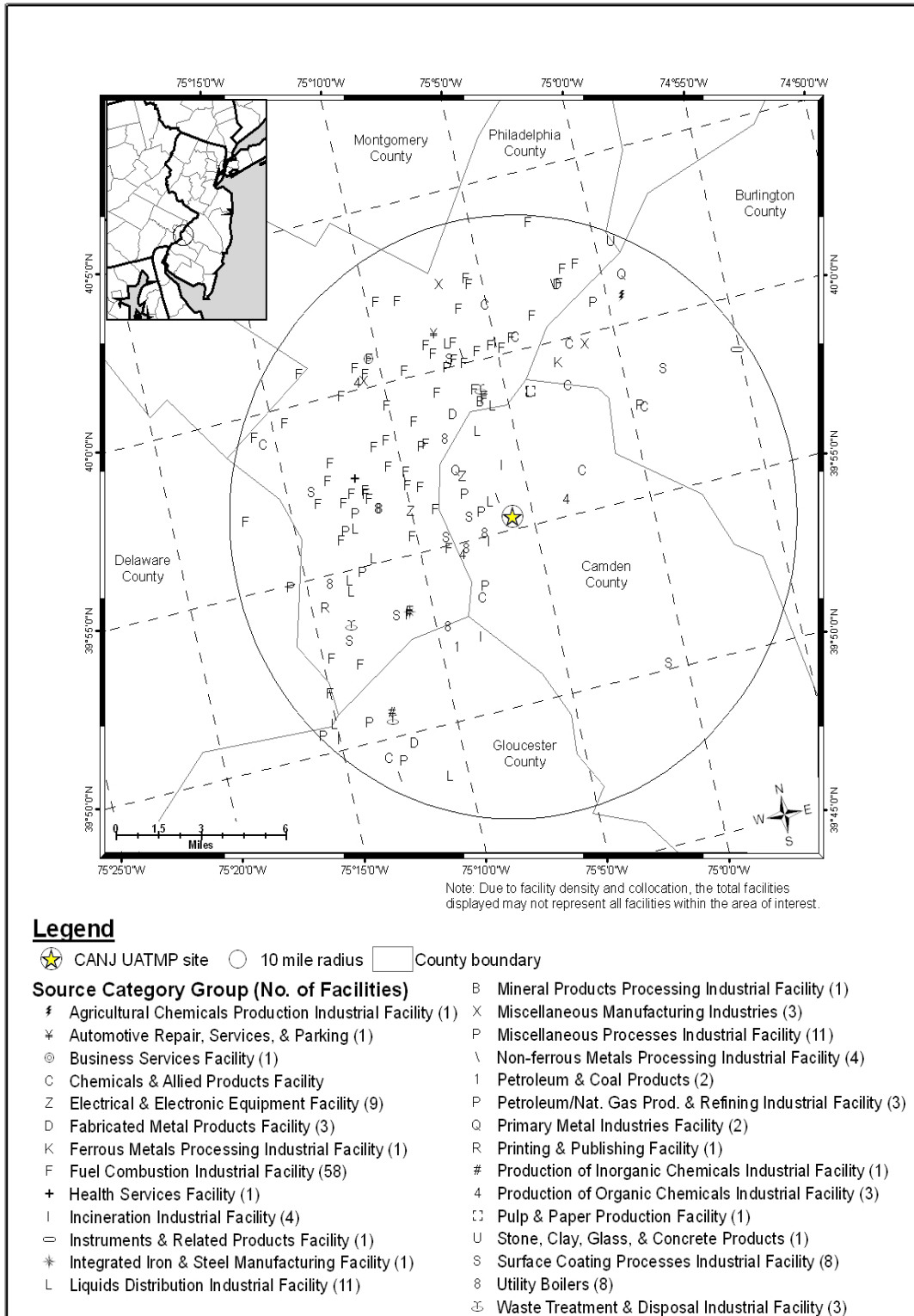


Figure 14-6. Facilities Located Within 10 Miles of CHNJ

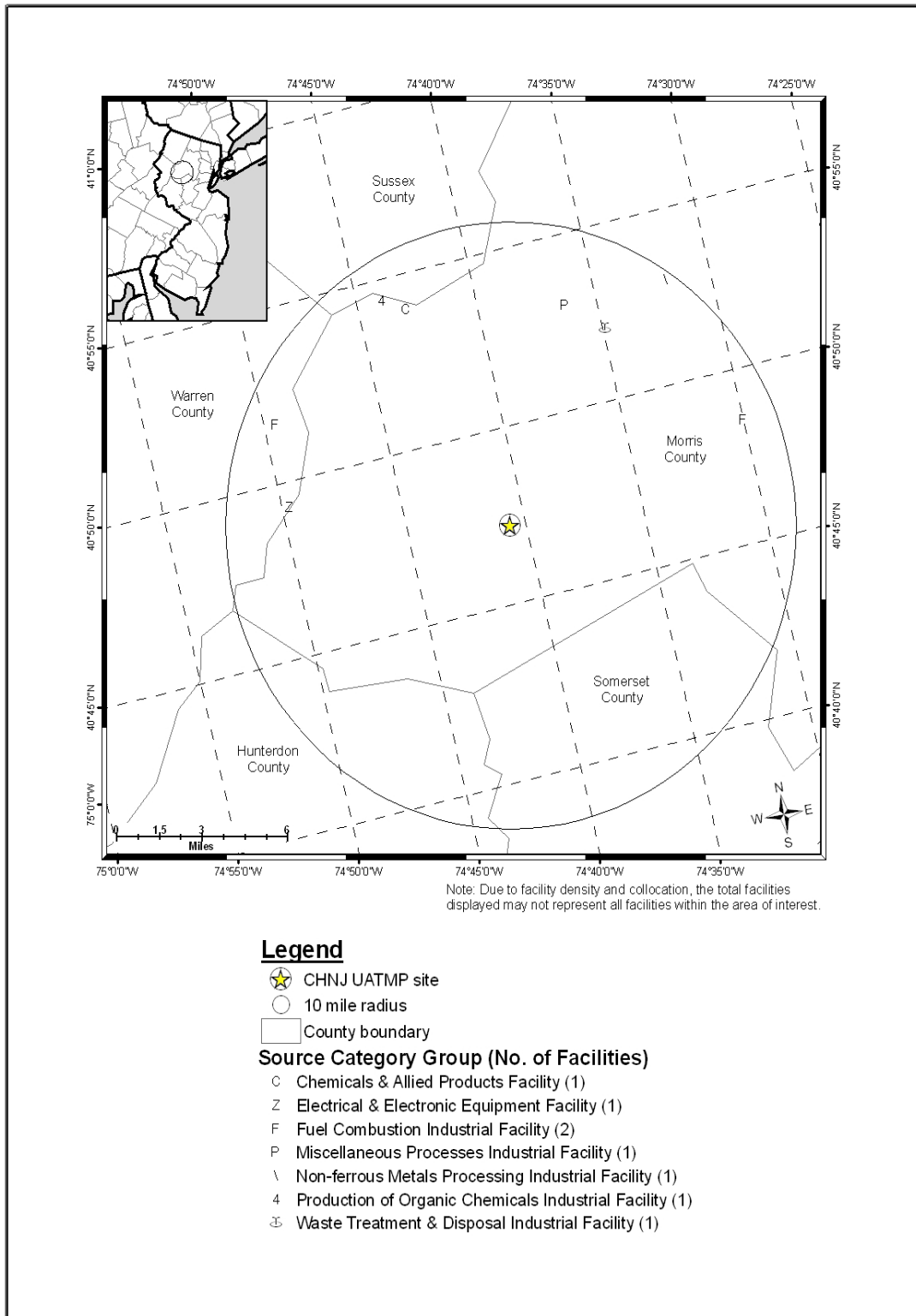


Figure 14-7. Facilities Located Within 10 Miles of ELNJ and NBNJ

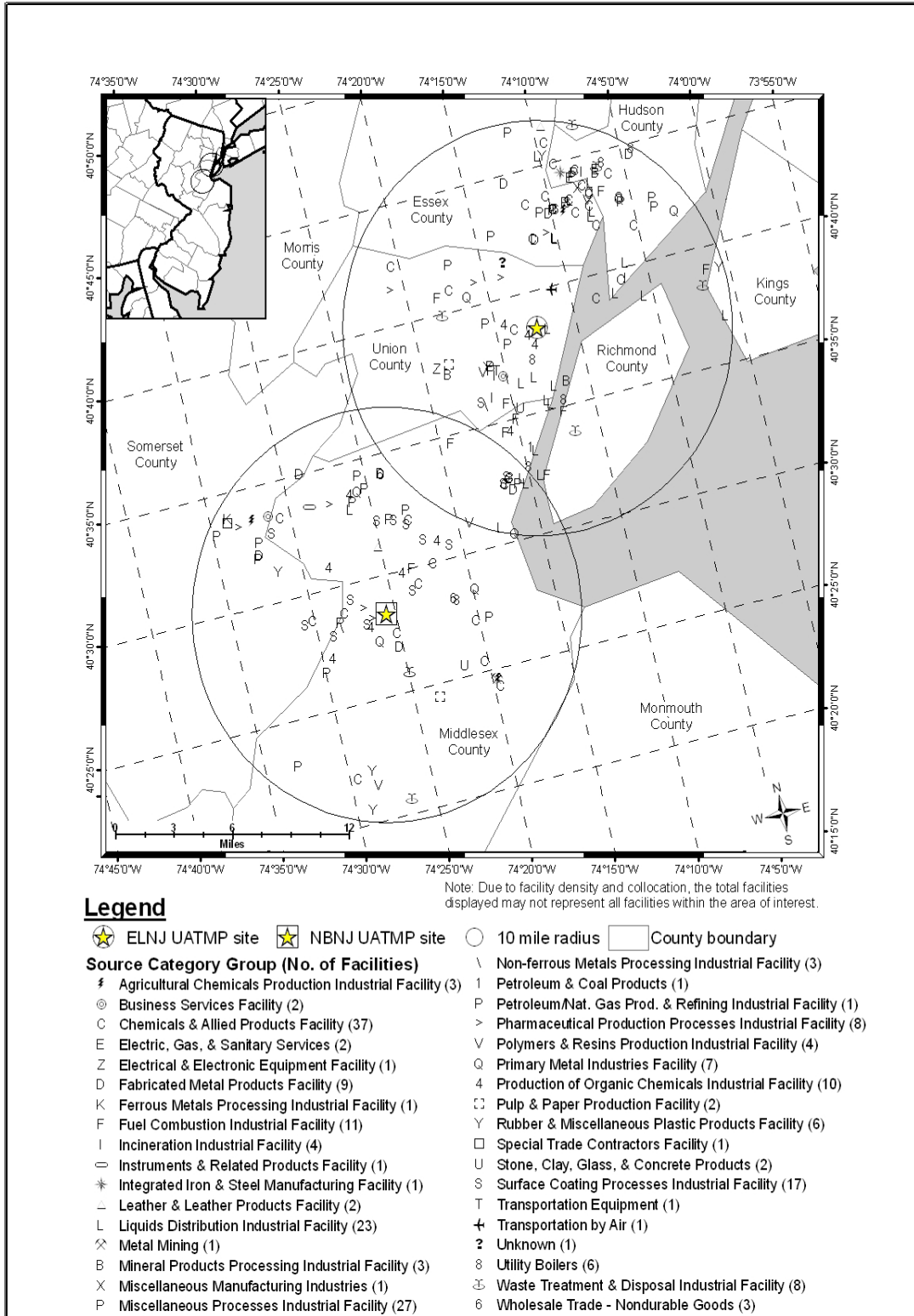


Figure 14-8. Composite Back Trajectory Map for CANJ

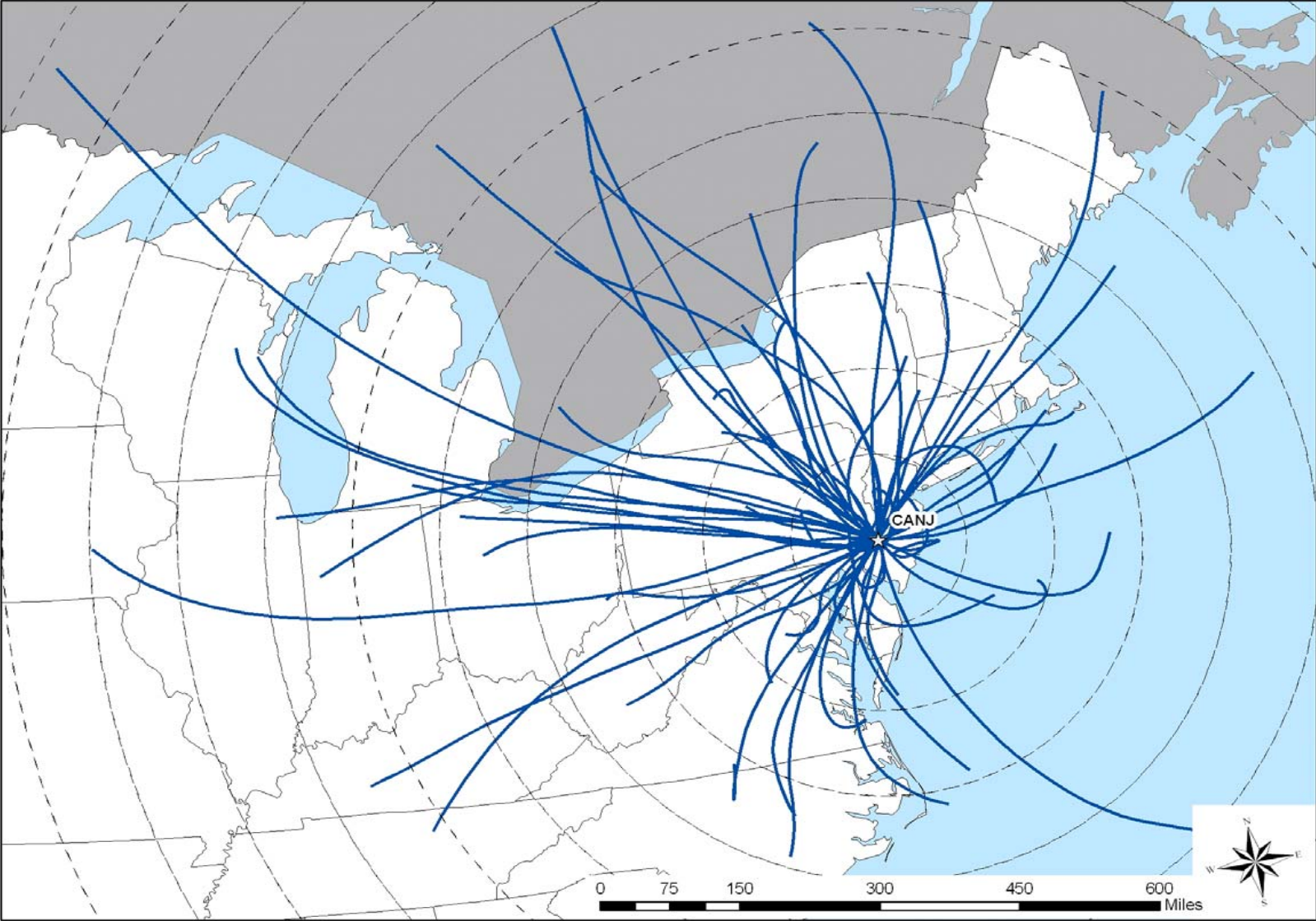


Figure 14-9. Composite Back Trajectory Map for CHNJ

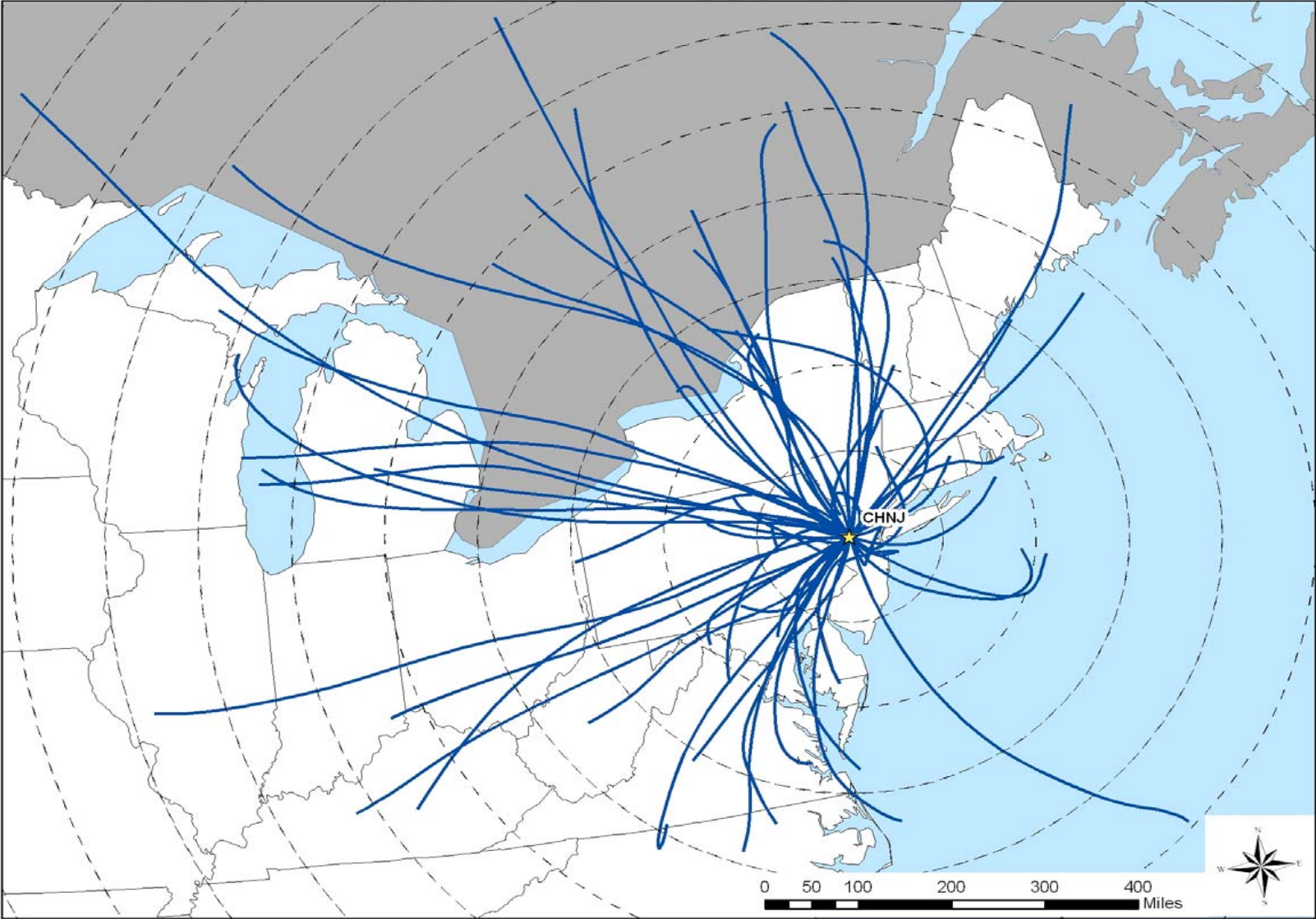


Figure 14-10. Composite Back Trajectory Map for ELNJ

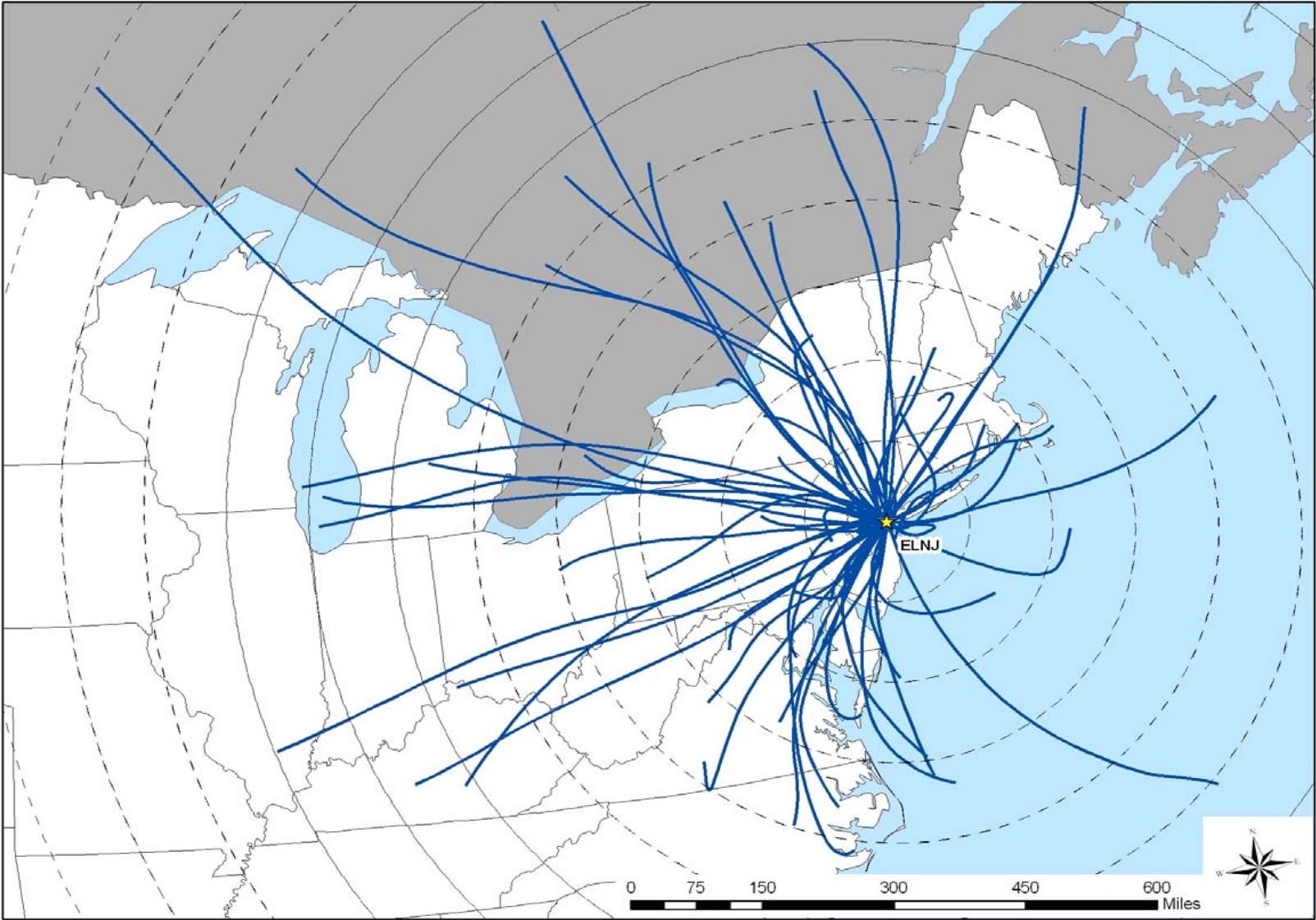


Figure 14-11. Composite Back Trajectory Map for NBNJ

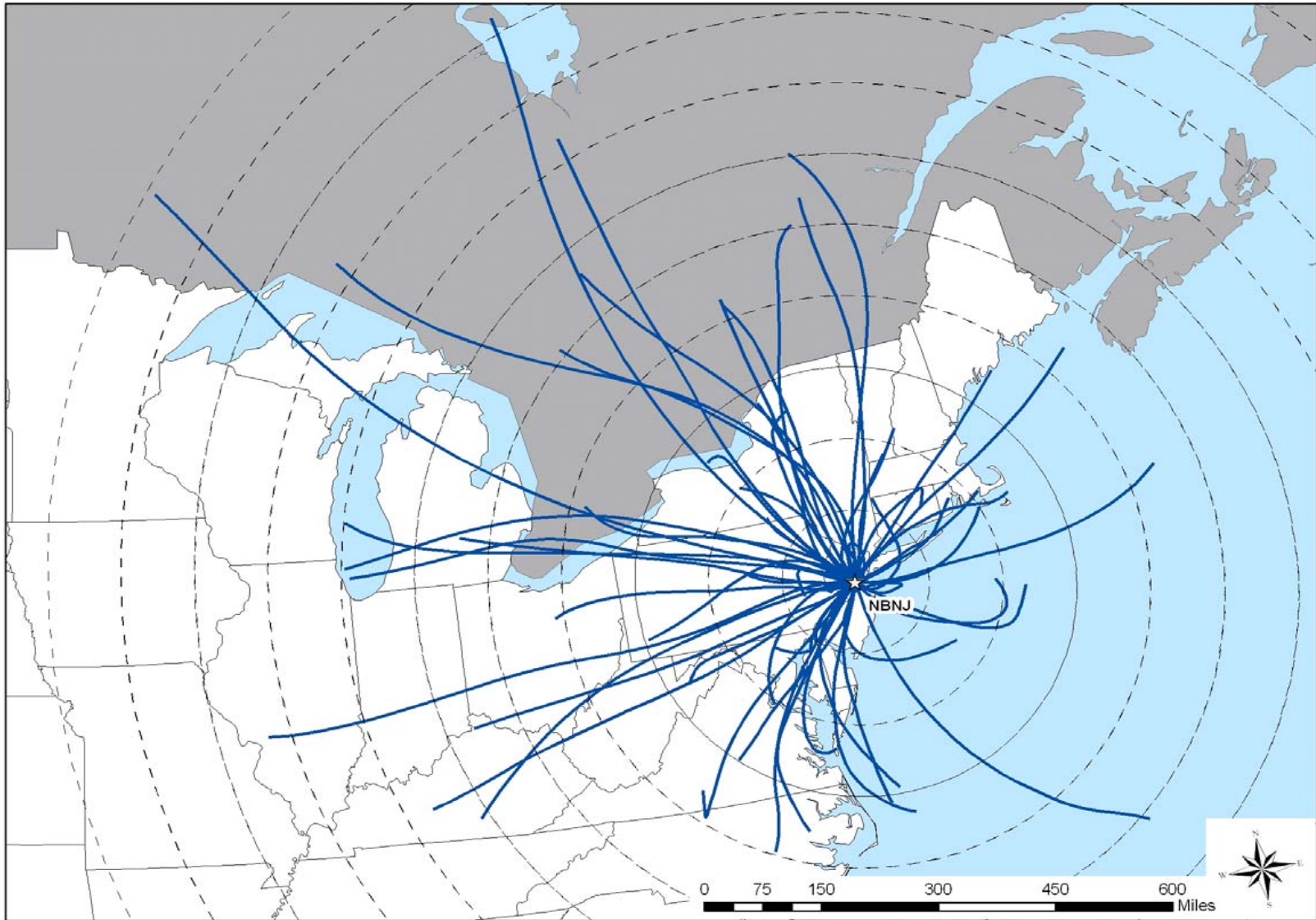


Figure 14-12. 2004 Total VOC Profile at CANJ

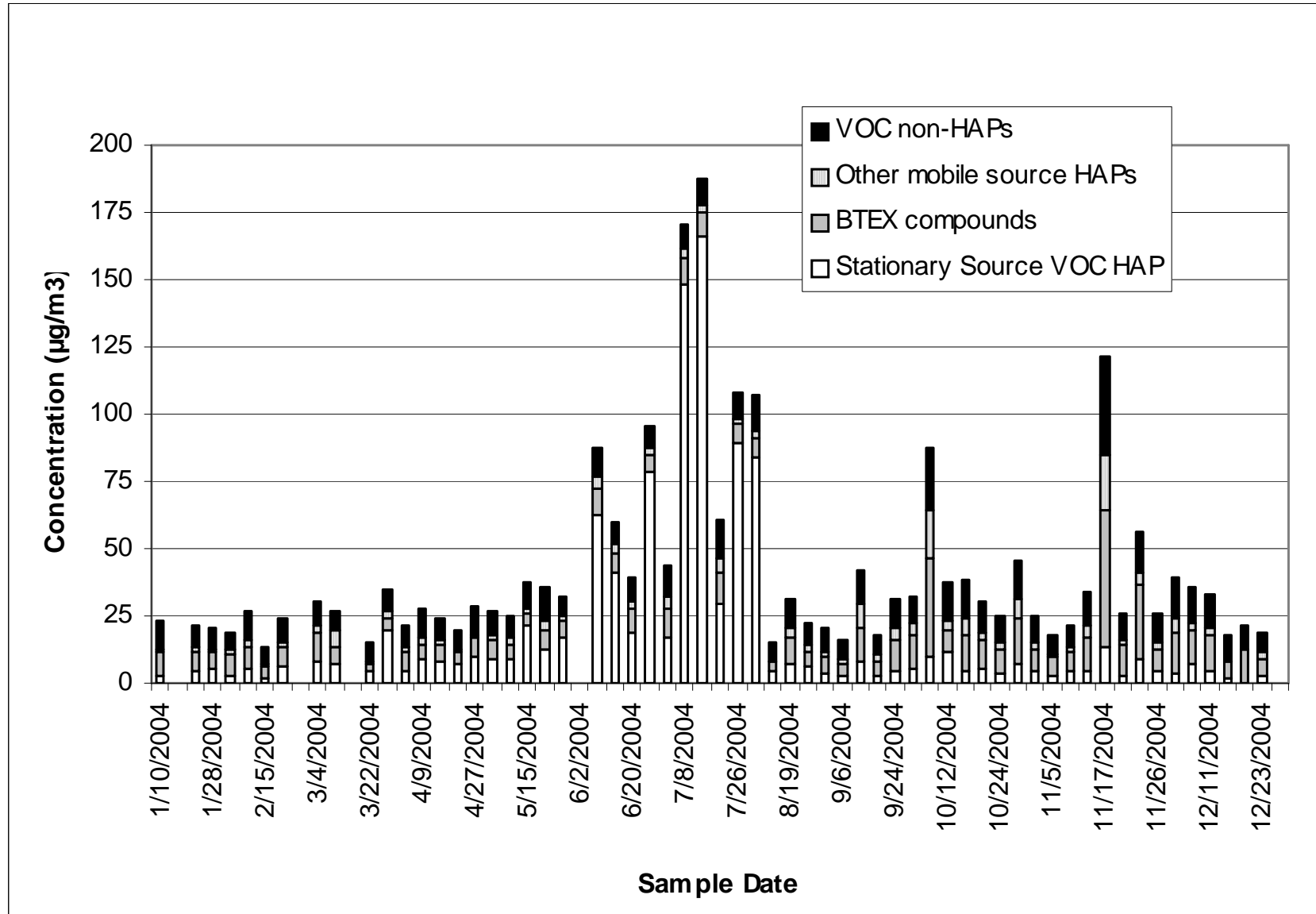


Figure 14-13. 2004 Total VOC Profile at CHNJ

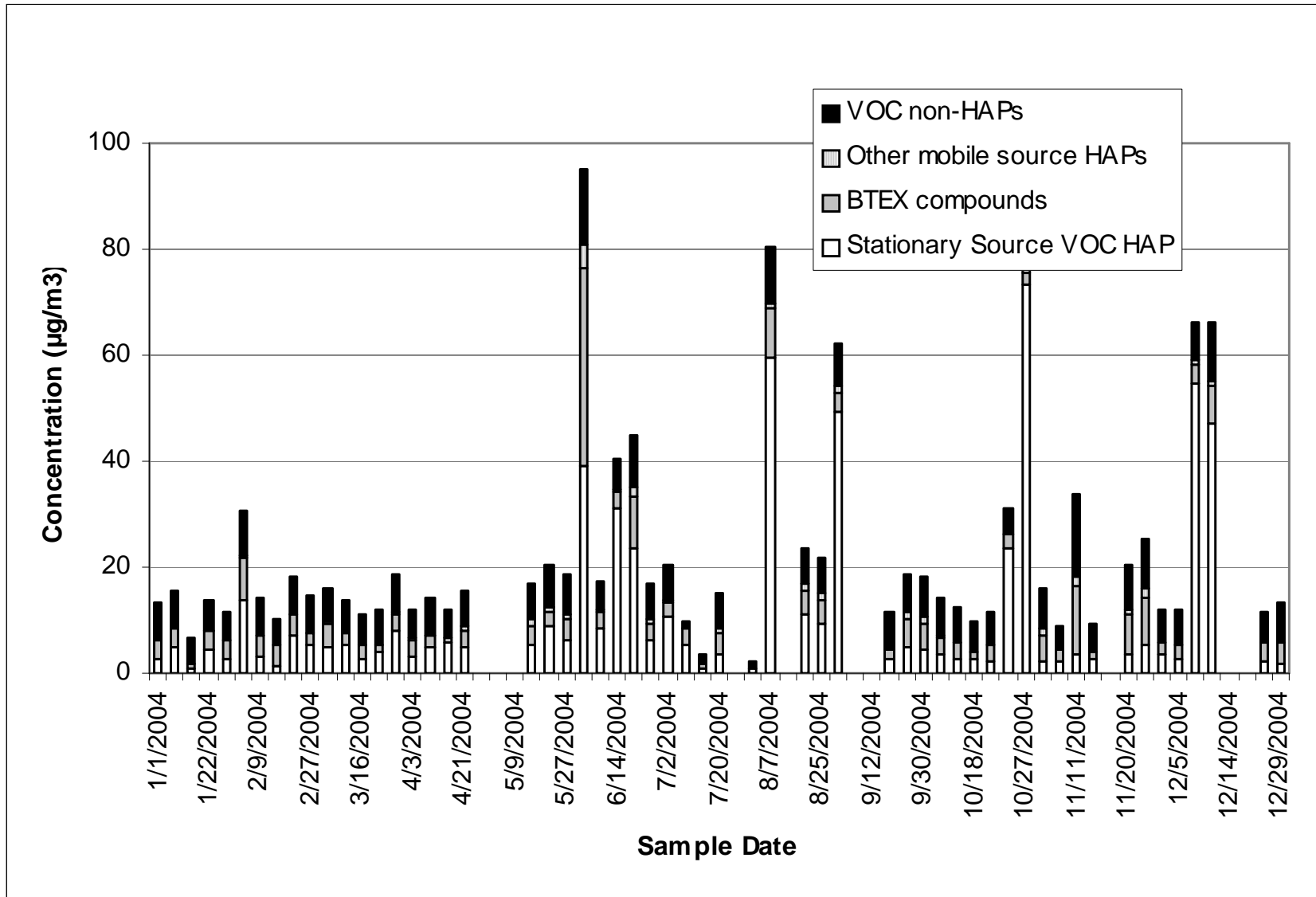


Figure 14-14. 2004 Total VOC Profile at ELNJ

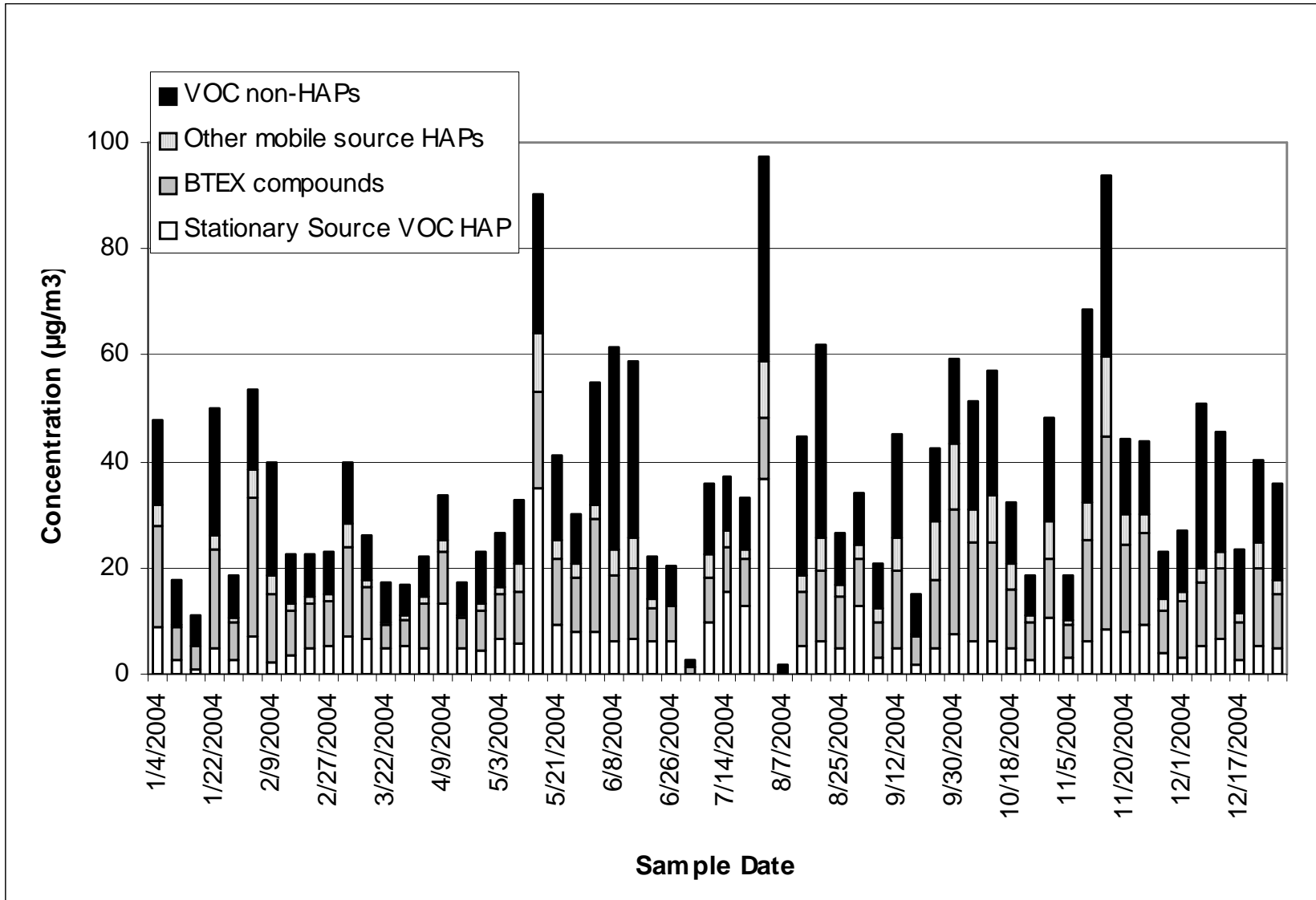


Figure 14-15. 2004 Total VOC Profile at NBNJ

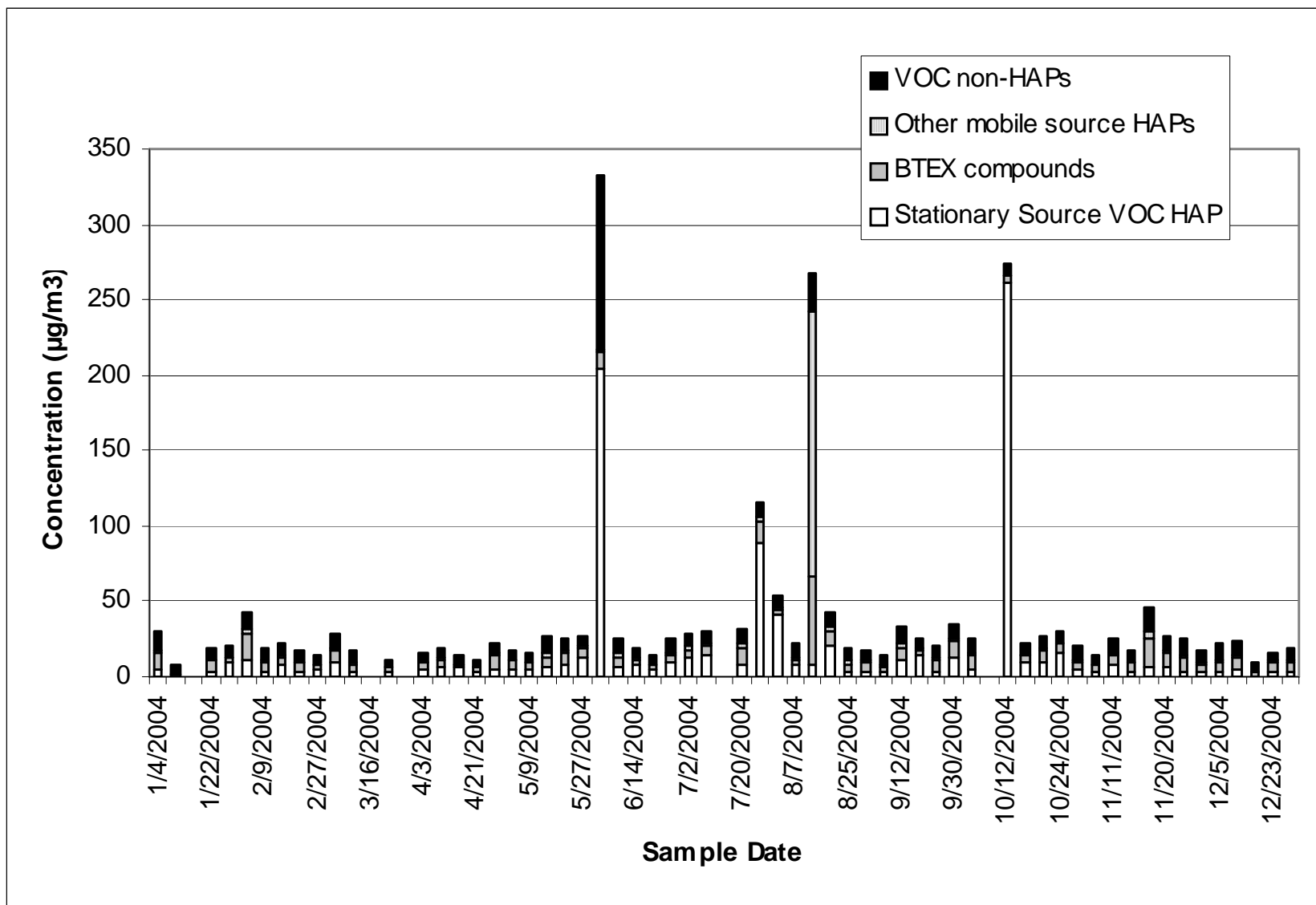


Table 14-1. Average Concentration and Meteorological Parameters for Sites in New Jersey

Site Name	Type	Average UATMP Concentration (µg/m ³)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average u-component of the Wind (kts)	Average v-component of the Wind (kts)
CANJ	All 2004		63.12 (±1.90)	55.57 (±1.78)	42.87 (±2.02)	49.63 (±1.69)	65.39 (±1.53)	1017.94 (±0.73)	1.86 (±0.53)	-0.66 (±0.49)
	sample day	61.54 (±13.48)	63.10 (±4.15)	55.44 (±3.92)	42.80 (±1.55)	49.54 (±3.75)	65.33 (±3.52)	1017.47 (±1.78)	2.14 (±1.37)	-1.40 (±1.24)
CHNJ	All 2004		62.01 (±1.91)	52.33 (±1.77)	41.71 (±2.02)	47.49 (±1.71)	70.34 (±1.38)	1017.28 (±0.75)	-0.07 (±0.23)	-0.99 (±0.30)
	sample day	31.67 (±8.19)	60.34 (±4.31)	50.97 (±4.08)	40.65 (±4.78)	46.37 (±3.99)	70.88 (±3.49)	1016.79 (±2.03)	-0.05 (±0.64)	-1.31 (±0.70)
ELNJ	All 2004		61.92 (±1.92)	54.51 (±1.82)	41.76 (±2.03)	48.61 (±1.72)	65.03 (±1.56)	1017.55 (±0.75)	1.88 (±0.54)	-1.65 (±0.53)
	sample day	50.21 (±5.70)	62.46 (±4.36)	54.85 (±4.21)	42.23 (±4.76)	48.99 (±3.99)	65.46 (±3.68)	1016.37 (±1.92)	2.36 (±1.25)	-1.62 (±1.31)
NBNJ	All 2004		62.01 (±1.91)	52.33 (±1.77)	41.71 (±2.02)	47.49 (±1.71)	70.34 (±1.38)	1017.28 (±0.75)	-0.07 (±0.23)	-0.99 (±0.30)
	sample day	56.20 (±17.54)	61.77 (±4.25)	51.95 (±4.10)	41.60 (±4.80)	47.28 (±4.00)	70.90 (±3.36)	1016.76 (±1.93)	0.13 (±0.57)	-1.13 (±0.68)

Table 14-2. Summary of the Toxic Cancer Compounds at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Camden, New Jersey - CANJ						
Acrylonitrile	2.21 E-05	24.57	24.57	0.33	4	22.14
Acetaldehyde	2.15 E-05	23.91	48.48	9.79	52	21.54
Benzene	1.14 E-05	12.67	61.15	1.46	60	11.41
1,3-Butadiene	8.99 E-06	9.98	71.12	0.30	18	8.99
Carbon Tetrachloride	8.77 E-06	9.74	80.86	0.58	57	8.77
<i>p</i> -Dichlorobenzene	7.05 E-06	7.82	88.68	0.64	8	7.05
Tetrachloroethylene	3.91 E-06	4.34	93.02	0.66	24	3.91
Vinyl Chloride	2.59 E-06	2.87	95.89	0.29	2	2.59
<i>trans</i> -1,3-dichloropropene	1.72 E-06	1.91	97.81	0.43	2	1.72
Trichloroethylene	1.65 E-06	1.83	99.64	0.82	20	1.65
Dichloromethane	2.82 E-07	0.31	99.95	0.60	40	0.28
Formaldehyde	4.53 E-08	0.05	100.00	8.24	52	0.05
Chester, New Jersey - CHNJ						
Acrylonitrile	3.76 E-05	55.96	55.96	0.55	3	37.63
Carbon Tetrachloride	8.83 E-06	13.12	69.09	0.59	45	8.83
Benzene	5.40 E-06	8.03	77.11	0.69	55	5.40
1,3-Butadiene	5.31 E-06	7.90	85.01	0.18	2	5.31
Acetaldehyde	4.36 E-06	6.48	91.49	1.98	54	4.36
Tetrachloroethylene	2.84 E-06	4.22	95.71	0.48	11	2.84
<i>trans</i> -1,3-dichloropropene	1.95 E-06	2.90	98.61	0.49	4	1.95
Trichloroethylene	5.37 E-07	0.80	99.41	0.27	2	0.54
Dichloromethane	3.77 E-07	0.56	99.97	0.80	29	0.38

Table 14-2. Summary of the Toxic Cancer Compounds at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Formaldehyde	1.89 E-08	0.03	100.00	3.44	54	0.02
Elizabeth, New Jersey - ELNJ						
Acrylonitrile	2.26 E-05	30.91	30.91	0.33	5	22.58
Benzene	1.17 E-05	16.08	46.99	1.51	59	11.74
Acetaldehyde	1.05 E-05	14.31	61.30	4.75	59	10.45
Carbon Tetrachloride	8.51 E-06	11.65	72.95	0.57	51	8.51
1,3-Butadiene	7.95 E-06	10.88	83.84	0.26	27	7.95
<i>p</i> -Dichlorobenzene	5.73 E-06	7.85	91.69	0.52	3	5.73
Tetrachloroethylene	3.33 E-06	4.56	96.24	0.56	27	3.33
<i>trans</i> -1,3-Dichloropropene	1.75 E-06	2.40	98.64	0.44	3	1.75
Trichloroethylene	5.64 E-07	0.77	99.42	0.28	4	0.56
Dichloromethane	4.01 E-07	0.55	99.97	0.85	50	0.40
Formaldehyde	2.50 E-08	0.03	100.00	4.55	59	0.03
New Brunswick, New Jersey - NBNJ						
Acrylonitrile	2.26 E-05	26.94	26.94	0.33	3	22.63
Acetaldehyde	1.61 E-05	19.12	46.06	7.30	59	16.06
<i>p</i> -Dichlorobenzene	1.22 E-05	14.57	60.63	1.11	1	12.24
Carbon Tetrachloride	8.66 E-06	10.31	70.94	0.58	55	8.66
Benzene	7.56 E-06	9.00	79.94	0.97	60	7.56
1,2-Dichloropropane	6.15 E-06	7.32	87.26	0.32	1	6.15
1,3-Butadiene	4.48 E-06	5.33	92.59	0.15	4	4.48
Tetrachloroethylene	3.41 E-06	4.06	96.65	0.58	17	3.41
<i>trans</i> -1,3-Dichloropropene	1.63 E-06	1.95	98.60	0.41	3	1.63
Trichloroethylene	9.14 E-07	1.09	99.69	0.46	2	0.91
Dichloromethane	2.30 E-07	0.27	99.96	0.49	49	0.23
Formaldehyde	3.27 E-08	0.04	100.00	5.95	59	0.03

Table 14-3. Summary of the Toxic Noncancer Compounds at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
Camden, New Jersey - CANJ						
Acetaldehyde	1.09 E+00	36.70	36.70	9.79	52	13
Formaldehyde	8.41 E-01	28.36	65.06	8.24	52	12
Acetonitrile	4.19 E-01	14.13	79.19	25.12	29	5
Acrylonitrile	1.63 E-01	5.49	84.68	0.33	4	0
1,3-Butadiene	1.50 E-01	5.05	89.73	0.30	18	0
Bromomethane	1.34 E-01	4.53	94.27	0.67	10	0
Benzene	4.88 E-02	1.65	95.91	1.46	60	0
Xylenes	4.18 E-02	1.41	97.32	4.18	60	0
<i>trans</i> -1,3-Dichloropropene	2.16 E-02	0.73	98.05	0.43	2	0
Carbon Tetrachloride	1.46 E-02	0.49	98.54	0.58	57	0
Chloromethane	1.39 E-02	0.47	99.01	1.25	59	0
Toluene	9.31 E-03	0.31	99.32	3.72	59	0
1,1-Dichloroethene	6.15 E-03	0.21	99.53	1.23	1	0
Vinyl Chloride	2.94 E-03	0.10	99.63	0.29	2	0
Tetrachloroethylene	2.45 E-03	0.08	99.71	0.66	24	0
Chloroform	2.39 E-03	0.08	99.79	0.23	4	0
Trichloroethylene	1.37 E-03	0.05	99.84	0.82	20	0
Methyl <i>tert</i> -Butyl Ether	1.01 E-03	0.03	99.98	3.03	57	0
<i>p</i> -Dichlorobenzene	8.01 E-04	0.03	99.90	0.64	8	0
Ethylbenzene	6.11 E-04	0.02	99.92	0.61	60	0
Dichloromethane	6.00 E-04	0.02	99.94	0.60	40	0
Methyl Ethyl Ketone	4.96 E-04	0.02	99.96	2.48	54	0
1,1,1-Trichloroethane	4.37 E-04	0.01	99.97	0.44	1	0
Styrene	4.30 E-04	0.01	99.99	0.43	47	0
Methyl Isobutyl Ketone	2.40 E-04	0.01	100.00	0.72	21	0

Table 14-3. Summary of the Toxic Noncancer Compounds at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
Chloroethane	8.97 E-05	0.00	100.00	0.90	2	0
Chester, New Jersey - CHNJ						
Formaldehyde	3.51 E-01	26.42	26.42	3.44	54	2
Acrylonitrile	2.77 E-01	20.85	47.27	0.55	3	0
Acetaldehyde	2.20 E-01	16.60	63.86	1.98	54	2
Acetonitrile	1.91 E-01	14.43	78.29	11.49	33	1
Bromomethane	9.32 E-02	7.02	85.32	0.47	1	0
1,3-Butadiene	8.85 E-02	6.67	91.99	0.18	2	0
<i>trans</i> -1,3-Dichloropropene	2.44 E-02	1.84	93.82	0.49	4	0
Benzene	2.31 E-02	1.74	95.56	0.69	55	0
Xylenes	1.77 E-02	1.34	96.90	1.77	54	0
Carbon Tetrachloride	1.47 E-02	1.11	98.01	0.59	45	0
Chloromethane	1.28 E-02	0.97	98.98	1.16	57	0
Toluene	4.41 E-03	0.33	99.31	1.76	57	0
Chloroform	3.77 E-03	0.28	99.59	0.37	2	0
Tetrachloroethylene	1.78 E-03	0.13	99.73	0.48	11	0
Dichloromethane	8.02 E-04	0.06	99.79	0.80	29	0
1,1,1-Trichloroethane	5.46 E-04	0.04	99.83	0.55	1	0
Methyl Ethyl Ketone	4.70 E-04	0.04	99.86	2.35	46	0
Styrene	4.52 E-04	0.03	99.90	0.45	19	0
Trichloroethylene	4.48 E-04	0.03	99.93	0.27	2	0
Ethylbenzene	3.46 E-04	0.03	99.96	0.35	46	0
Methyl Isobutyl Ketone	2.66 E-04	0.02	99.98	0.80	6	0
Methyl <i>tert</i> -Butyl Ether	2.49 E-04	0.02	100.00	0.75	31	0
Chloroethane	6.07 E-05	0.00	100.00	0.61	1	0

Table 14-3. Summary of the Toxic Noncancer Compounds at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
Elizabeth, New Jersey - ELNJ						
Acetaldehyde	5.28 E-01	34.66	34.66	4.75	59	2
Formaldehyde	4.65 E-01	30.49	65.15	4.55	59	1
Acrylonitrile	1.66 E-01	10.90	76.05	0.33	5	0
1,3-Butadiene	1.32 E-01	8.70	84.75	0.26	27	0
Xylenes	5.54 E-02	3.64	88.38	5.54	59	0
Benzene	5.02 E-02	3.29	91.68	1.51	59	0
Acetonitrile	4.34 E02	2.85	94.53	2.61	26	0
<i>trans</i> -1,3-Dichloropropene	2.19 E-02	1.44	95.97	0.44	3	0
Methyl Methacrylate	1.47 E-02	0.97	96.93	10.30	5	0
Carbon Tetrachloride	1.42 E-02	0.93	97.87	0.57	51	0
Chloromethane	1.33 E-02	0.88	98.74	1.20	58	0
Toluene	9.39 E-03	0.62	99.36	3.75	60	0
Chloroform	2.51 E-03	0.16	99.52	0.25	8	0
Tetrachloroethylene	2.09 E-03	0.14	99.66	0.56	27	0
Methyl <i>tert</i> -Butyl Ether	1.22 E-03	0.08	99.74	3.66	55	0
Dichloromethane	8.54 E-04	0.06	99.80	0.85	50	0
Ethylbenzene	7.70 E-04	0.05	99.85	0.77	58	0
<i>p</i> -Dichlorobenzene	6.51 E-04	0.04	99.89	0.52	3	0
Methyl Ethyl Ketone	4.89 E-04	0.03	99.92	2.44	51	0
Trichloroethylene	4.70 E-04	0.02	99.97	0.29	3	0
1,1,1-Trichloroethane	2.91 E-04	0.02	99.97	0.29	3	0
Styrene	2.70 E-04	0.02	99.99	0.27	43	0
Methyl Isobutyl Ketone	1.76 E-04	0.01	100.00	0.53	12	0

Table 14-3. Summary of the Toxic Noncancer Compounds at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
New Brunswick, New Jersey - NBNJ						
Acetaldehyde	8.11 E-01	38.75	38.75	7.30	59	13
Formaldehyde	6.07 E-01	29.01	67.75	5.95	59	7
Acetonitrile	2.16 E-01	10.30	78.05	12.93	37	1
Acrylonitrile	1.66 E-01	7.95	86.00	0.33	3	0
1,2-Dichloropropane	8.09 E-02	3.86	89.86	0.32	1	0
1,3-Butadiene	7.47 E-02	3.57	93.42	0.15	4	0
Benzene	3.23 E-02	1.54	94.97	0.97	60	0
Xylenes	3.12 E-02	1.49	96.46	3.12	59	0
<i>trans</i> -1,3-Dichloropropene	2.04 E-02	0.98	97.43	0.41	3	0
Carbon Tetrachloride	1.44 E-02	0.69	98.12	0.58	55	0
Chloromethane	1.36 E-02	0.65	98.77	1.22	59	0
Toluene	7.55 E-03	0.36	99.13	3.02	60	0
Methyl Methacrylate	4.39 E-03	0.21	99.34	3.07	1	0
Chloroform	2.36 E-03	0.11	99.46	0.23	9	0
Tetrachloroethylene	2.14 E-03	0.10	99.56	0.58	17	0
Chloroethane	1.87 E-03	0.09	99.65	18.71	1	0
Methyl <i>tert</i> -Butyl Ether	1.50 E-03	0.07	99.72	4.49	54	0
<i>p</i> -Dichlorobenzene	1.39 E-03	0.07	99.79	1.11	1	0
Methyl Isobutyl Ketone	1.20 E-03	0.06	99.84	3.59	3	0
Methyl Ethyl Ketone	1.16 E-03	0.06	99.90	5.82	52	0
Trichloroethylene	7.61 E-04	0.04	99.93	0.46	2	0
Ethylbenzene	5.41 E-04	0.03	99.96	0.54	58	0
Dichloromethane	4.88 E-04	0.02	99.98	0.49	49	0
Styrene	3.47 E-04	0.02	100.00	0.35	31	0

Table 14-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Sites

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Camden, New Jersey - CANJ								
1,3-Butadiene	0.00	-0.02	-0.11	-0.07	-0.26	0.45	-0.08	-0.02
Acetaldehyde	0.32	0.29	0.26	0.28	0.12	-0.28	-0.03	-0.03
Acetonitrile	0.49	0.53	0.52	0.54	0.20	-0.20	-0.05	0.32
Acrylonitrile	-0.35	-0.26	-0.25	-0.25	-0.05	-0.50	-0.38	-0.69
Benzene	-0.10	-0.11	-0.12	-0.12	-0.10	0.29	0.05	0.16
Bromomethane	0.08	0.11	0.09	0.09	0.05	-0.36	0.13	-0.12
Carbon Tetrachloride	0.08	0.10	0.11	0.11	0.06	0.07	-0.08	0.00
Formaldehyde	0.53	0.51	0.45	0.49	0.14	-0.27	-0.09	0.14
<i>p</i> -Dichlorobenzene	0.13	0.00	-0.13	-0.06	-0.42	0.53	0.42	-0.10
Tetrachloroethylene	-0.11	-0.05	-0.03	-0.05	0.00	0.21	-0.18	-0.05
Vinyl Chloride	NA							
Chester, New Jersey - CHNJ								
1,3-Butadiene	NA							
Acetaldehyde	0.23	0.20	0.19	0.20	0.10	-0.11	0.04	0.01
Acetonitrile	0.16	0.16	0.21	0.18	0.23	-0.17	0.13	-0.04
Acrylonitrile	NA							
Benzene	-0.22	-0.21	-0.10	-0.17	0.25	-0.16	0.12	0.25
Bromomethane	NA							
Carbon Tetrachloride	0.18	0.21	0.20	0.21	0.05	-0.06	0.13	-0.03
Formaldehyde	0.31	0.28	0.26	0.28	0.11	-0.13	0.05	0.00
Tetrachloroethylene	-0.50	-0.42	-0.37	-0.40	0.19	0.22	-0.20	-0.50
<i>trans</i> -1,3-Dichloropropene	-0.42	-0.45	-0.41	-0.44	-0.14	0.27	-0.19	-0.87
Elizabeth, New Jersey - ELNJ								
1,3-Butadiene	-0.10	-0.11	-0.02	-0.09	0.21	0.22	-0.14	0.23
Acetaldehyde	0.46	0.43	0.39	0.41	0.07	0.15	0.00	0.45
Acetonitrile	0.42	0.46	0.44	0.46	0.19	-0.29	0.02	0.22

Table 14-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Camden, Chester, Elizabeth, and New Brunswick, New Jersey Sites (Cont.)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Acrylonitrile	-0.09	0.04	0.07	0.06	0.31	0.06	-0.43	-0.10
Benzene	-0.02	-0.02	0.07	0.02	0.26	0.12	0.06	0.45
Carbon Tetrachloride	0.04	0.07	0.10	0.08	0.10	0.07	0.09	0.13
Formaldehyde	0.12	0.10	0.03	0.07	-0.14	0.13	0.11	0.14
<i>p</i> -Dichlorobenzene	NA							
Tetrachloroethylene	-0.40	-0.43	-0.38	-0.42	0.08	0.26	-0.18	-0.03
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	0.04	0.02	0.09	0.04	0.23	0.09	-0.02	0.37
New Brunswick, New Jersey - NBNJ								
1,2-Dichloropropene	NA							
1,3-Butadiene	-0.81	-0.38	-0.33	-0.33	-0.23	-0.43	0.28	-0.04
Acetaldehyde	0.35	0.37	0.34	0.36	0.13	-0.05	0.01	-0.08
Acetonitrile	0.04	0.01	-0.01	0.00	-0.07	-0.19	0.09	-0.25
Acrylonitrile	NA							
Benzene	-0.17	-0.16	-0.08	-0.13	0.17	0.12	-0.02	0.24
Carbon Tetrachloride	0.13	0.14	0.15	0.15	0.10	0.08	-0.04	-0.03
Formaldehyde	0.32	0.34	0.32	0.34	0.13	-0.07	0.01	-0.08
<i>p</i> -Dichlorobenzene	NA							
Tetrachloroethylene	0.32	0.23	0.10	0.16	-0.45	-0.06	0.14	-0.26
Xylenes	0.14	0.19	0.24	0.22	0.24	0.00	-0.04	0.30

Table 14-5. Motor Vehicle Information vs. Daily Concentration for New Jersey Monitoring Sites

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned¹	Vehicles per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
CANJ	513,909	399,282	0.78	2,030,976	1,584,161	62,000	61.54 (\pm 13.48)
CHNJ	483,150	375,383	0.78	234,148	182,635	12,623	31.67 (\pm 8.19)
ELNJ	529,360	411,286	0.78	2,179,781	1,700,229	170,000	50.21 (\pm 5.70)
NBNJ	780,995	606,794	0.78	787,380	614,156	63,000	56.20 (\pm 17.54)

¹ County level vehicle ownership data was not available. State level registration data was therefore allocated to the county-level using county-level population data.

15.0 Sites in North Carolina

This section presents meteorological, concentration, and spatial trends for the UATMP sites in North Carolina (CANC and RTPNC). CANC is a rural site located in Candor near the Uwharrie National Forest. RTPNC is an urban site located in the Research Triangle Park area. Figures 15-1 through 15-2 are topographical maps showing the monitoring sites in their rural and urban locations. Figures 15-3 through 15-4 identify facilities within 10 miles of these sites as reported to the 2002 NEI. The CANC site has very few sources nearby, mostly located to the north or west of the site, and most are involved in fuel combustion industries or lumber and wood products. The RTPNC site has a few more facilities nearby, mostly to the north and east, and the majority of them are involved in fuel combustion. Hourly meteorological data were retrieved for all of 2004 at the Moore County Airport and Raleigh-Durham International Airport (WBAN 3720 and 13722, respectively) for calculating correlations of meteorological data with ambient air concentration measurements.

Table 15-1 highlights the average UATMP concentration at these sites, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average u - and v -components of the wind) for the entire year and on sampling days. Candor is located in south-central North Carolina, about halfway between Charlotte and Fayetteville, on the outskirts of the Uwharrie National Forest. This area is considered to be the sandhills region, where the sandy soil allows for rapid drainage, as well as rapid warming during the day and cooling during the night. As a result, daytime temperatures rise quickly, while nighttime temperatures cool quickly. The Mid-Atlantic location of this site allows for fairly ample rainfall. This information can be verified at <http://www.pinehurstproperty.com/climate.html>. Research Triangle Park is located between Raleigh and Durham in central North Carolina. Its Southeastern location allows for warm, usually muggy summers, and generally mild winters. Afternoon thunderstorms are typical during the summer, although rainfall is distributed rather equally throughout the year. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

15.1 Prevalent Compounds at the North Carolina Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 15-2 summarizes the cancer weighting scores, and Table 15-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

The North Carolina sites sampled only carbonyls. As can be shown in Tables 15-2 and 15-3, acetaldehyde was the only prevalent cancer compound at both sites, while both acetaldehyde and formaldehyde were prevalent for noncancer compounds. Both toxic carbonyl compounds were detected at CANC and RTPNC.

15.2 Toxicity Analysis

Acetaldehyde contributed to over 99% of the total toxicity for cancer compounds while the contribution to total noncancer toxicity was somewhat more evenly distributed. The number of detections of acetaldehyde equaled the number of detections of formaldehyde at both sites.

The acetaldehyde cancer risk was the highest among the toxic carbonyl compounds at CANC at 2.58 in a million. For the compounds that may lead to adverse noncancer health effects, the highest average noncancer toxicity was 0.199 (over 1 indicates a significant chance of a noncancer health effect) for formaldehyde at CANC. None of the carbonyl compound concentrations at either site were above their noncancer RfC weighting factors.

15.3 Meteorological and Concentration Averages at the North Carolina Site

Carbonyl compounds were measured at each site, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration (carbonyl compounds only) at CANC was 6.00 (\pm 1.52) $\mu\text{g}/\text{m}^3$, while at RTPNC the average concentration was 3.89 (\pm 0.88) $\mu\text{g}/\text{m}^3$. Table 15-1 also lists the averages for selected meteorological parameters from January 2004 to December 2004, and for days on which sampling occurred.

Table 15-4 presents the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. The highest correlation at CANC was computed between formaldehyde and the average temperature (0.56). Formaldehyde and maximum temperature, dew point temperature, and wet bulb temperature also had strong positive correlations, indicating that formaldehyde concentrations increase as temperature and moisture content increase. Acetaldehyde correlations at CANC were generally weak, with the exception of the *v*-component of the wind (0.27).

All but one correlation at the RTPNC site were at least moderately strong. All of the correlations between acetaldehyde and the temperature and moisture parameters were negative and very strong. Formaldehyde correlations with these same parameters tended to be positive and strong. These compounds also had moderately strong to strong correlations with the wind components. All of this would indicate that RTPNC prevalent compounds are strongly influenced by the meteorology of the area. However, there were only nine sample days at RTPNC. This small number of measurements could make the correlations appear stronger than they might with a larger sample size.

Figures 15-5 and 15-6 show the composite back trajectories for the CANC and RTPNC sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in Figure 15-5, the back trajectories originated predominantly from the west, northwest, and north of the CANC site. Each circle around the site in Figure 15-5 represents 100 miles; 79% of the trajectories originated within 500 miles, and 96% within 900 miles from the CANC site. The 24-hour airshed domain is extremely large. Back trajectories originated over 900 miles away.

Figure 15-6 shows few back trajectories as RTPNC sampled during only a portion of 2004. Back trajectories originated more frequently from the northwest. Each circle around the site in Figure 15-6 represents 100 miles; 67% of the trajectories originated within 400 miles, and

89% within 900 miles from the RTPNC site. The 24-hour airshed domain for RTPNC appears extremely large. Back trajectories originated nearly 1000 miles away.

15.4 Spatial Analysis

County-level vehicle registration and population in Montgomery and Durham counties, NC, were obtained from the North Carolina Department of Transportation and the U.S. Census Bureau, and are summarized in Table 15-5. Table 15-5 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 15-5 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the CANC and RTPNC site in Table 15-5. Although RTPNC has a higher population, more vehicles owned, and a larger traffic volume, its concentration is two-thirds that of the CANC site.

15.5 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

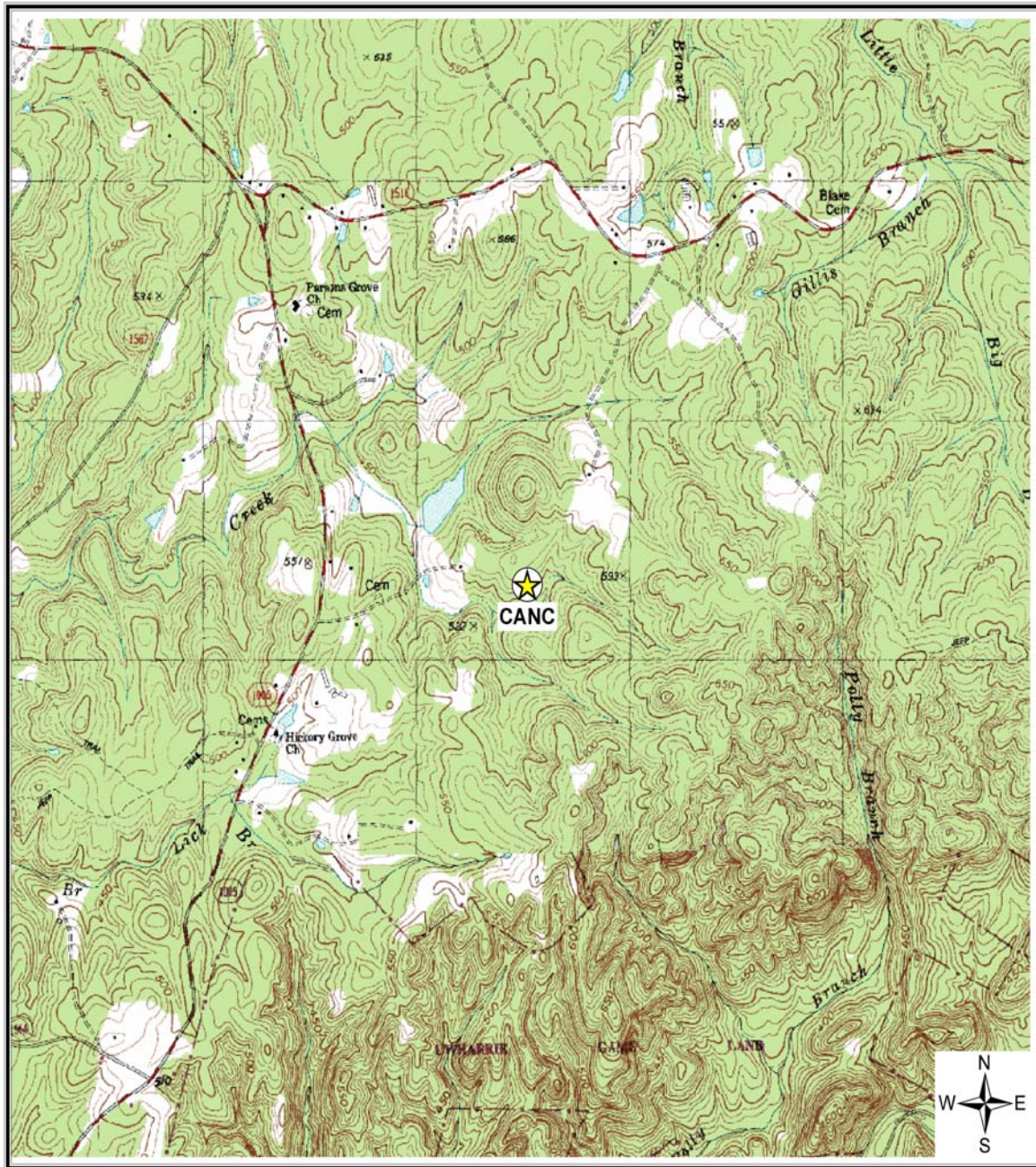
15.5.1 Site-Specific Trends Analyses

CANC participated in the 2003 and 2004 UATMP, while RTPNC has only participated in 2004. Therefore, site-specific trends analyses were not conducted for these two sites.

15.5.2 MSA-Specific Trends Analyses

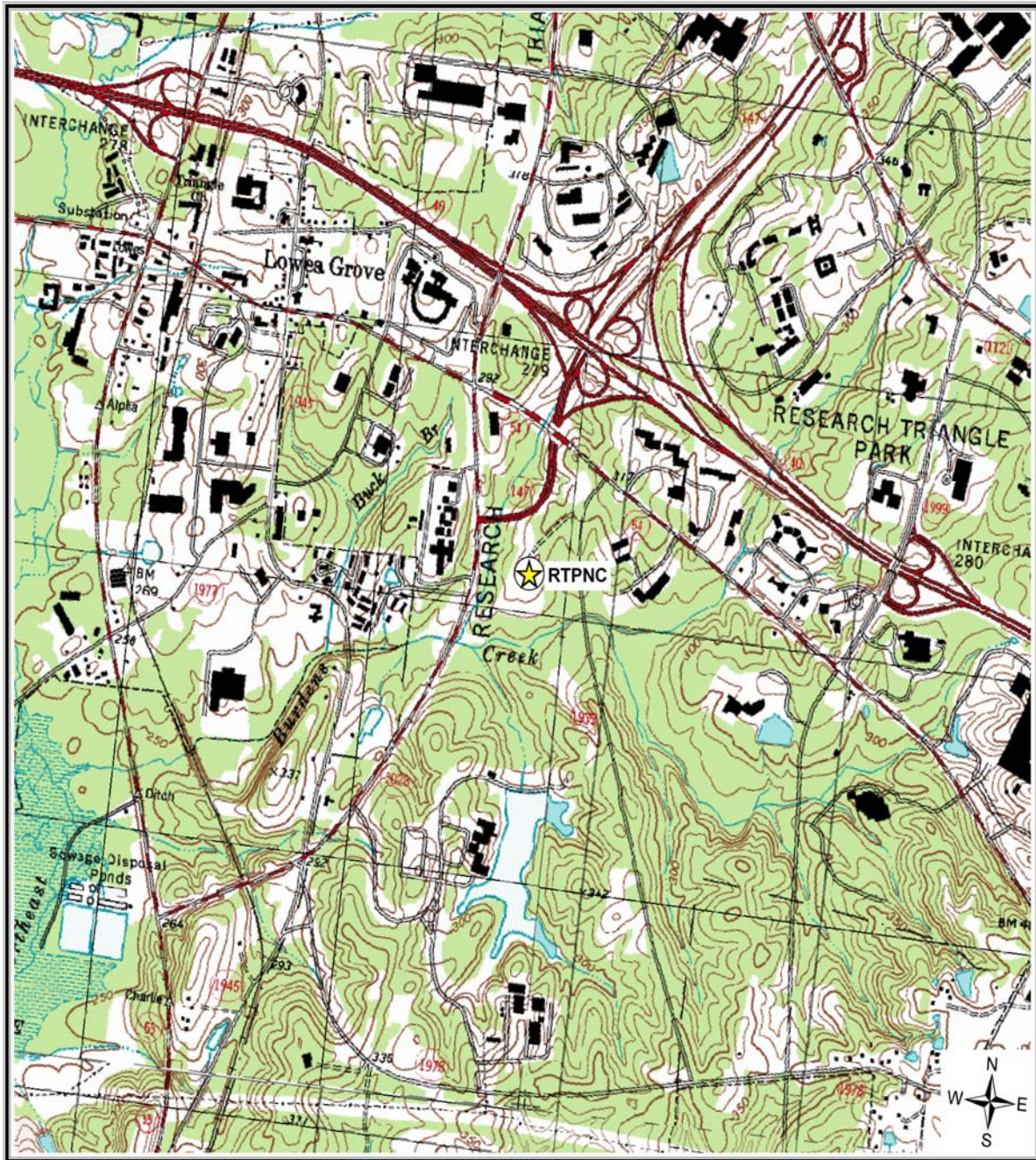
RTPNC resides in the Durham-Chapel Hill, NC MSA, while CANC is not in a designated MSA. The Durham-Chapel Hill MSA has experienced a 14.1% increase in population and estimated increase in vehicle miles traveled (VMT) from 1990 to 2003. Acetaldehyde and formaldehyde emissions have decreased significantly between 1990 and 2002. However, no prior concentration data is available via AQS for the 1990-2003 time frame, so no concentration comparison can be made. Trends for these and other compounds of interest can be found in Table 3-13. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

Figure 15-1. Candor, North Carolina (CANC) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 15-2. Research Triangle Park, North Carolina (RTPNC) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24, 000.

Figure 15-3. Facilities Located Within 10 Miles of CANC

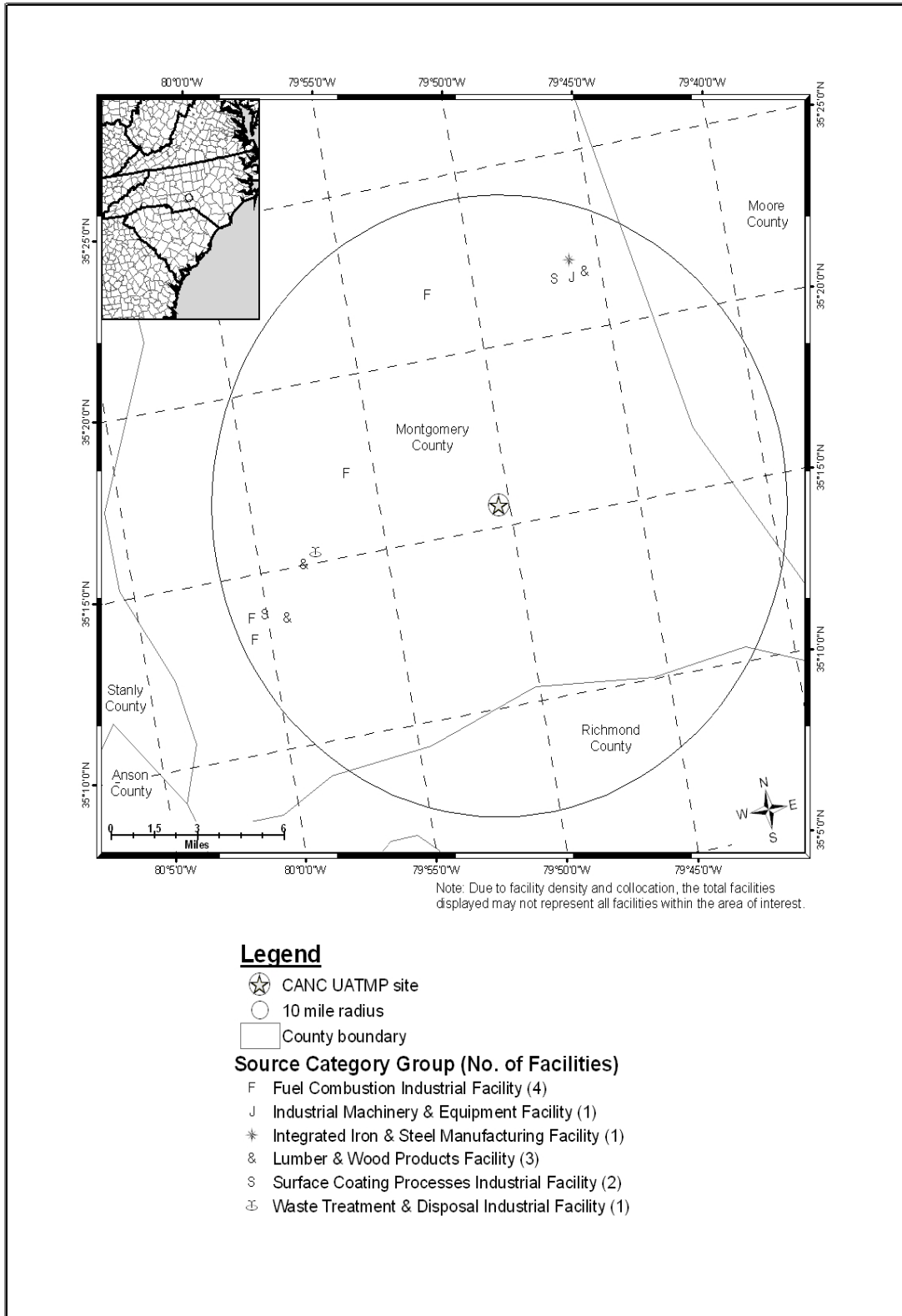


Figure 15-4. Facilities Located Within 10 Miles of RTPNC

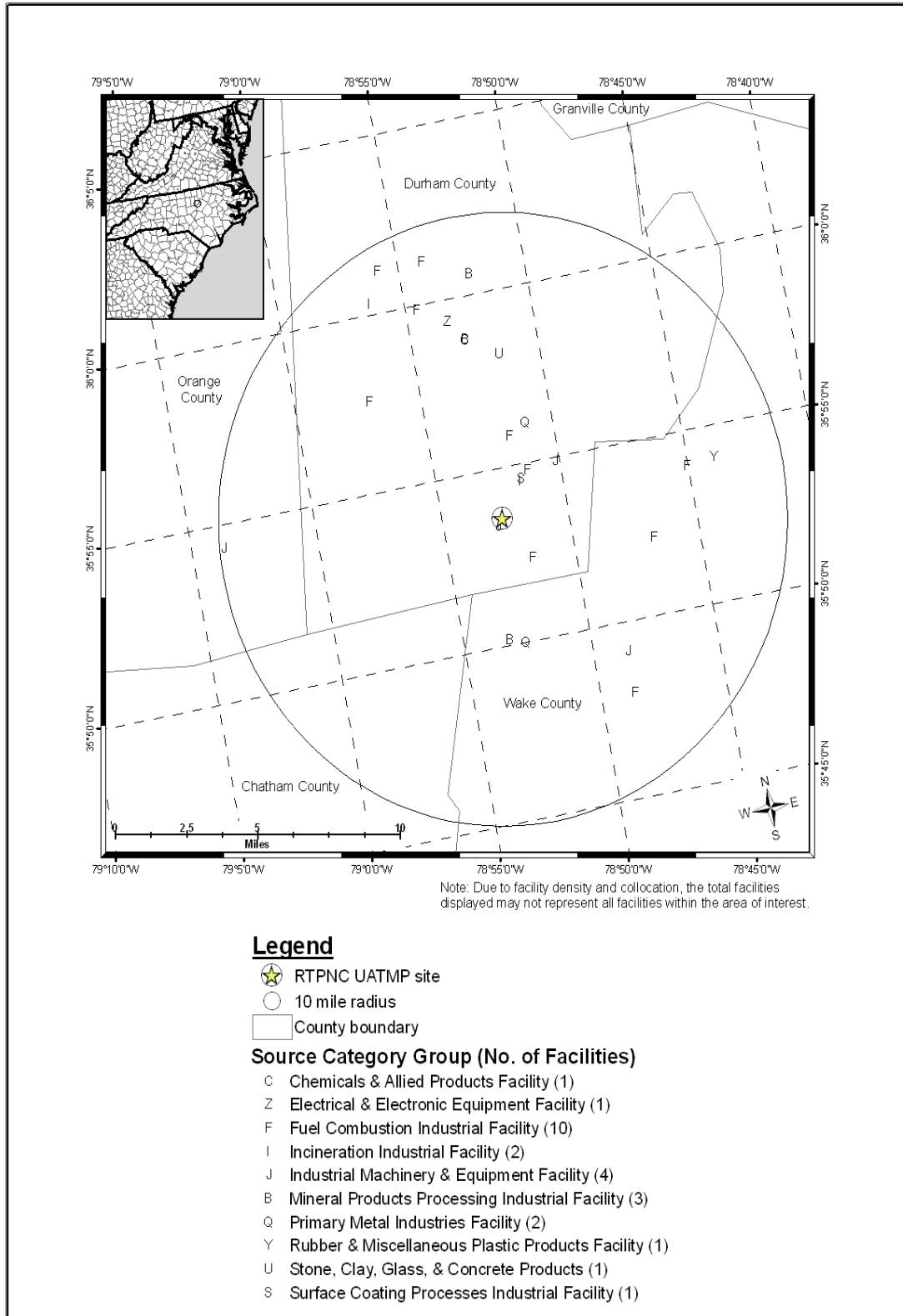


Figure 15-5. Composite Back Trajectory Map for CANC

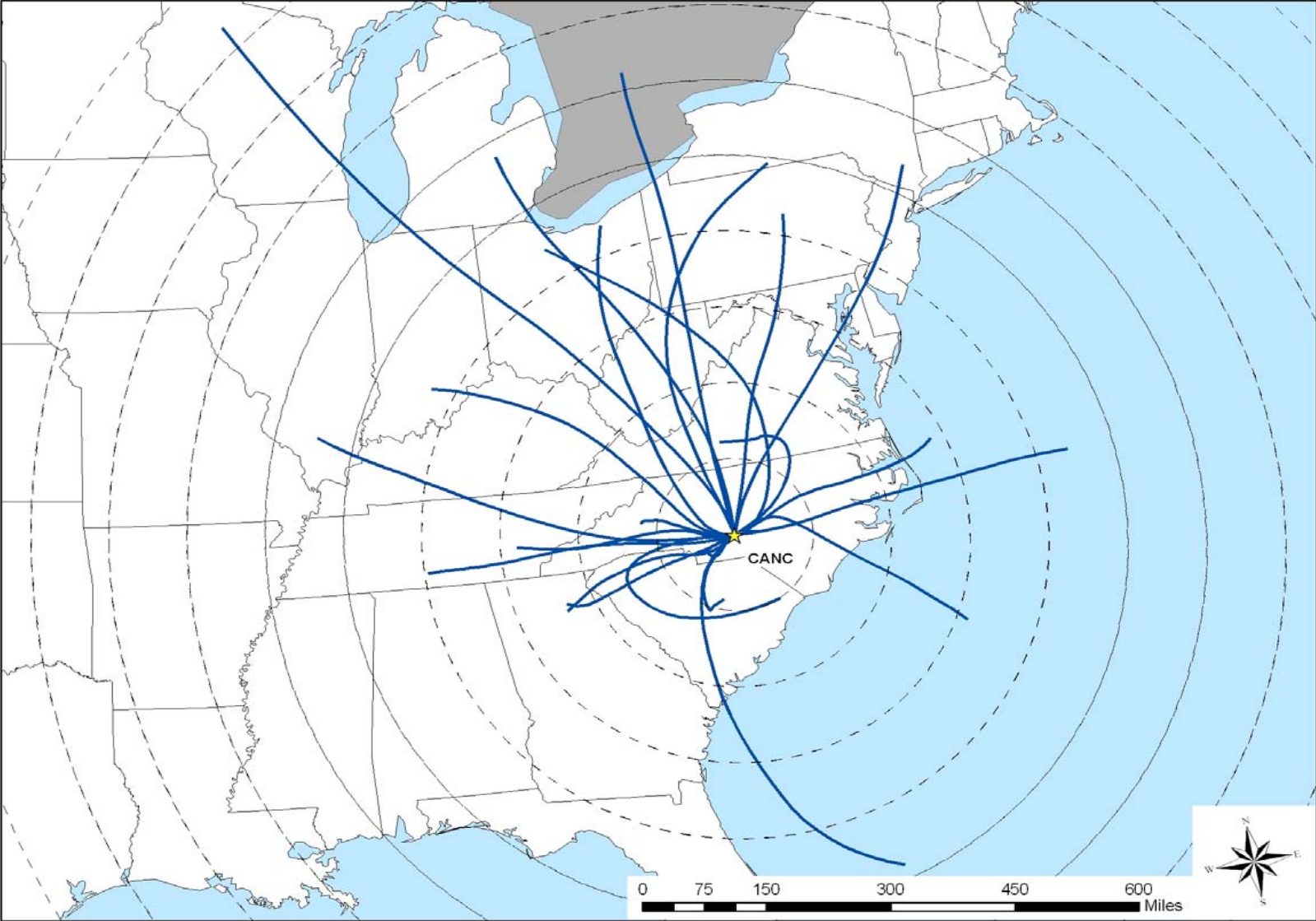


Figure 15-6. Composite Back Trajectory Map for RTPNC

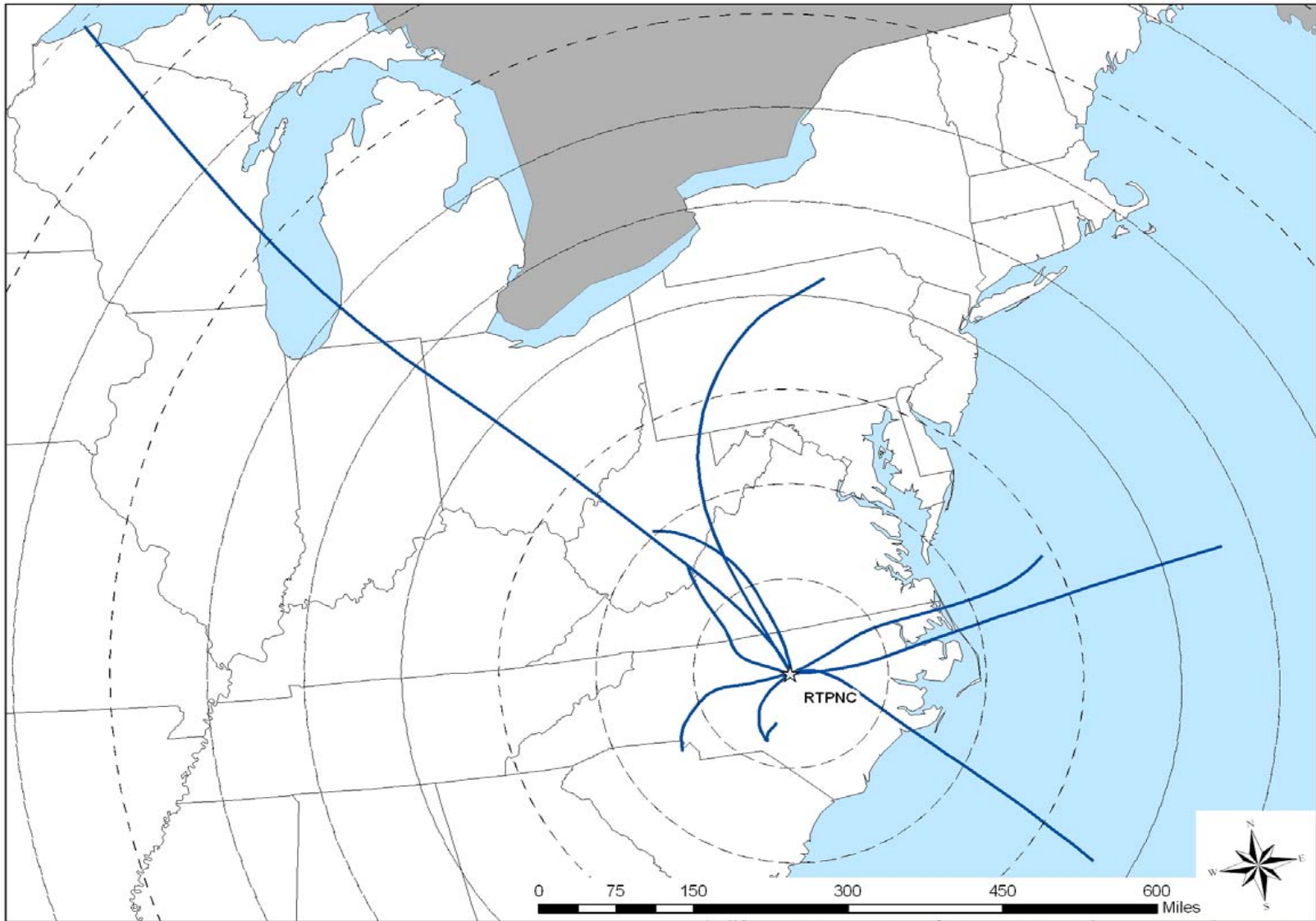


Table 15-1. Average Concentration and Meteorological Parameters for the Sites in North Carolina

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
CANC	All 2004	/ / / / / / / /	71.78 (± 1.68)	61.38 (± 1.62)	49.63 (± 1.93)	55.37 (± 1.59)	69.16 (± 1.56)	1019.14 (± 6.33) ¹	0.91 (± 0.35)	0.56 (± 0.34)
	sample day	6.00 (± 1.52)	68.55 (± 6.79)	58.66 (± 6.27)	47.45 (± 7.27)	53.09 (± 6.12)	70.18 (± 6.40)	1016.63 (± 2.21)	1.32 (± 1.27)	-0.71 (± 0.34)
RTPNC	All 2004	/ / / / / / / /	70.15 (± 1.62)	60.23 (± 1.59)	49.63 (± 1.89)	54.84 (± 1.58)	71.27 (± 1.44)	1018.75 (± 0.68)	0.94 (± 0.36)	0.64 (± 0.37)
	sample day	3.89 (± 0.88)	74.33 (± 6.18)	64.56 (± 6.44)	56.83 (± 8.08)	60.27 (± 6.84)	78.44 (± 6.21)	1016.90 (± 3.33)	-0.09 (± 2.12)	-0.64 (± 0.98)

¹ Sea level pressure are not recorded in this station. Station pressure in inches of Mercury was converted to mb to yield an “uncorrected” sea level pressure.

Table 15-2. Summary of the Toxic Cancer Compounds at the Candor and Research Triangle Park, North Carolina Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Candor, North Carolina - CANC						
Acetaldehyde	2.58 E-06	99.59	99.59	1.17	24	2.58
Formaldehyde	1.07 E-08	0.41	100.00	1.95	24	0.01
Research Triangle Park, North Carolina - RTPNC						
Acetaldehyde	1.75 E-06	99.55	99.55	0.80	9	1.75
Formaldehyde	7.93 E-09	0.45	100.00	1.44	9	0.01

Table 15-3. Summary of the Toxic Noncancer Compounds at the Candor and Research Triangle Park, North Carolina Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Candor, North Carolina - CANC						
Acetaldehyde	1.99 E-01	60.44	60.44	1.95	24	0
Formaldehyde	1.30 E-01	39.56	100.00	1.17	24	0
Research Triangle Park, North Carolina - RTPNC						
Acetaldehyde	1.47 E-01	62.47	62.47	1.44	9	0
Formaldehyde	8.84 E-02	37.53	100.00	0.80	9	0

Table 15-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Candor and Research Triangle Park, North Carolina Sites

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
Candor, North Carolina - CANC								
Acetaldehyde	0.13	0.14	0.12	0.11	-0.03	0.13	0.23	0.27
Formaldehyde	0.53	0.56	0.51	0.53	0.11	0.14	0.01	0.36
Research Triangle Park, North Carolina								
Acetaldehyde	-0.70	-0.79	-0.87	-0.85	-0.76	0.25	0.49	-0.51
Formaldehyde	0.69	0.71	0.69	0.71	0.41	0.01	-0.25	0.43

Table 15-5. Motor Vehicle Information vs. Daily Concentration for the North Carolina Monitoring Sites

Monitoring Station	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicle per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
CANC	27,306	26,623	0.97	11,014	10,684	100	6.00 (± 1.52)
RTPNC	236,781	259,865	1.10	380,541	417,640	12,000	3.89 (± 0.88)

16.0 Site in North Dakota

This section presents meteorological, concentration, and spatial trends for the UATMP site in North Dakota (SLND). This site is located on the Spirit Lake Nation Reservation, and Figure 16-1 is a topographical map showing the monitoring site in its urban location. Figure 16-2 identifies facilities within 10 miles of the site that reported to the 2002 NEI. The SLND site has no sources located within a ten mile radius. Hourly meteorological data were retrieved for all of 2004 at the Devils Lake Municipal Airport (WBAN 94928) for calculating correlations of meteorological data with ambient air concentration measurements.

Table 16-1 highlights the average UATMP concentration at the site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*- components of the wind) for the entire year and on sampling days. The Spirit Lake Indian Reservation is located in the northeast quadrant of North Dakota. It is bordered by Devil's Lake to the north and by the Sheyenne River to the south. Its climate is continental in nature, where temperature extremes are common and precipitation is moderate. Low temperatures in winter can dip into the -40s. This information can be found at <http://www.mnisose.org/profiles/splake.htm> and <http://www.cbhma.org/militaryposts.htm>.

16.1 Prevalent Compounds at the North Dakota Site

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound. Table 16-2 summarizes the cancer weighting scores, and Table 16-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

Table 16-2 shows that all four of the prevalent cancer compounds at SLND reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. However, several other detected compounds do not reflect this nationwide list. This is because SLND sampled VOC and SVOC only and only VOC and carbonyl compounds were considered for

nationwide prevalence. For the noncancer compounds summarized in Table 16-3, four of the seven prevalent noncancer compounds were listed among the nationwide noncancer prevalent list.

Prevalent toxic compounds not detected at the North Dakota site were: *cis*-1,3-dichloropropene; 1,3-butadiene; ethyl acrylate; 1,2-dichloroethane; 1,2-dichloropropane; tetrachloroethylene; vinyl chloride; bromomethane; and chloroprene.

16.2 Toxicity Analysis

Acrylonitrile and carbon tetrachloride contributed to nearly 75% of the site's cancer toxicity, although benzene had the highest number of detects. Acrylonitrile also made up over 60% of the site's noncancer toxicity value. The acrylonitrile cancer risk was the highest among the toxic compounds at 22.43 in a million. For the compounds that may lead to adverse noncancer health effects, the average acrylonitrile toxicity was 0.0165 (over 1 indicates a significant chance of a noncancer health effect). None of the compound concentrations were above their noncancer RfC weighting factors.

16.3 Meteorological and Concentration Averages at the North Dakota Site

VOC and SVOC were measured at this site, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration (VOC only) at SLND was 49.02 (\pm 28.50) $\mu\text{g}/\text{m}^3$. Table 16-1 also lists the averages for selected meteorological parameters from January 2004 to December 2004, and for days on which sampling occurred. As previously stated, SLND opted to sample for SVOC in addition to VOC. The average SVOC concentration is presented in Table 16-4. Also listed in Table 16-4 is the SVOC compound with the highest concentration.

Table 16-5 presents the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. Strong correlations between acrylonitrile and nearly all of the weather parameters were computed at SLND. However, acrylonitrile was only detected five times at SLND, which can lead to unusually high

correlations. Acetonitrile and chloromethane both exhibited moderately strong positive correlations with the temperature and moisture parameters (except relative humidity), while benzene had moderately strong negative correlations with these parameters. The strongest correlation with the wind was between acetonitrile and the u-component (-0.34). Correlations for *p*-dichlorobenzene could not be computed due to the low number of detects (fewer than 4).

Figure 16-3 shows the composite back trajectory for the SLND site for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in Figure 16-3, the back trajectories originated predominantly from the south or northwest of the site. Each circle around the site in Figure 16-3 represents 100 miles; 67% of the trajectories originated within 400 miles, and 97% within 700 miles from the SLND site. The 24-hour airshed domain is large. Back trajectories originated over 700 miles away.

16.4 Spatial Analysis

County-level vehicle registration and population in Benson County, ND, were obtained from the Motor Vehicle Division of the North Dakota Department of Transportation and the U.S. Census Bureau, and are summarized in Table 16-6. Table 16-6 also includes a vehicle registration to county population (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile car registration was computed using the 10-mile population surrounding the monitors and the car registration ratio. Table 16-6 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at the Spirit Lake Nation site in Table 16-6.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at the monitoring site. The SLND site's concentration ratios resemble those of the roadside study. However, the xylenes-ethylbenzene and toluene-ethylbenzene ratios are significantly lower than those of the roadside study, while the benzene-ethylbenzene ratio at SLND is somewhat higher than that of the roadside study.

16.5 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

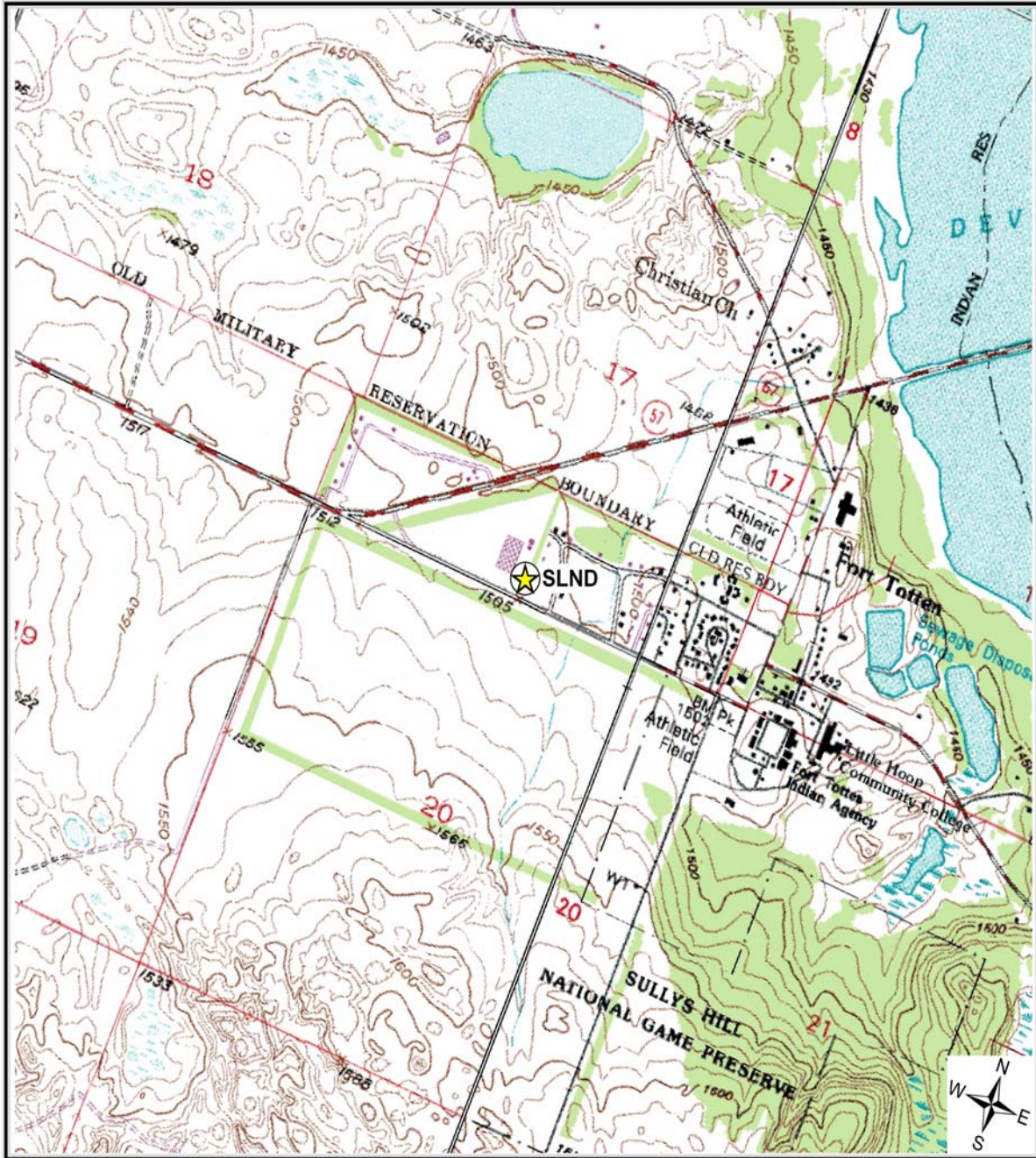
16.5.1 Site-Specific Trends Analyses

SLND is new to the UATMP this year, therefore, no site-specific trends analysis was conducted.

16.5.2 MSA-Specific Trends Analyses

SLND does not reside in a U.S. Census Bureau-designated MSA. Therefore, no MSA-specific trends analysis was conducted.

Figure 16-1. Spirit Lake Nation, North Dakota (SLND) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 16-2. Facilities Located Within 10 Miles of SLND

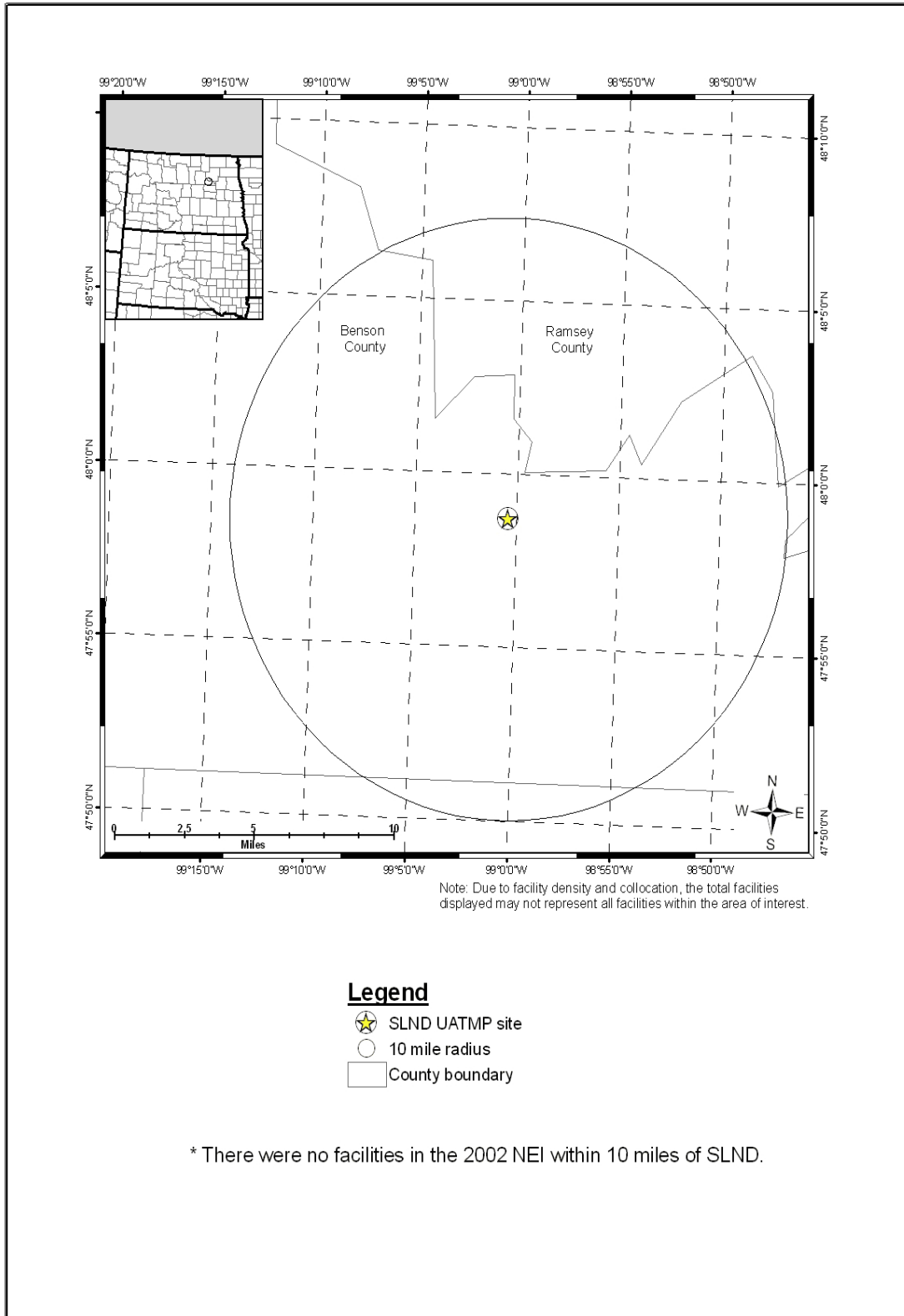


Figure 16-3. Composite Back Trajectory Map for SLND

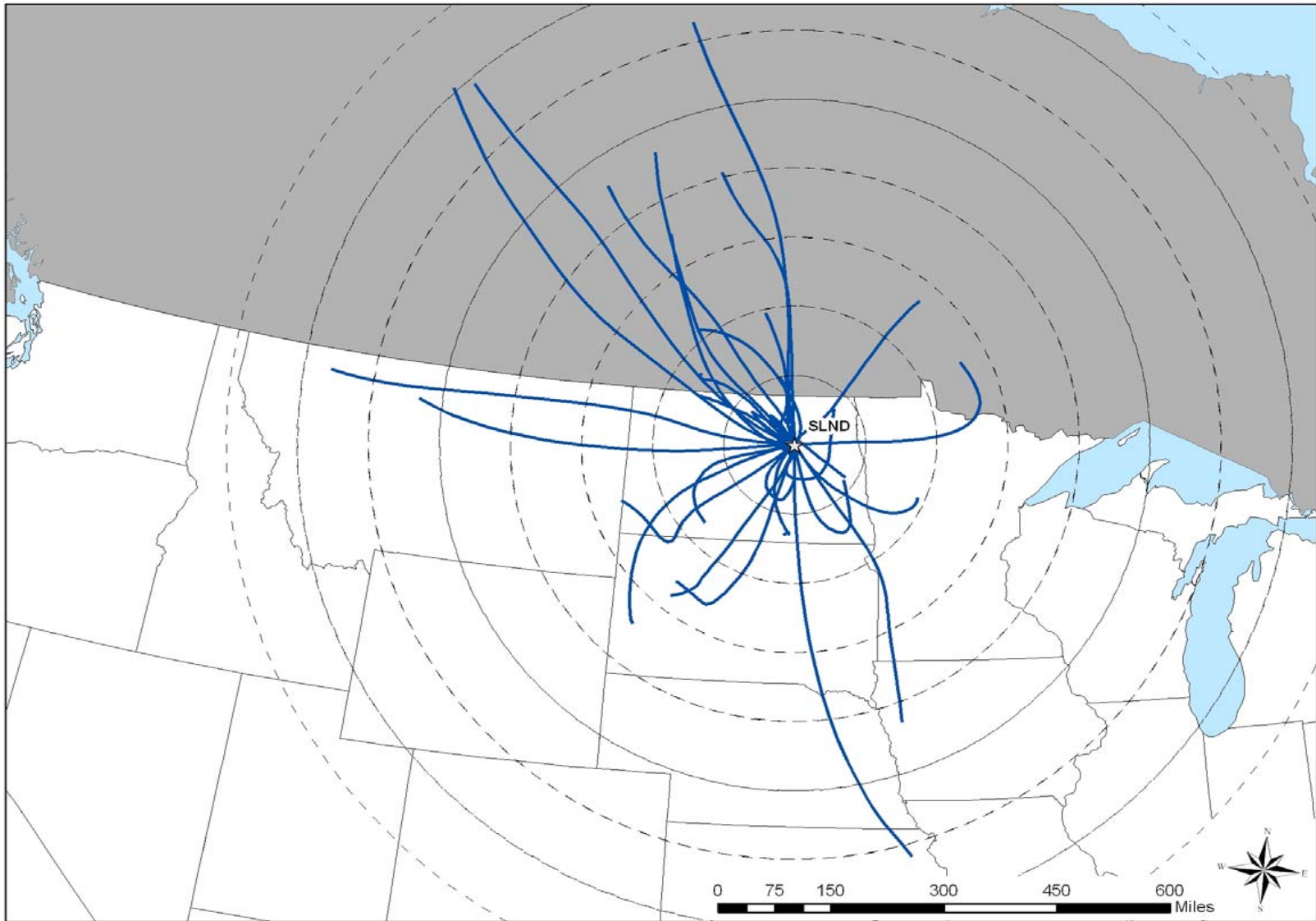


Table 16-1. Average Concentration and Meteorological Parameters for the Site in North Dakota

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
SLND	All 2004		47.42 (± 2.39)	39.28 (± 2.24)	29.97 (± 2.12)	35.40 (± 2.04)	72.14 (± 1.31)	1015.22 (± 7.26) ¹	1.08 (± 0.62)	-0.73 (± 0.69)
	sample day	49.02 (± 28.50)	53.62 (± 7.94)	45.16 (± 7.41)	35.28 (± 7.25)	40.78 (± 6.79)	71.04 (± 4.36)	1014.44 (± 2.72)	1.99 (± 2.01)	0.66 (± 2.11)

¹ Sea level pressure are not recorded in this station. Station pressure in inches of Mercury was converted to mb to yield an “uncorrected” sea level pressure.

Table 16-2. Summary of the Toxic Cancer Compounds at the Spirit Lake Nation, North Dakota Monitoring Site - SLND

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	2.24 E-05	54.27	54.27	0.33	5	22.43
Carbon Tetrachloride	8.34 E-06	20.18	74.45	0.56	22	8.34
Benzene	5.43 E-06	13.13	87.58	0.70	25	5.43
<i>p</i> -Dichlorobenzene	3.97 E-06	9.60	97.18	0.36	1	3.97
Trichloroethylene	9.67 E-07	2.34	99.52	0.48	1	0.97
Dichloromethane	1.31 E-07	0.32	99.84	0.28	2	0.13
Benzo (a) pyrene	4.06 E-08	0.10	99.94	<0.00	3	0.04
Benzo (b) fluoranthene	6.77 E-09	0.02	99.95	<0.00	10	0.01
Indeno (1,2,3-cd) pyrene	6.77 E-09	0.02	99.97	<0.00	8	0.01
Benzo (k) fluoranthene	6.16 E-09	0.01	99.99	<0.00	9	0.01
Benzo (a) anthracene	4.89 E-09	0.01	100.00	<0.00	9	<0.00
Chrysene	8.00 E-10	0.00	100.00	<0.00	18	<0.00

Table 16-3. Summary of the Toxic Noncancer Compounds at the Spirit Lake Nation, North Dakota Monitoring Site - SLND

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Acrylonitrile	1.65 E-01	60.15	60.15	0.33	5	0
Acetonitrile	2.47 E-02	8.99	69.14	1.48	8	0
Benzene	2.32 E-02	8.46	77.60	0.70	25	0
Xylenes	1.89 E-02	6.88	84.47	1.89	23	0
Carbon Tetrachloride	1.39 E-02	5.07	89.55	0.56	22	0
Chloromethane	1.28 E-02	4.68	94.23	1.16	25	0
Methyl Ethyl Ketone	7.04 E-03	2.57	96.79	35.18	24	0
Toluene	2.93 E-03	1.07	97.86	1.17	25	0
Styrene	1.70 E-03	0.62	98.48	1.70	20	0
Methyl Methacrylate	1.62 E-03	0.59	99.07	1.13	3	0
Trichloroethylene	8.06 E-04	0.29	99.36	0.48	1	0
<i>p</i> -Dichlorobenzene	4.51 E-04	0.16	99.53	0.36	1	0
Naphthalene	4.45 E-04	0.16	99.69	<0.00	22	0
Ethylbenzene	2.95 E-04	0.11	99.80	0.29	23	0
Dichloromethane	2.78 E-04	0.10	99.90	0.28	2	0
Methyl Isobutyl Ketone	2.42 E-04	0.09	99.99	0.73	4	0
Chloroethane	3.43 E-05	0.01	100.00	0.34	1	0

Table 16-4. SVOC Concentrations for the North Dakota Monitoring Site

Monitoring Site	Average Total SVOC Concentration (ng/m³)	SVOC Compound with the Highest Concentration (ng/m³)
SLND	4.56	Naphthalene (17.1)

Table 16-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Spirit Lake Nation, North Dakota Site (SLND)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
Acetonitrile	0.27	0.31	0.32	0.32	0.12	0.14	-0.34	-0.07
Acrylonitrile	0.51	0.56	0.54	0.56	0.10	-0.41	0.55	-0.49
Benzene	-0.38	-0.40	-0.38	-0.40	0.05	-0.15	0.19	0.12
Carbon Tetrachloride	0.08	0.04	0.09	0.07	0.10	0.01	0.28	0.02
Chloromethane	0.32	0.28	0.28	0.28	0.03	-0.22	-0.09	0.05
Methyl Ethyl Ketone	0.20	0.22	0.28	0.26	0.22	-0.21	-0.01	-0.24
<i>p</i> -Dichlorobenzene	NA							
Xylenes	0.01	0.02	0.04	0.03	0.06	-0.09	0.12	-0.08

Table 16-6. Motor Vehicle Information vs. Daily Concentration for the North Dakota Monitoring Site

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
SLND	6,881	6,678	0.97	0 ^a	0	925	49.20 (± 28.50)

^a Not available.

17.0 Sites in South Dakota

This section presents meteorological, concentration, and spatial trends for the UATMP sites in South Dakota (CUSD and SFSD). One site is located in Sioux Falls, situated in southeastern South Dakota, and the other is in Custer, in western South Dakota, south of Rapid City. Figures 17-1 and 17-2 are topographical maps showing the monitoring sites in their urban and rural locations. Figures 17-3 and 17-4 identify facilities within 10 miles of the sites that reported to the 2002 NEI. The SFSD map shows that there are very few industrial facilities near the monitoring site; most of these facilities are to the northwest of the site. The CUSD map shows no facilities nearby. Hourly meteorological data were retrieved for all of 2004 at the Sioux Falls Joe Foss Field Airport (WBAN 14944) and the Custer County Airport weather station (WBAN 94032) near the sites for calculating correlations of meteorological data with ambient air concentration measurements.

Table 17-1 highlights the UATMP average concentration at each site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*- components of the wind) for the entire year and on days samples were taken. The Sioux Falls area has a continental climate, with cold winters, warm summers, and often drastic day to day variations. Precipitation varies throughout the year, but is typically sufficient for the springtime growing season. On average, a south wind blows in the summer and a northwesterly wind blows in the winter. The weather in Custer is considered semi-arid continental; annual precipitation is light. Warm summers and relatively mild winters are characteristic of this area, thanks to the Black Hills to the west, allowing winters to be more mild in comparison to the rest of the state. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

17.1 Prevalent Compounds at the South Dakota Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 17-2 summarizes the cancer

weighting scores and Table 17-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

Table 17-2 shows that most of the detected cancer compounds reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. Only *trans*-1,3-dichloropropene (detected at CUSD), dichloromethane (detected at both sites), and formaldehyde (detected at both sites) were not listed among the nationwide prevalent cancer compounds. However, all of the site-specific prevalent cancer compounds are also on the nationwide list, with the exception of *trans*-1,3-dichloropropene. For the noncancer compounds summarized in Table 17-3, only one compound not listed on the nationwide prevalent noncancer compound list was detected at CUSD and SFSD. However, all of the site-specific prevalent noncancer compounds are also on the nationwide noncancer prevalent list.

Prevalent toxic compounds not detected at the South Dakota sites were: 1,2-dichloroethane; 1,2-dichloropropane; chloroprene; *cis*-1,3-dichloropropene; ethyl acrylate; *p*-dichlorobenzene; and vinyl chloride.

17.2 Toxicity Analysis

Acrylonitrile, 1,3-butadiene, benzene, carbon tetrachloride, and acetaldehyde were the only prevalent cancer compounds across both sites. At both sites, acrylonitrile and carbon tetrachloride made up over fifty percent of the total cancer toxicity, although the number of detects of acrylonitrile was low. Conversely, benzene was detected the most at each site, but contributed to about 12% of the total cancer toxicity or less at both sites.

Acetonitrile, formaldehyde, acetaldehyde, 1,3-butadiene, acrylonitrile, and benzene were the prevalent noncancer compounds at both sites. At both sites, benzene was detected the most

frequently of the noncancer prevalent compounds, but accounted for less than three percent of the total noncancer toxicity.

The acrylonitrile cancer risk at CUSD was the highest between the two sites at 17.46 in a million, while at SFSD, the acrylonitrile cancer risk was 14.76 in a million. For the compounds that may lead to adverse noncancer health effects, the highest average acetonitrile toxicity was at CUSD at 0.73 (over 1 indicates a significant chance of a noncancer health effect). Of the eleven adverse health concentrations measured at the South Dakota sites, four were for acetonitrile.

17.3 Meteorological and Concentration Averages at the South Dakota Sites

Carbonyl compounds and VOC were measured at these sites, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration at CUSD was 48.73 (\pm 23.63) $\mu\text{g}/\text{m}^3$, while at SFSD it was considerably lower, 22.77 (\pm 2.19) $\mu\text{g}/\text{m}^3$. Table 17-1 also lists the averages for selected meteorological parameters from January 2004 to December 2004, and for days on which sampling occurred.

These sites also opted to have total and speciated nonmethane organic compounds (TNMOC/SNMOC) sampled during their air toxic sampling. SNMOC/NMOC compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for SFSD was 151.58 ppbC, of which nearly 25% could be identified through speciation. Of the speciated compounds, *n*-hexane measured the highest concentration at the SFSD site (36.48 ppbC). The average total NMOC value for CUSD was 217.13 ppbC, of which nearly 27% could be identified through speciation. Of the speciated compounds, propane measured the highest concentration at the CUSD site (431.00 ppbC). This information is presented in Table 17-4.

Table 17-5 is the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. At CUSD, 1,3-butadiene had the strongest correlations with relative humidity (-0.81). This compounds had moderately strong negative correlations with the other two moisture parameters and both wind components as well. Benzene had moderately strong to strong negative correlations with maximum, average, dewpoint, and wet bulb temperatures. The remainder of the correlations at CUSD were relatively weak.

Most of the correlations between the prevalent compounds and weather variables were rather weak at the SFSD site. However, strong positive correlations were computed between formaldehyde and the temperature parameters, dew point, and wet bulb temperature. Pearson correlations could not be computed for 1,3-butadiene due to the low number of detects (fewer than 4).

Figures 17-5 and 17-6 show the composite back trajectories for the CUSD and SFSD sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in Figure 17-5, the back trajectories originated predominantly from the southwest, west, and northwest of the CUSD site. Each circle around the site in Figure 17-5 represents 100 miles; 88% of the trajectories originated within 500 miles, and 98% within 900 miles from the CUSD site. The 24-hour airshed domain is extremely large. Back trajectories originated over 900 miles away.

Figure 17-6 shows that back trajectories originated predominantly from the south, northwest, and north of SFSD. Each circle around the site in Figure 17-6 represents 100 miles; 64% of the trajectories originated within 400 miles, and 99% within 800 miles from the SFSD site. The 24-hour airshed domain for SFSD is also large. Back trajectories originated over 800 miles away.

17.4 Spatial Analysis

County-level vehicle registration and population in Custer County and Minnehaha County, SD, were obtained from the South Dakota Department of Revenue, South Dakota Division of Motor Vehicles and the U.S. Census Bureau, and are summarized in Table 17-6. Table 17-6 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile car registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 17-6 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration at each South Dakota site in Table 17-6. SFSD has both the largest daily traffic volume and the largest vehicle ownership within a ten mile radius, compared to CUSD, although CUSD's average daily UATMP concentration is nearly twice that of SFSD.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The concentration ratios for CUSD resemble those of the SFSD. For each site, the benzene-ethylbenzene ratio is higher than the xylene-ethylbenzene ratio, whereas the reverse is true for the roadside study.

CUSD and SFSD sampled for SNMOC in addition to VOC and carbonyl compounds. Acetylene and ethylene are SNMOCs that are primarily emitted from mobile sources. Tunnel studies conducted on mobile source emissions have found that ethylene and acetylene are typically detected in a 1.7 to 1 ratio. For more information, please refer to Section 3.4.4. Listed in Table 17-4 is the ethylene-acetylene ratio for these sites and what percent of the expected 1.7 ratio it represents. As shown, SFSD's ethylene-acetylene ratio is only within 52% of the expected 1.7 ratio (0.85). This would indicate that the emissions near SFSD may not be primarily from mobile sources. CUSD's ethylene-acetylene ratio is within 62% of the expected 1.7 ratio (1.05). This would indicate that the concentrations near SFSD are influenced by mobile source emissions.

17.5 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

17.5.1 Site-Specific Trends Analyses

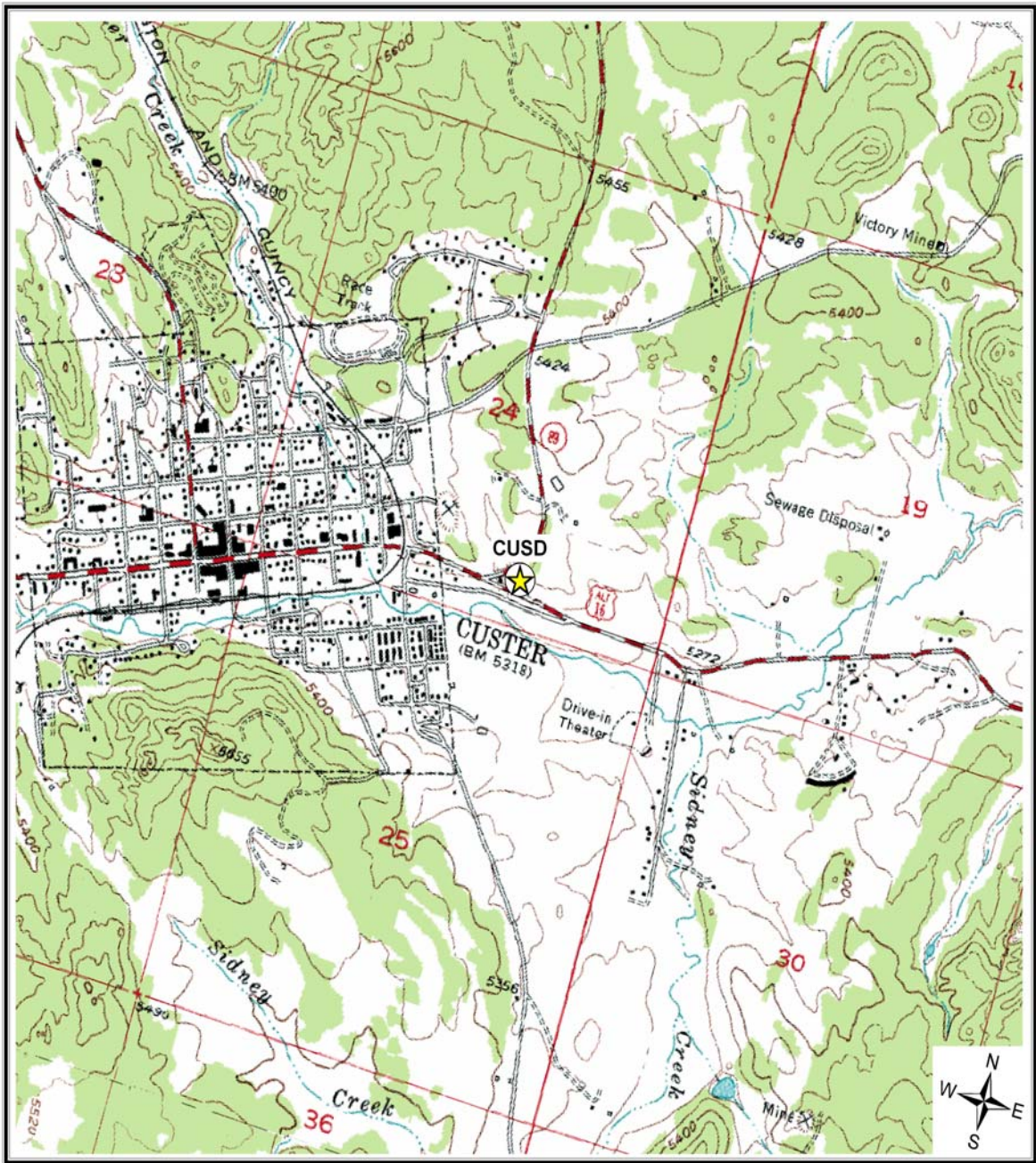
SFSD has been a participant in the UATMP since 1999, while CUSD has participated since 2002. A comparison of SDSD's annual average formaldehyde and benzene concentrations show that concentrations have been decreasing since 2002. Concentrations of 1,3-butadiene spiked in 2002, dropped significantly in 2003, and are up slightly for 2004. Please refer to Figure 3-46.

Concentrations at CUSD have not changed significantly over the last three years. Formaldehyde concentrations have decreased; 1,3-butadiene concentrations increased slightly from 2003; and benzene concentrations have decreased slightly since 2003. Please refer to Figure 3-32.

17.5.2 MSA-Specific Trends Analyses

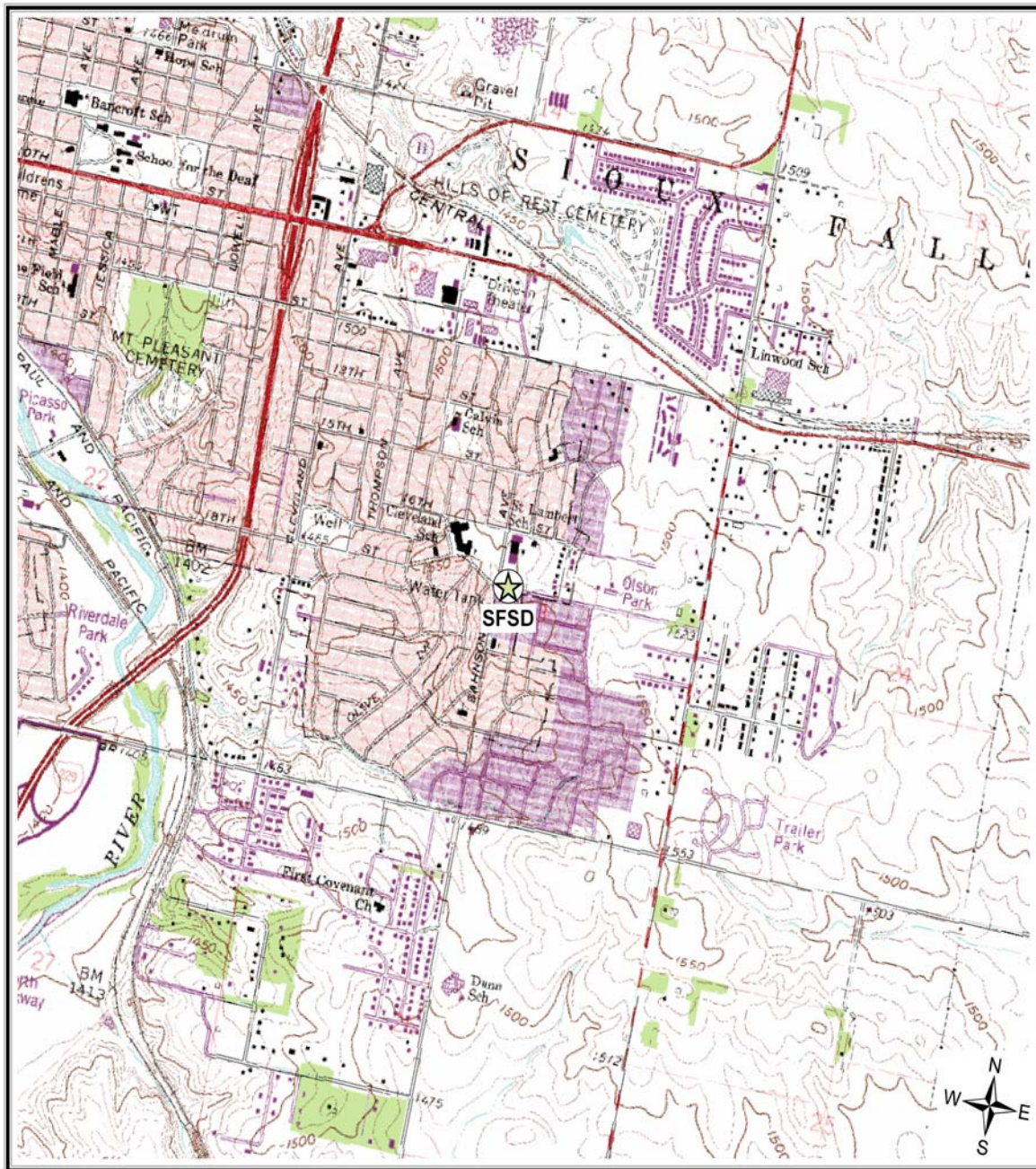
SFSD resides in the Sioux Falls, SD MSA. The Sioux Falls, SD MSA has experienced a 29.2% increase in population and estimated vehicle miles traveled (VMT) from 1990 to 2003. Emissions at the Sioux Falls MSA have decreased for each pollutant considered between 1990 and 2002. The 2004 concentrations, based on the UATMP site representing this MSA (SFSD), decrease slightly from the 2002-2003 time period. Trends for these and other compounds of interest can be found in Table 3-13. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

Figure 17-1. Custer, South Dakota (CUSD) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 17-2. Sioux Falls, South Dakota (SFSD) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 17-3. Facilities Located Within 10 Miles of CUSD

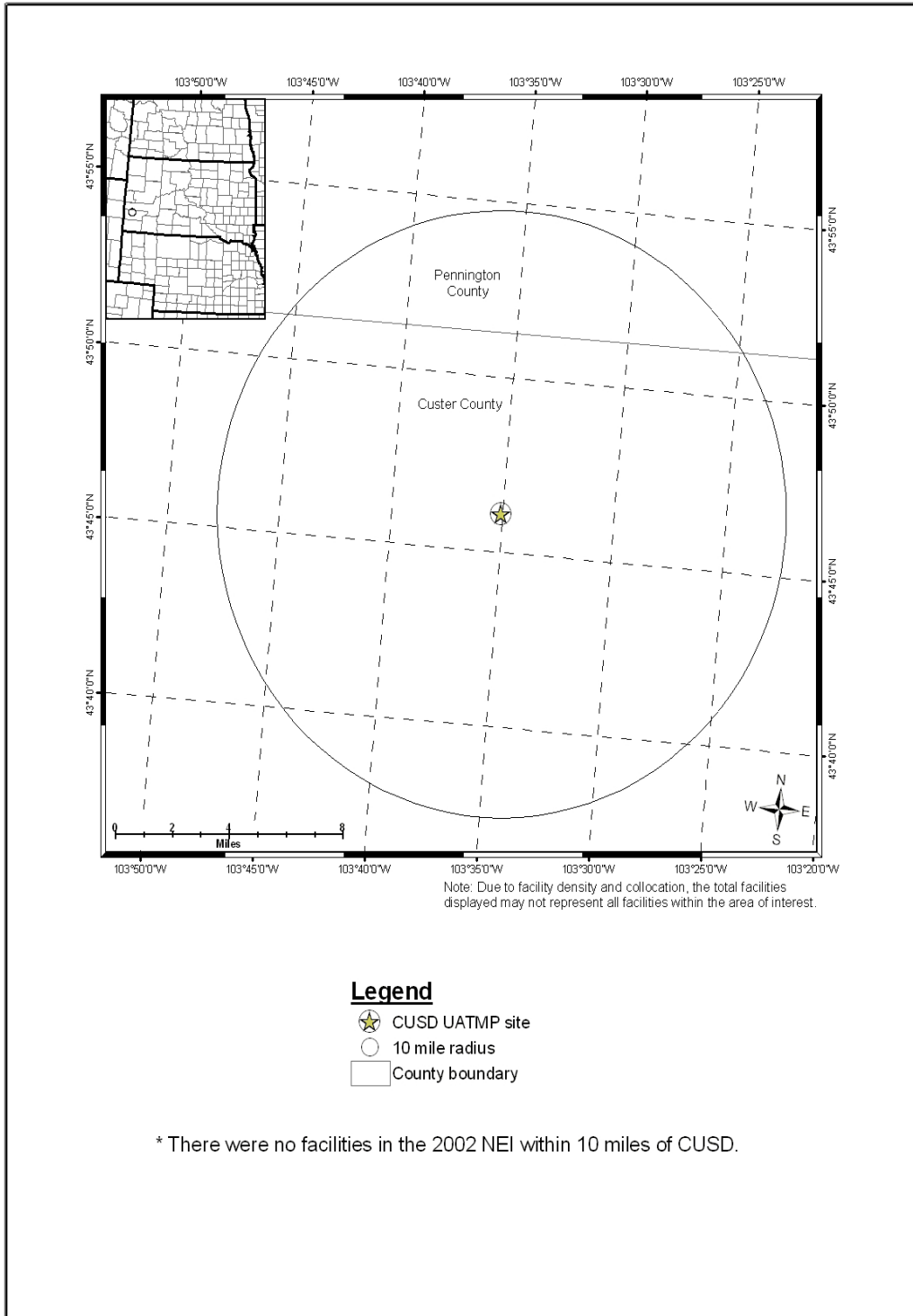


Figure 17-4. Facilities Located Within 10 Miles of SFSD

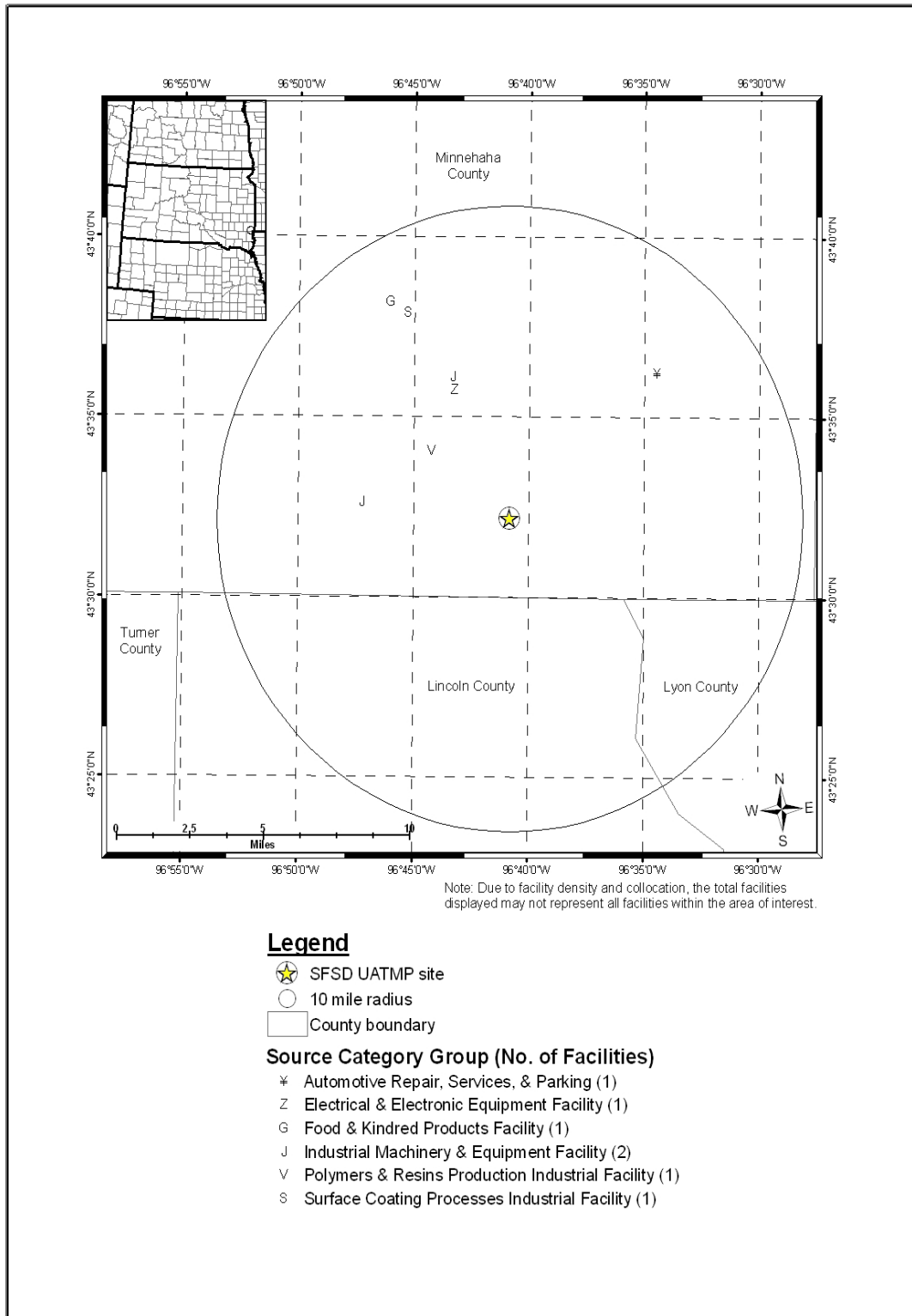


Figure 17-5. Composite Back Trajectory Map for CUSD

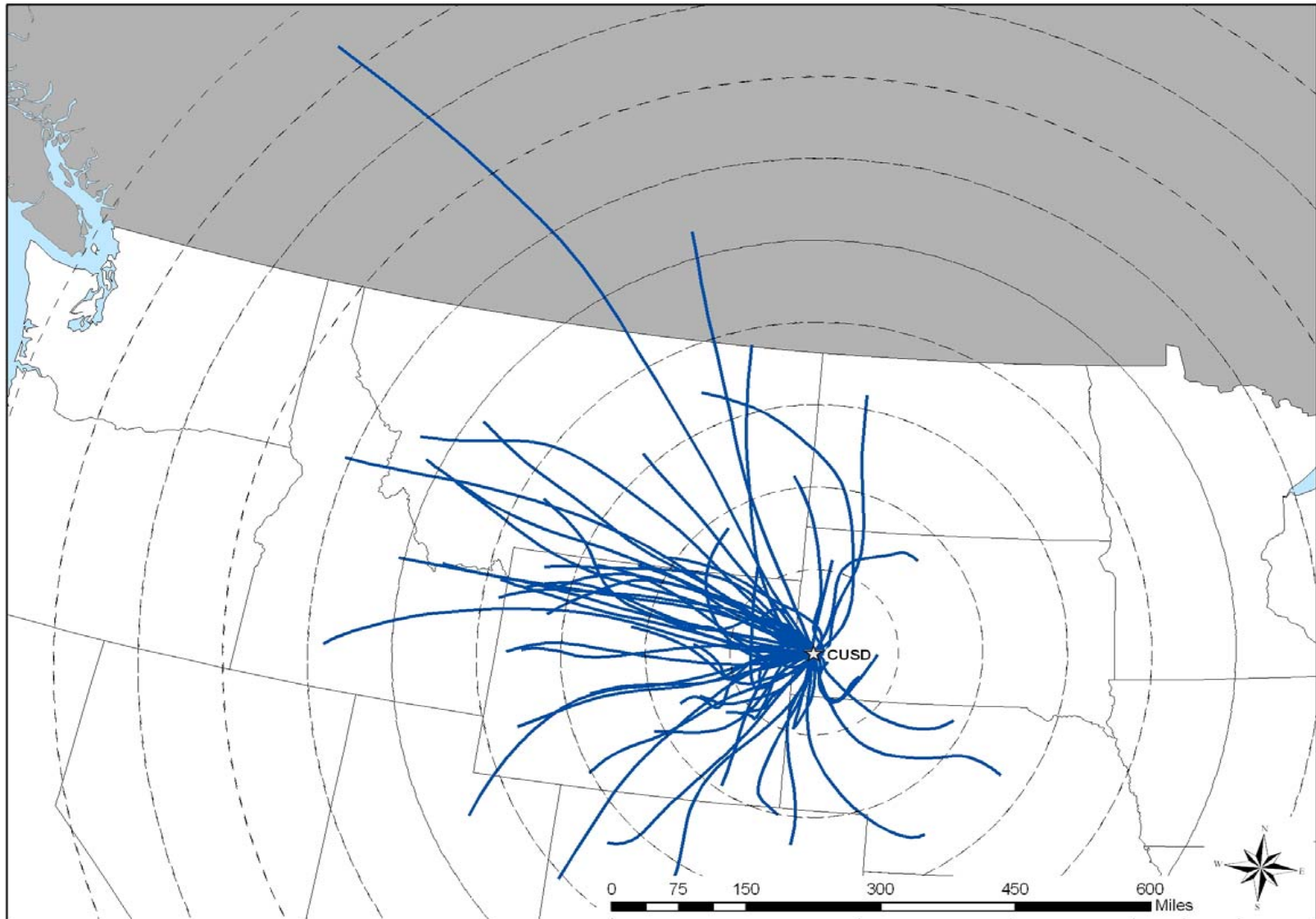


Figure 17-6. Composite Back Trajectory Map for SFSD

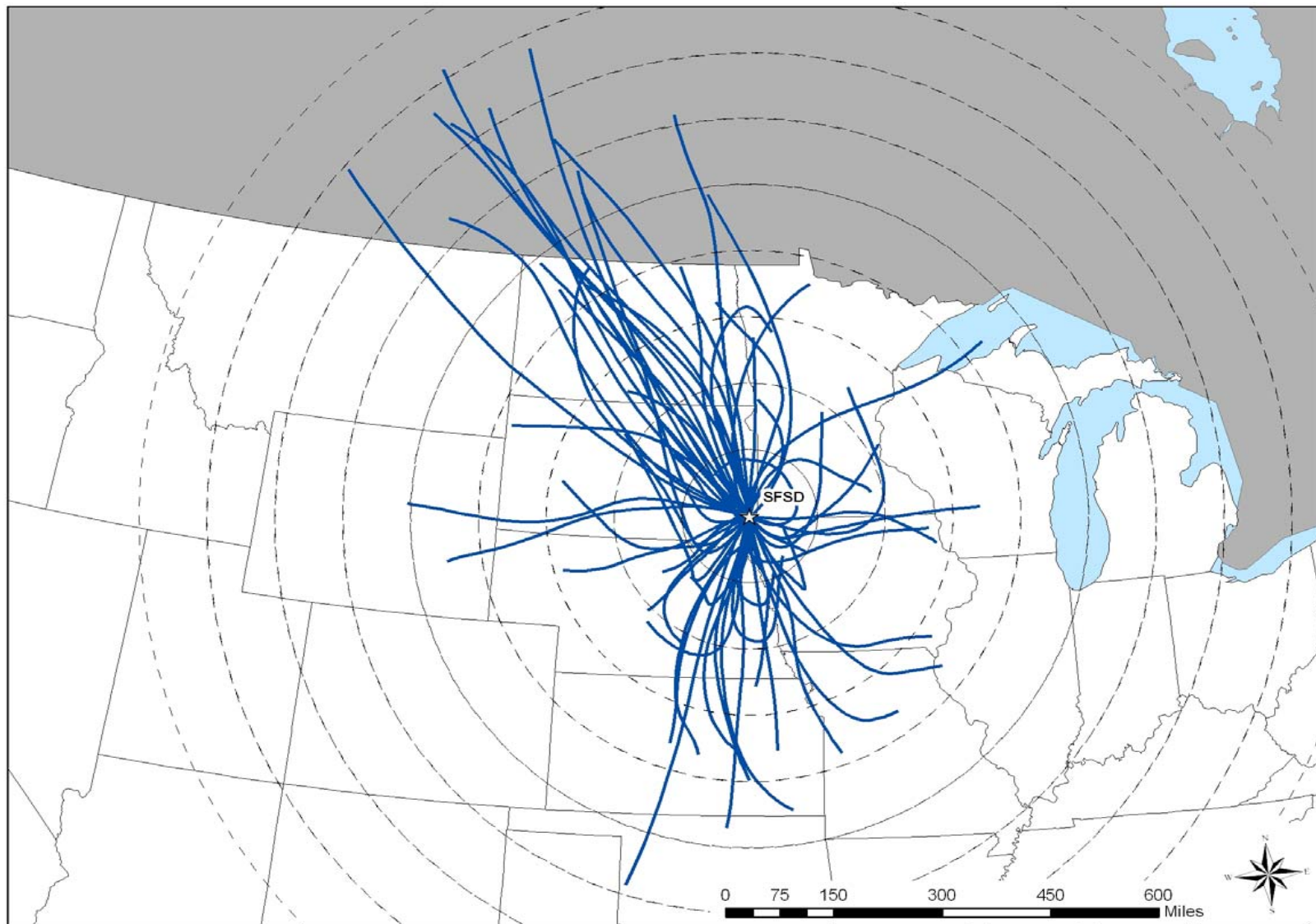


Table 17-1. Average Concentration and Meteorological Parameters for Sites in South Dakota

Site Name	Type	Average UATMP Concentration (ug/m ³)	Average Maximum Temperature (°F)	Average Temperature (°F)	Average Dewpoint Temperature (°F)	Average Wet Bulb Temperature (°F)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
CUSD	All 2004	/ / / / / / / /	54.60 (±1.78)	43.97 (±1.59)	27.65 (±1.30)	36.65 (±1.78)	57.67 (±1.53)	1014.71 (±0.72)	2.44 (±0.41)	-0.95 (±0.28)
	sample day	48.73 (±23.63)	55.52 (±4.73)	44.52 (±4.26)	26.83 (±3.50)	36.52 (±3.43)	54.82 (±3.36)	1014.02 (±1.69)	2.81 (±0.94)	-1.11 (±0.68)
SFSD	All 2004	/ / / / / / / /	57.04 (±2.21)	47.16 (±2.09)	36.84 (±2.01)	42.26 (±1.91)	70.22 (±1.19)	1016.37 (±0.80)	0.27 (±0.53)	0.36 (±0.64)
	sample day	22.77 (±2.19)	52.63 (±5.21)	43.08 (±4.79)	33.04 (±4.55)	38.55 (±4.34)	70.45 (±2.79)	1017.16 (±1.96)	0.32 (±1.16)	0.76 (±1.45)

Table 17-2. Summary of the Toxic Cancer Compounds at the Custer and Sioux Falls, South Dakota Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Custer, South Dakota - CUSD						
Acrylonitrile	1.75 E-05	35.24	35.24	0.26	3	17.46
Carbon Tetrachloride	8.16 E-06	16.46	51.70	0.54	54	8.16
1,3-Butadiene	7.69 E-06	15.53	67.23	0.26	6	7.69
Benzene	5.61 E-06	11.32	78.55	0.72	62	5.61
Acetaldehyde	4.77 E-06	9.63	88.18	2.17	58	4.77
Tetrachloroethylene	3.10 E-06	6.26	94.44	0.53	2	3.10
<i>trans</i> -1,3-Dichloropropene	1.80 E-06	3.63	98.07	0.45	3	1.80
Dichloromethane	9.39 E-07	1.90	99.97	2.00	7	0.94
Formaldehyde	1.46 E-08	0.03	100.00	2.65	58	0.01
Sioux Falls, South Dakota - SFSD						
Acrylonitrile	1.48 E-05	33.36	33.36	0.22	2	14.76
Carbon Tetrachloride	8.74 E-06	19.76	53.12	0.58	51	8.74
Acetaldehyde	7.72 E-06	17.45	70.57	3.51	62	7.72
1,3-Butadiene	6.64 E-06	15.00	85.57	0.22	1	6.64
Benzene	5.56 E-06	12.56	98.13	0.71	67	5.56
Dichloromethane	8.11 E-07	1.83	99.96	1.73	3	0.81
Formaldehyde	1.57 E-08	0.04	100.00	2.85	62	0.02

Table 17-3. Summary of the Toxic Noncancer Compounds at the Custer and Sioux Falls, South Dakota Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Custer, South Dakota - CUSD						
Acetonitrile	7.33 E-01	44.24	44.24	43.96	33	4
Formaldehyde	2.71 E-01	16.33	60.57	2.65	58	1
Acetaldehyde	2.41 E-01	14.55	75.13	2.17	58	1
Acrylonitrile	1.28 E-01	7.75	82.88	0.26	3	0
1,3-Butadiene	1.11 E-01	6.72	89.60	0.22	6	0
Bromomethane	7.77 E-02	4.69	94.29	0.39	1	0
Benzene	2.40 E-02	1.45	95.73	0.72	62	0
<i>trans</i> -1,3-Dichloropropene	2.25 E-02	1.36	97.09	0.45	3	0
Carbon Tetrachloride	1.36 E-02	0.82	97.91	0.54	54	0
Chloromethane	1.30 E-02	0.79	98.70	1.17	62	0
Xylenes	3.22 E-03	0.32	99.37	0.64	67	0
<i>n</i> -Hexane	3.12 E-03	0.19	99.50	0.62	62	0
Toluene	2.83 E-03	0.17	99.67	1.13	62	0
Dichloromethane	2.00 E-03	0.12	99.79	2.00	7	0
Tetrachloroethylene	1.95 E-03	0.12	99.91	0.53	2	0
Styrene	5.84 E-04	0.04	99.94	0.58	39	0
Methyl <i>tert</i> -Butyl Ether	2.87 E-04	0.02	99.96	0.86	41	0
Methyl Ethyl Ketone	2.84 E-04	0.02	99.98	1.42	49	0
Ethylbenzene	2.42 E-04	0.01	99.99	0.24	49	0
Methyl Isobutyl Ketone	1.37 E-04	0.01	100.00	0.41	1	0
Sioux Falls, South Dakota - SFSD						
Acetaldehyde	3.90 E-01	38.87	38.87	3.51	62	3
Formaldehyde	2.91 E-01	29.04	67.91	2.85	62	2
1,3-Butadiene	1.11 E-01	11.03	78.94	0.22	1	0
Acrylonitrile	1.09 E-01	10.82	89.76	0.22	2	0

Table 17-3. Summary of the Toxic Noncancer Compounds at the Custer and Sioux Falls, South Dakota Monitoring Sites (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Acetonitrile	3.20 E-02	3.19	92.94	1.92	18	0
Benzene	2.37 E-02	2.37	95.31	0.71	67	0
Carbon Tetrachloride	1.46 E-02	1.45	96.76	0.58	51	0
Chloromethane	1.22 E-02	1.22	97.98	1.10	66	0
Xylenes	1.07 E-02	1.07	99.05	1.07	67	0
<i>n</i> -Hexane	3.22 E-03	0.32	99.37	0.64	67	0
Toluene	2.97 E-03	0.30	99.67	1.19	67	0
Dichloromethane	1.73 E-03	0.17	99.84	1.73	3	0
Styrene	5.97 E-04	0.06	99.90	0.60	30	0
Methyl Ethyl Ketone	3.27 E-04	0.03	99.93	1.64	51	0
Methyl <i>tert</i> -Butyl Ether	2.93 E-04	0.03	99.96	0.88	27	0
Ethylbenzene	2.54 E-04	0.03	99.99	0.25	66	0
Methyl Isobutyl Ketone	1.43 E-04	0.01	100.00	0.43	2	0

Table 17-4. TNMOC Measured by the Custer and Sioux Falls, South Dakota (CUSD and SFSD) Monitoring Sites

Monitoring Site	Average TNMOC Speciated (ppbC)	Average TNMOC w/ Unknowns (ppbC)	% TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)	Ethylene to Acetylene Ratio	% of Expected Ratio
CUSD	58.16	217.13	27%	Propane (431.00)	1.05	62%
SFSD	38.31	151.58	25%	<i>n</i> -Hexane (36.48)	0.88	52%

Table 17-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Custer and Sioux Falls, South Dakota Sites

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Custer, South Dakota - CUSD								
1,3-Butadiene	-0.18	-0.29	-0.48	-0.36	-0.81	0.14	-0.36	-0.35
Acetaldehyde	0.22	0.20	0.06	0.15	-0.27	0.11	-0.16	-0.02
Acetonitrile	0.27	0.23	0.29	0.26	0.05	0.12	-0.12	0.01
Acrylonitrile	NA							
Benzene	-0.48	-0.50	-0.50	-0.51	0.06	0.22	0.12	0.06
Bromomethane	NA							
Carbon Tetrachloride	-0.07	-0.07	-0.03	-0.05	0.05	-0.09	0.20	-0.08
Formaldehyde	0.21	0.19	0.05	0.14	-0.26	0.13	-0.16	-0.03
Tetrachloroethylene	NA							
<i>trans</i> -1,3-Dichloropropene	NA							
Sioux Falls, South Dakota								
1,3-Butadiene	NA							
Acetaldehyde	0.25	0.24	0.23	0.24	-0.03	0.04	-0.05	0.03
Acetonitrile	-0.20	-0.22	-0.18	-0.20	0.12	0.38	-0.13	0.21
Acrylonitrile	NA							
Benzene	-0.18	-0.14	-0.08	-0.11	0.23	-0.06	-0.01	-0.24
Carbon Tetrachloride	0.03	0.05	0.07	0.05	0.07	-0.17	0.05	-0.04
Formaldehyde	0.51	0.51	0.50	0.51	-0.05	-0.13	-0.06	0.21

Table 17-6. Motor Vehicle Information vs. Daily Concentration for the South Dakota Monitoring Sites

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
CUSD	7,585	9,120	1.20	4,449	5,339	1,940	48.73 (± 23.63)
SFSD	154,617	152,815	0.99	154,472	152,927	4,320	22.77 (± 2.19)

18.0 Sites in Tennessee

This section presents meteorological, concentration, and spatial trends for the UATMP sites in Tennessee (DITN, EATN, KITN, LDTN, and LOTN). Two sites are located in Nashville in central Tennessee (EATN and LOTN), one is to the west of Nashville in Dickson (DITN), one is in Kingsport in the northeast corner of the state (KITN), and one is located to the southwest of Knoxville (LDTN). Figures 18-1 through 18-5 are topographical maps showing the monitoring sites in their urban locations. Figures 18-6 through 18-9 identify facilities within 10 miles of the sites that reported to the 2002 NEI. The two Nashville sites are very close to each other and, of the five Tennessee sites, have the largest number of industrial sites within 10 miles of the monitors, with a majority of the industrial sites located to the southeast, south, and southwest of the UATMP sites. Many of these industrial sites are surface coating, printing and publishing, and liquids distribution facilities. The Dickson site is surrounded by the fewest industrial sources. The Kingsport also site has few industrial sites nearby. The Loudon site has more sources nearby than DITN and KITN, and several of these are involved in waste treatment and disposal or rubber and miscellaneous plastics. Hourly meteorological data were retrieved for all of 2004 at four weather stations near the sites for calculating correlations of meteorological data with ambient air concentration measurements. The four weather stations are the Nashville/Metropolitan International Airport, Knoxville McGhee-Tyson Airport, Clarksville Outlaw Airport, and Bristol Tri-City Airport (WBAN 13897, 13891, 3894, and 13877, respectively).

Table 18-1 highlights the UATMP average concentration at each site, along with temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*- components of the wind) for the entire year and on days samples were taken. Nashville's climate is rather moderate in nature, lacking extreme fluctuations in temperature. The city has a long growing season and boasts four distinct seasons. The Dickson area has a climate similar to Nashville, although diurnal temperature fluctuations are probably greater due to the loss of the urban heat island. Kingsport is located in northeastern Tennessee, approximately equidistant from the Appalachian Mountains to the east and the Clinch

and Cumberland Mountains to the west. The mountains tend to have a moderating effect on the area's climate and the city sees all four seasons. Loudon is located to the southwest of Knoxville. The Tennessee River and Watts Bar Lake run through town, influencing the area's weather by moderating temperatures and affecting wind patterns. The Appalachian Mountains lie to the east. The area has ample rainfall year-round and, like Kingsport and Nashville, experiences all four seasons. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987), and at the following website: <http://www.blueshoenashville.com/weather.html>.

18.1 Prevalent Compounds at the Tennessee Sites

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at each site. Table 18-2 summarizes the cancer weighting scores and Table 18-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

Table 18-2 shows that most of the prevalent cancer compounds at the TN sites reflect the nationwide prevalent cancer compound list, as listed in Section 3 of this report. However, as the Nashville sites also sampled metal compounds, arsenic compounds are considered prevalent at these two sites. Aside from arsenic compounds, only *trans*-1,3-dichloropropene was considered prevalent (at DITN and LOTN) and was not listed among the nationwide prevalent cancer compounds. Only acetaldehyde, benzene, tetrachloroethylene, and carbon tetrachloride were prevalent across all five sites. For the noncancer compounds summarized in Table 18-3, most of the prevalent compounds were listed among the nationwide noncancer prevalent list, although many others detected were not, especially at the more urbanized locations (EATN and LOTN). Formaldehyde, benzene, and acetaldehyde were the only prevalent noncancer compounds across all five sites. For the two sites that sampled metal compounds, arsenic and manganese compounds were considered prevalent.

Prevalent toxic compounds not detected at the Tennessee sites were: 1,2-dichloroethane; 1,2-dichloropropane; vinyl chloride; bromomethane; chloroprene; 1,1-dichloroethene; and *cis*-1,3-dichloropropene.

18.2 Toxicity Analysis

At three of the five sites (EATN, KITN, and LDTN), acrylonitrile, benzene, and carbon tetrachloride contributed to nearly 60% or more of the total cancer toxicity. For the other two sites (LOTN and DITN), benzene and carbon tetrachloride contributed the most to cancer toxicity. For the two sites that sampled metal compounds, EATN and LOTN, arsenic compounds contributed to 9% and 17%, respectively, of the total cancer toxicity. The acrylonitrile cancer risk was highest of all the compounds, at 38.74 in a million at LDTN, 21.77 in a million at EATN, and 13.28 in a million at KITN.

For the compounds that may lead to adverse noncancer health effects, acetaldehyde and formaldehyde contributed to nearly 43% or more of the noncancer toxicity. The average toxicity was highest for formaldehyde at LDTN at 0.813, where over 1 indicates a significant chance of a noncancer health effect. Of the eight adverse health concentrations measured at the Tennessee sites, all eight were at LDTN for formaldehyde.

18.3 Meteorological and Concentration Averages at the Tennessee Sites

Carbonyl compounds and VOC were measured at all five sites, as indicated in Tables 3-3 and 3-4. The Nashville sites opted to sample metal compounds in addition to carbonyls and VOC. Table 18-1 lists the average UATMP concentration for each of the sites as well as the averages for selected meteorological parameters from January 2004 to December 2004, and on days samples were taken. Average metal compound concentrations are listed in Table 18-4. The average metals concentration at EATN was somewhat higher than at LOTN.

Table 18-5 is the summary of calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report. The highest correlation at the Dickson site

was between acetonitrile and maximum temperature (-0.94). Many of the other correlations with acetonitrile are also strong. However, the compound was detected only six times, and this low number of detects can skew the correlations. Formaldehyde had strong positive correlations with maximum and average temperature, dew point, and wet bulb temperature, and carbon tetrachloride had moderately strong positive correlations with these same parameters and relative humidity. All of the correlations with the *u*-component of the wind were negative, indicating that concentrations of the prevalent compounds at DITN increase as winds decrease from the east or west. Pearson correlations could not be computed for tetrachloroethylene and *trans*-1,3-dichloropropene at DITN due to the low number of detects (fewer than 4).

The strongest correlations at LDTN were computed between acrylonitrile and several of the meteorological parameters. However, this compound was detected only four times, and this low number of detects can skew the correlations. Similar to DITN, moderately strong positive correlations were computed between carbon tetrachloride and maximum temperature, average temperature, dew point, and wet bulb temperature. A moderately strong negative correlation was computed between acetaldehyde and relative humidity (-0.38) and moderately strong positive correlations were computed between acetaldehyde and both wind components (0.36 and 0.43). Most of the remaining correlations at LDTN were weak. Pearson correlations could not be computed for 1,3-butadiene, tetrachloroethylene, and *trans*-1,3-dichloropropene at LDTN due to the low number of detects (fewer than 4).

Moderately strong to very strong correlations were computed between tetrachloroethylene and all of the weather parameters at KITN. However, this compound was detected only four times, and this low number of detects can skew the correlations. Similar to DITN, formaldehyde and carbon tetrachloride had moderately strong to strong positive correlations with maximum temperature, average temperature, dew point, and wet bulb temperature, as did acetaldehyde and acetonitrile. Acetonitrile and carbon tetrachloride also had strong positive correlations with relative humidity. Five of the prevalent compounds at KITN had strong positive correlations with the *v*-component of the wind, indicating that concentrations of the prevalent compounds tend to increase and winds increase from the north or south. Pearson correlations could not be

computed for acrylonitrile, *p*-dichlorobenzene, and *trans*-1,3-dichloropropene at KITN due to the low number of detects (fewer than 4).

At the Nashville sites, formaldehyde exhibited strong to very strong positive correlations with maximum temperature, average temperature, dew point, and wet bulb temperature, while total xylenes exhibited moderately strong correlations with the same parameters. Interestingly, formaldehyde has strong positive correlations with these parameters at all five TN sites. At EATN, several of the compounds exhibited moderately strong to strong positive correlations with the *v*-component of the wind. With the exception of carbon tetrachloride, all of the prevalent compounds had positive correlations with the *v*-component of the wind, indicating that as winds increase from the north or south, concentrations of the prevalent compounds also increase. This trend is not evident at LOTN. At LOTN, nearly all of the prevalent compounds exhibited negative correlations with relative humidity. This trend is not evident at EATN. Pearson correlations could not be computed for acrylonitrile and ethyl acrylate at EATN and *trans*-1,3-dichloropropene at LOTN due to the low number of detects (fewer than 4).

Figures 18-10 through 18-14 show the composite back trajectories for the Tennessee sites for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in these figures, the back trajectories originate from many different directions around the monitoring sites, although there does appear to be fewer trajectories originating from the east and southeast of the sites. Each circle around the sites in Figures 18-10 through 18-14 represents 100 miles; between 53% (LDTN) and 74% (KITN) of the trajectories originated within 300 miles, and between 90% (KITN) and 96% (EATN) within 700 miles from the Tennessee sites. The 24-hour airshed domain is extremely large. Back trajectories originated over 800 miles away at most of the sites.

18.4 Spatial Analysis

County-level vehicle registration and population in Davidson, Dickson, Loudon, and Sullivan Counties were obtained from the Tennessee Department of Safety and the U.S. Census Bureau, and are summarized in Table 18-6. Table 18-6 also includes vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 18-6 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to each site on a daily basis. This information is compared to the average daily UATMP concentration of the prevalent compounds at each Tennessee site in Table 18-6. EATN has both the highest traffic volume passing the site and the largest estimate registered vehicles within 10 miles but has the second highest average UATMP concentration of the Tennessee sites.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. The concentration ratios for EATN, LOTN, and KITN generally resemble those of the roadside study. At LDTN, the benzene-ethylbenzene ratio is slightly higher than the xylenes-ethylbenzene ratio, whereas the benzene-ethylbenzene ratio is lower than the xylenes-ethylbenzene ratio for the roadside study. DITN's toluene-ethylbenzene ratio is the highest of all the UATMP sites, and nearly twice that of the next highest toluene-ethylbenzene ratio for any site. Its benzene-ethylbenzene ratio is slightly higher than its xylenes-ethylbenzene ratio, unlike that of the roadside study.

18.5 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

18.5.1 Site-Specific Trends Analyses

EATN and LOTN have been participants in the UATMP since 2002, while the other three Tennessee sites have participated since 2003. A comparison of EATN's annual average formaldehyde concentrations shows that formaldehyde concentrations have increased in 2004 after a slight decrease in 2003. Benzene concentrations have been decreasing slightly since 2002, while 1,3-butadiene concentrations have changed little at EATN. Interestingly, trends at LOTN are very similar to those at EATN. Please refer to Figures 3-34 and 3-40.

18.5.2 MSA-Specific Trends Analyses

All five Tennessee sites reside in MSAs, three in the Nashville-Davidson-Murfreesboro, TN MSA (EATN, LOTN, DITN), one in the Knoxville, TN MSA (LDTN), and one in the Kingsport-Bristol-Bristol, TN-VA MSA (KITN). The Nashville MSA has experienced a 30.8% increase in population and a 93.6% increase in vehicle miles traveled (VMT) from 1990 to 2003. VOC, metal and carbonyl compound emissions have decreased between 27% and 94% between 1990 and 2002. The 2004 concentrations of these compounds for the UATMP sites representing this MSA (EATN and LOTN) have decreased significantly from the 2002-2003 time period. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

The Knoxville MSA has experienced a 19.1% increase in population and a 60.9% increase in VMT from 1990 to 2003. VOC and carbonyl compound emissions have decreased between 20% and 56% from 1990 to 2002. Concentrations in 2004 of these compounds are unchanged, based on concentrations of the UATMP site representing this MSA (LDTN). However, both ethylbenzene and total xylenes had no previous concentration to compare with. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

The Kingsport MSA has experienced a 8.7% increase in population and estimated VMT. VOC and carbonyl compound emissions have decreased between 42% and 81% from 1990 to 2002. The 2004 VOC and carbonyl compound concentrations, as represented by the UATMP

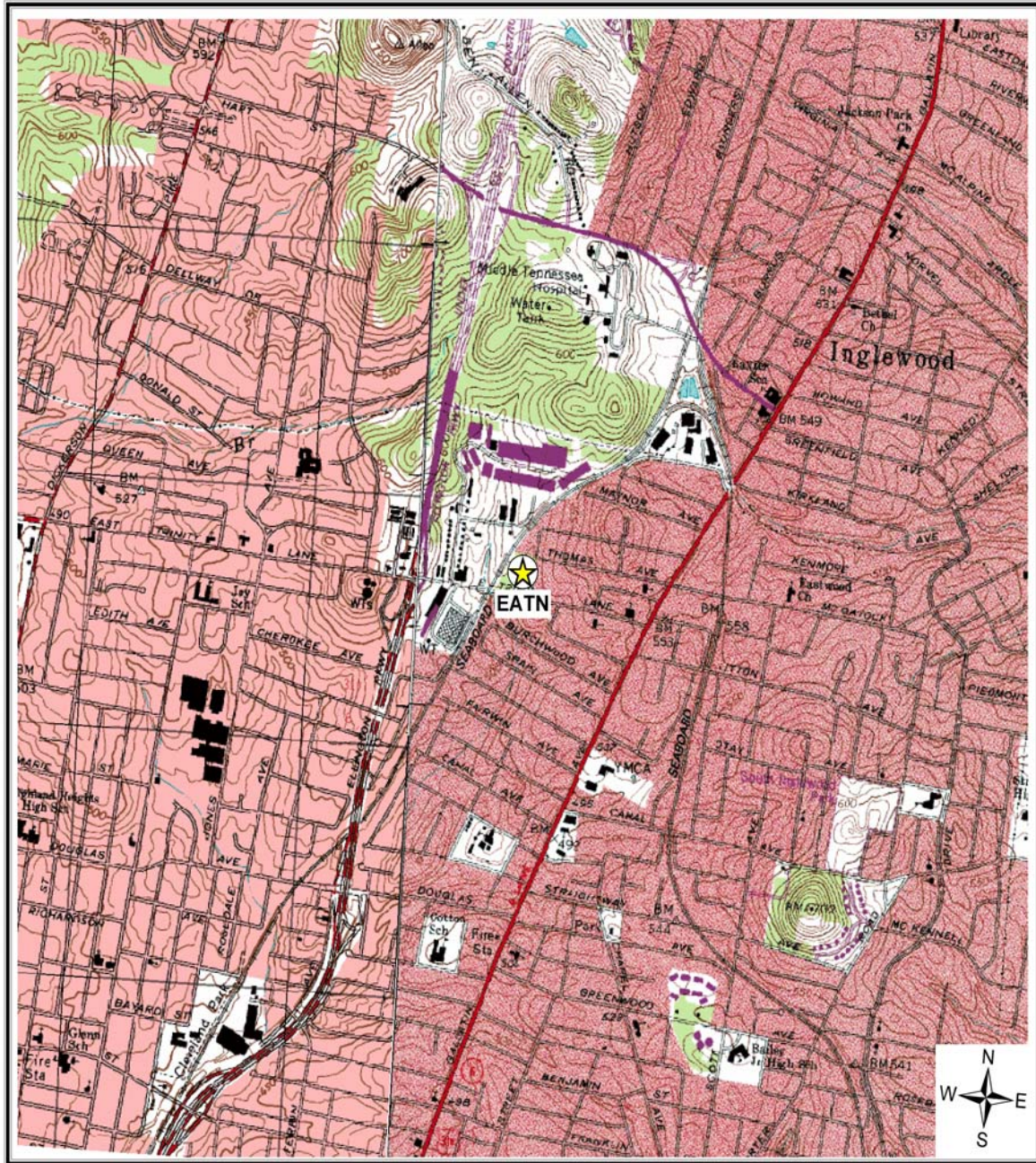
site residing in this MSA (KITN), appear to be decreasing or holding steady compared to the 2002-2003 average concentrations. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program. Trends for these and other compounds of interest can be found in Table 3-13.

Figure 18-1. Dickson, Tennessee (DITN) Monitoring Site



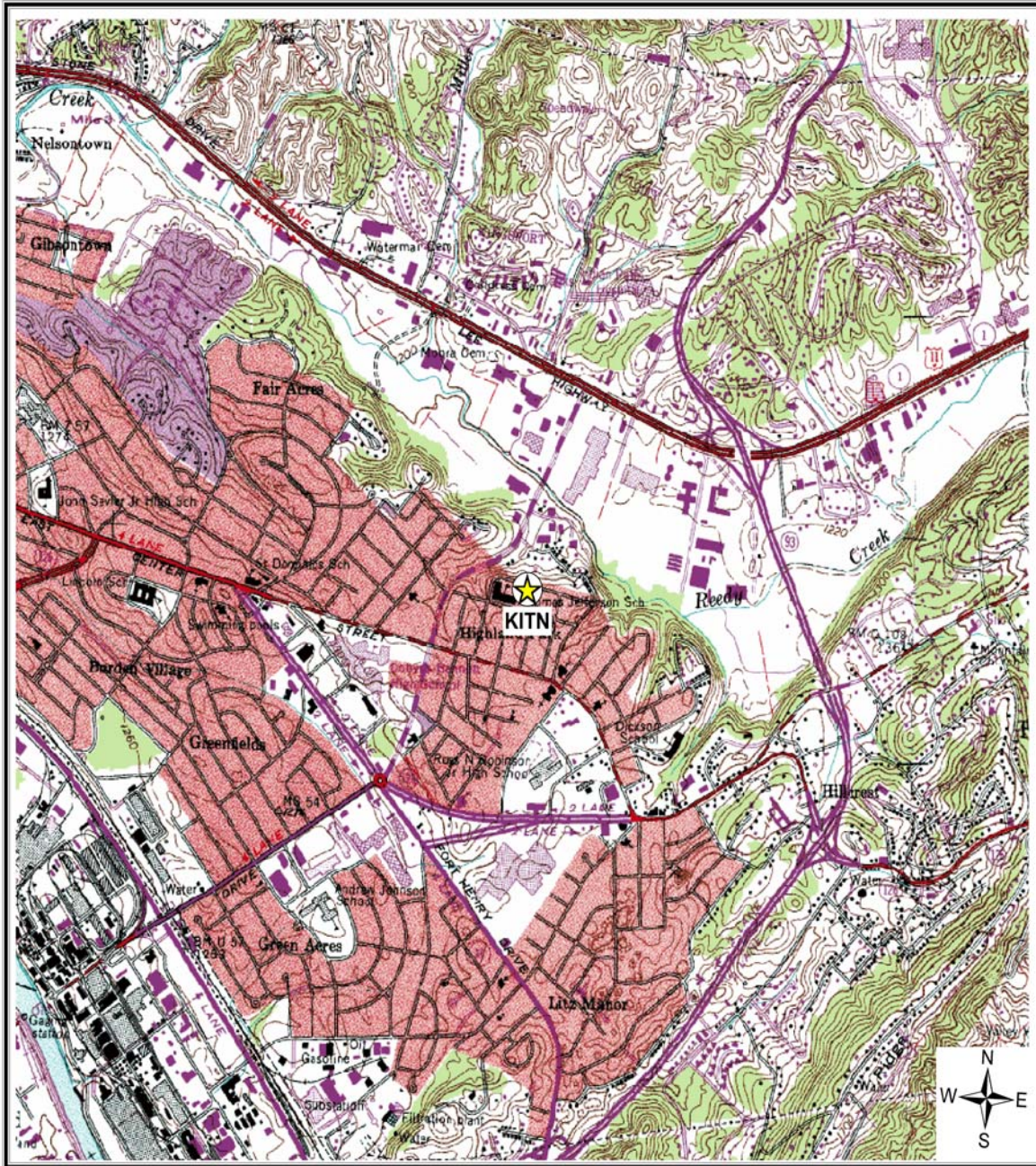
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 18-2. Nashville Site 1, Tennessee (EATN) Monitoring Site



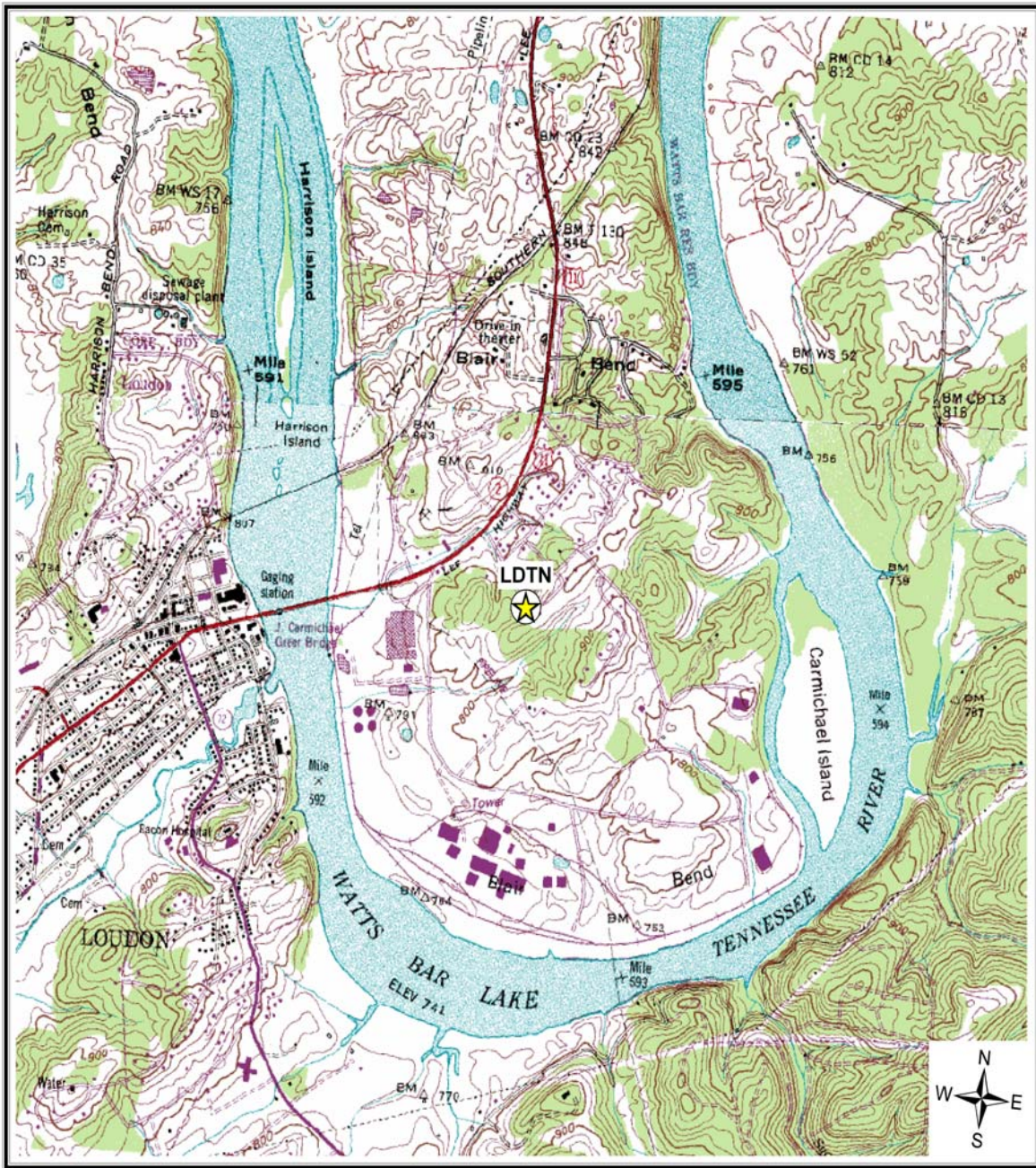
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 18-3. Kingsport, Tennessee (KITN) Monitoring Site



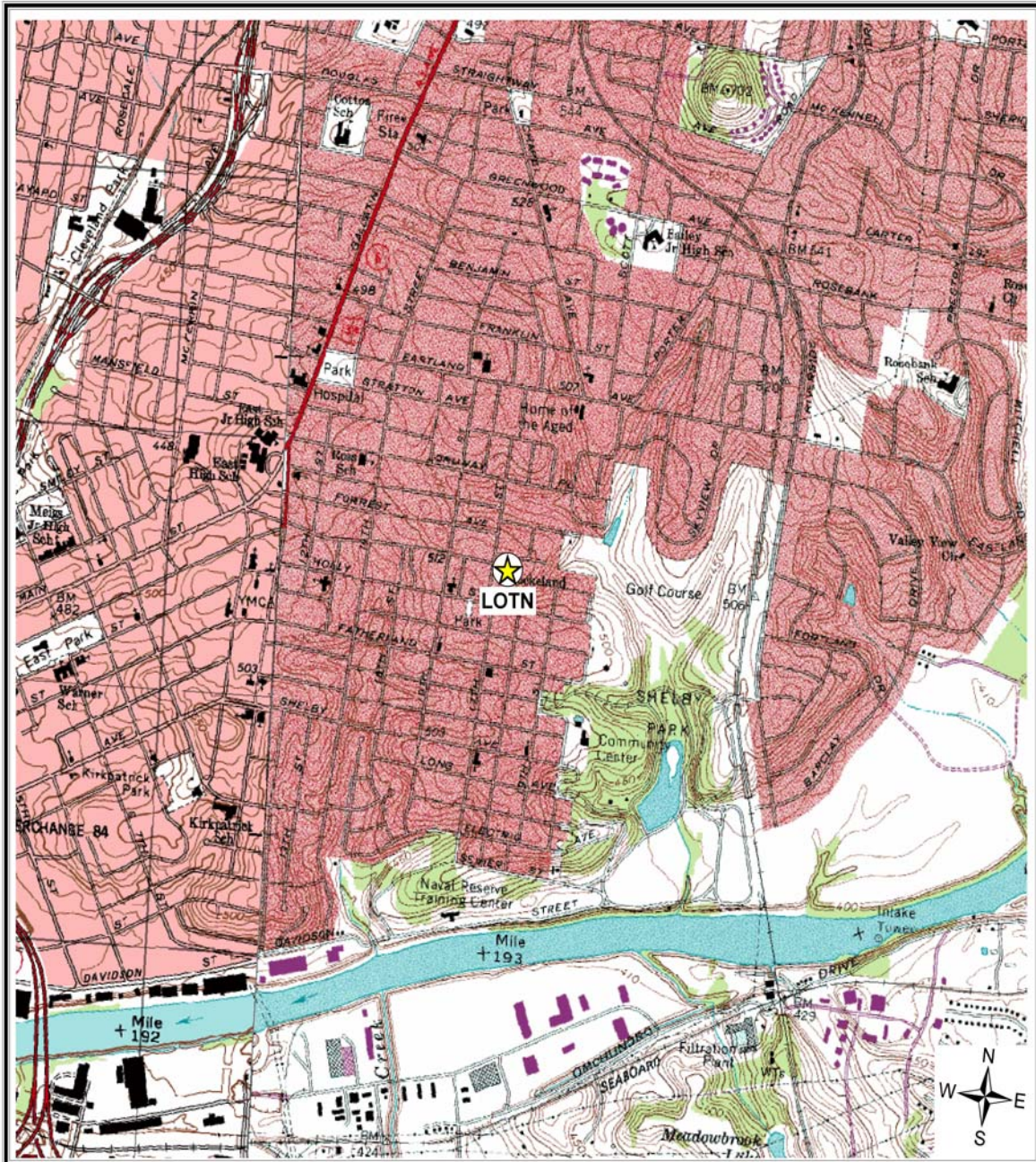
Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 18-4. Loudon, Tennessee (LDTN) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 18-5. Nashville Site 2 (LOTN) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:25,000.

Figure 18-6. Facilities Located Within 10 Miles of DITN

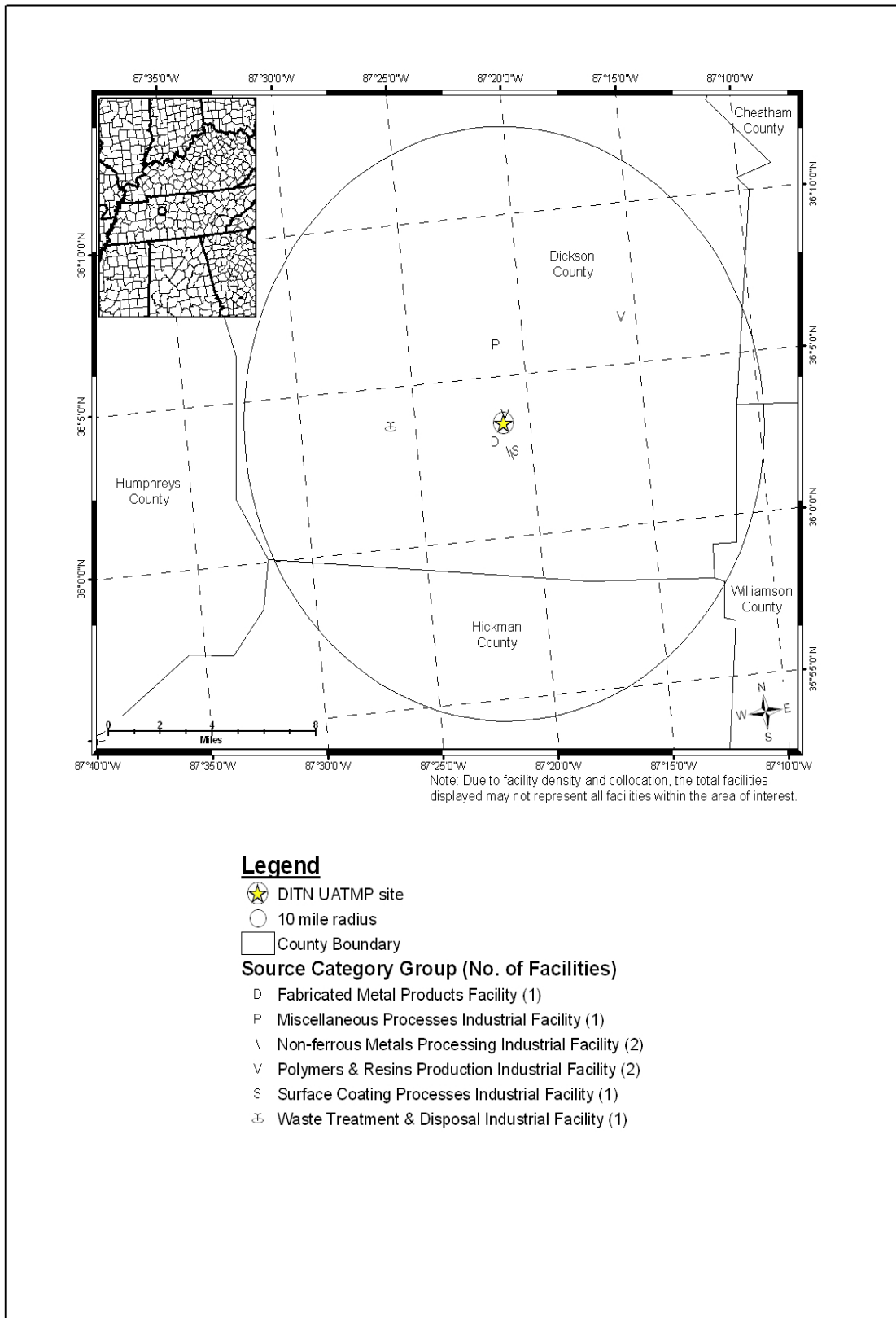


Figure 18-7. Facilities Located Within 10 Miles of EATN and LOTN

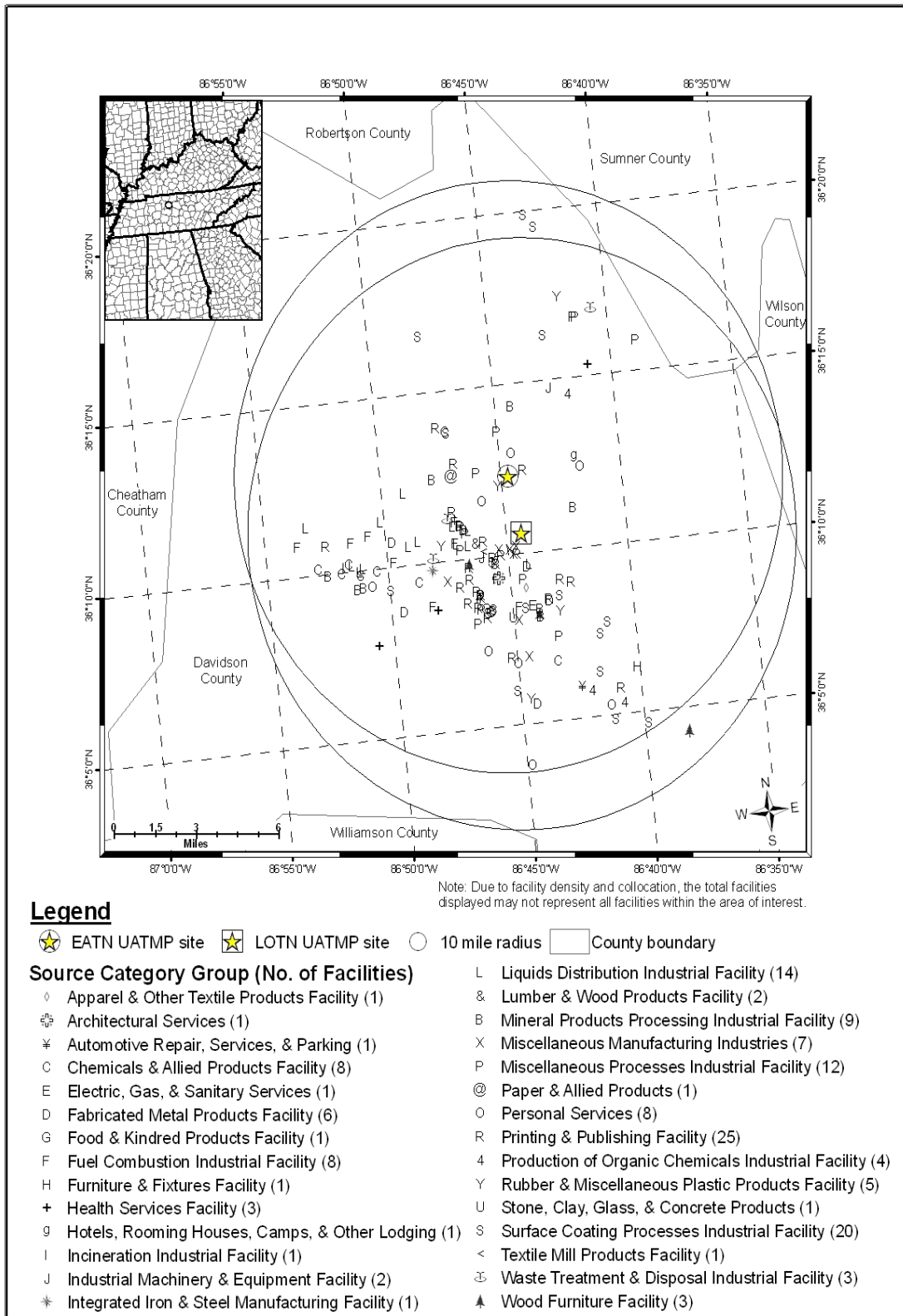


Figure 18-8. Facilities Located Within 10 Miles of KITN

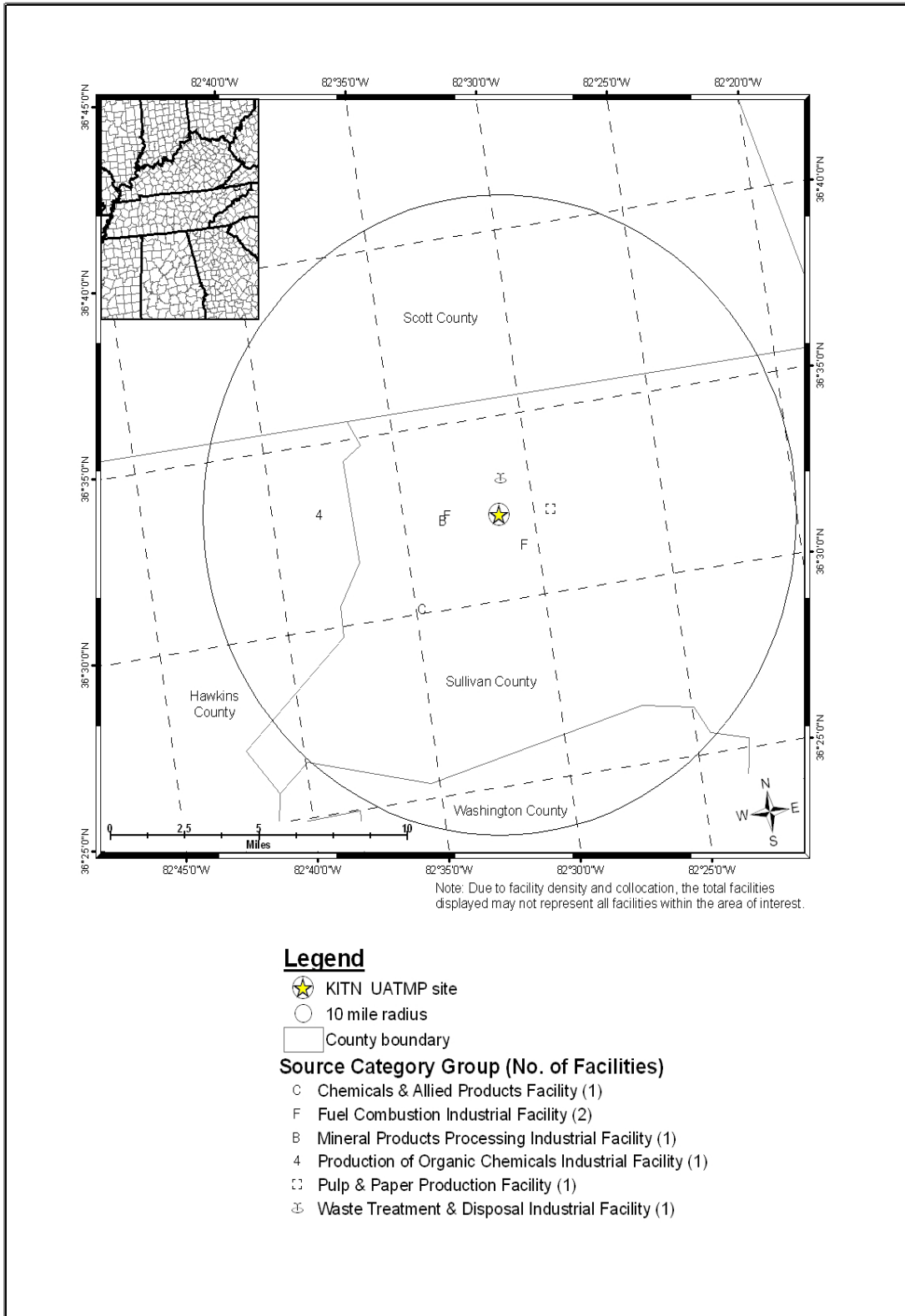


Figure 18-9. Facilities Located Within 10 Miles of LDTN

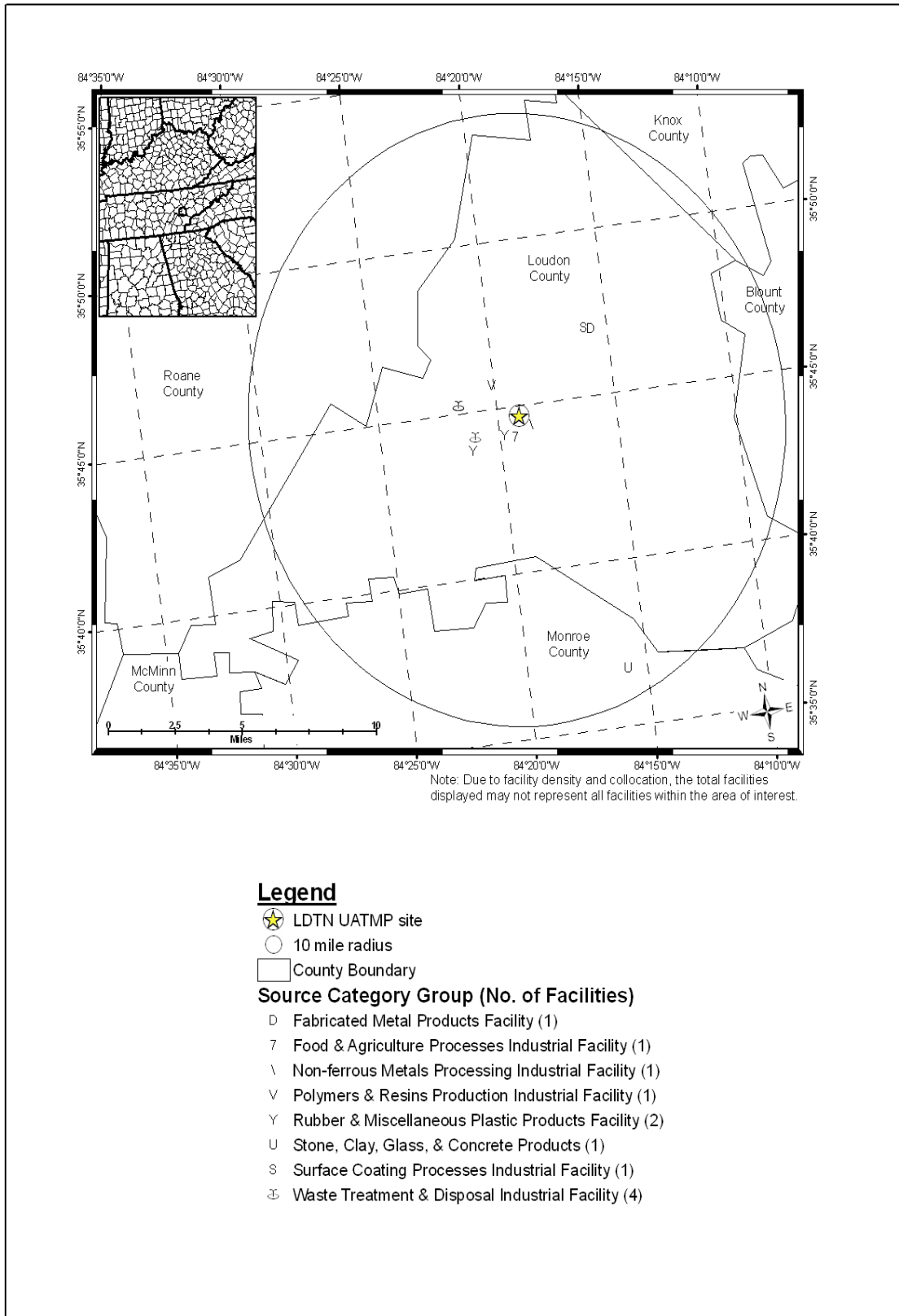


Figure 18-10. Composite Back Trajectory Map for DITN

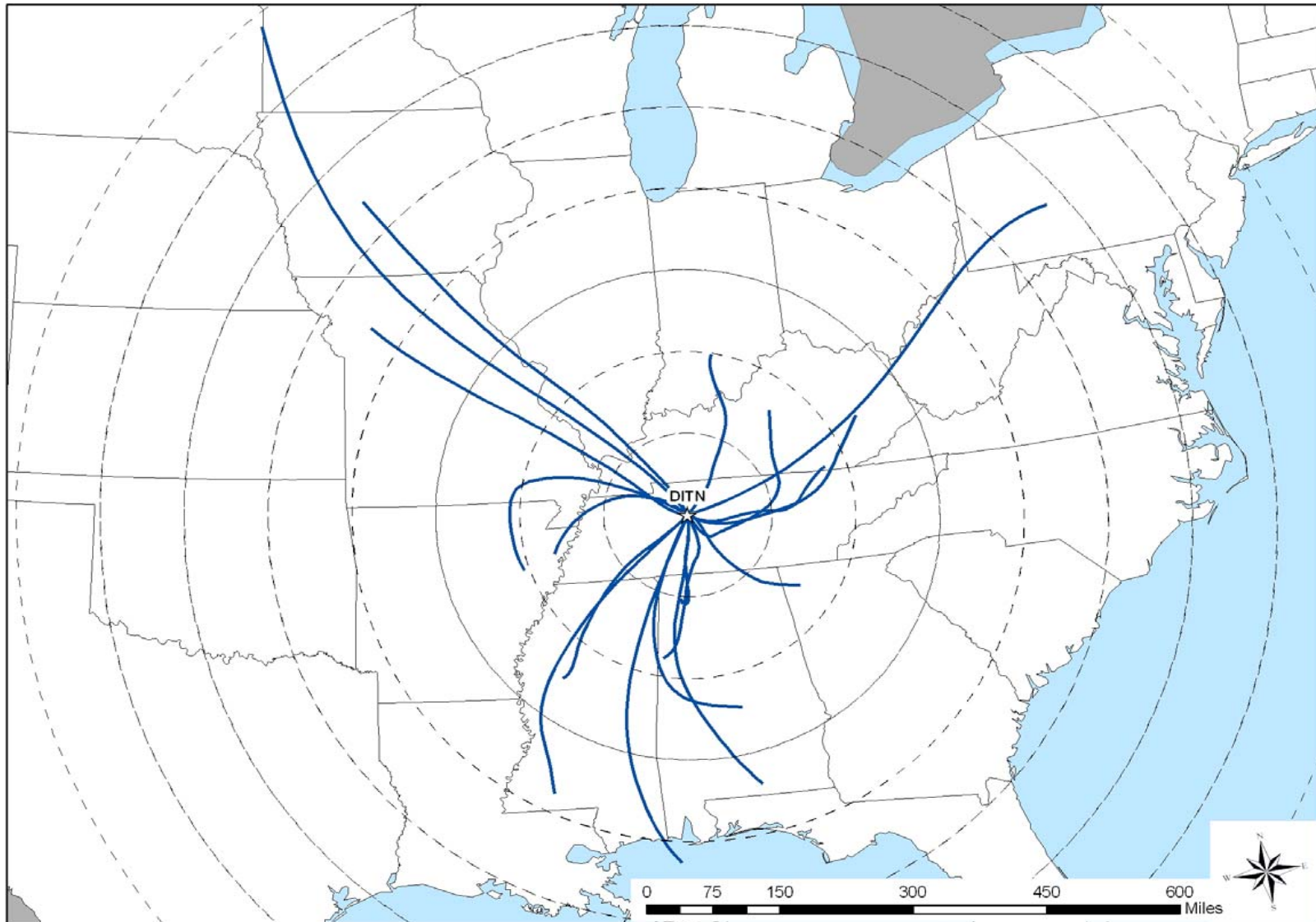


Figure 18-11. Composite Back Trajectory Map for EATN

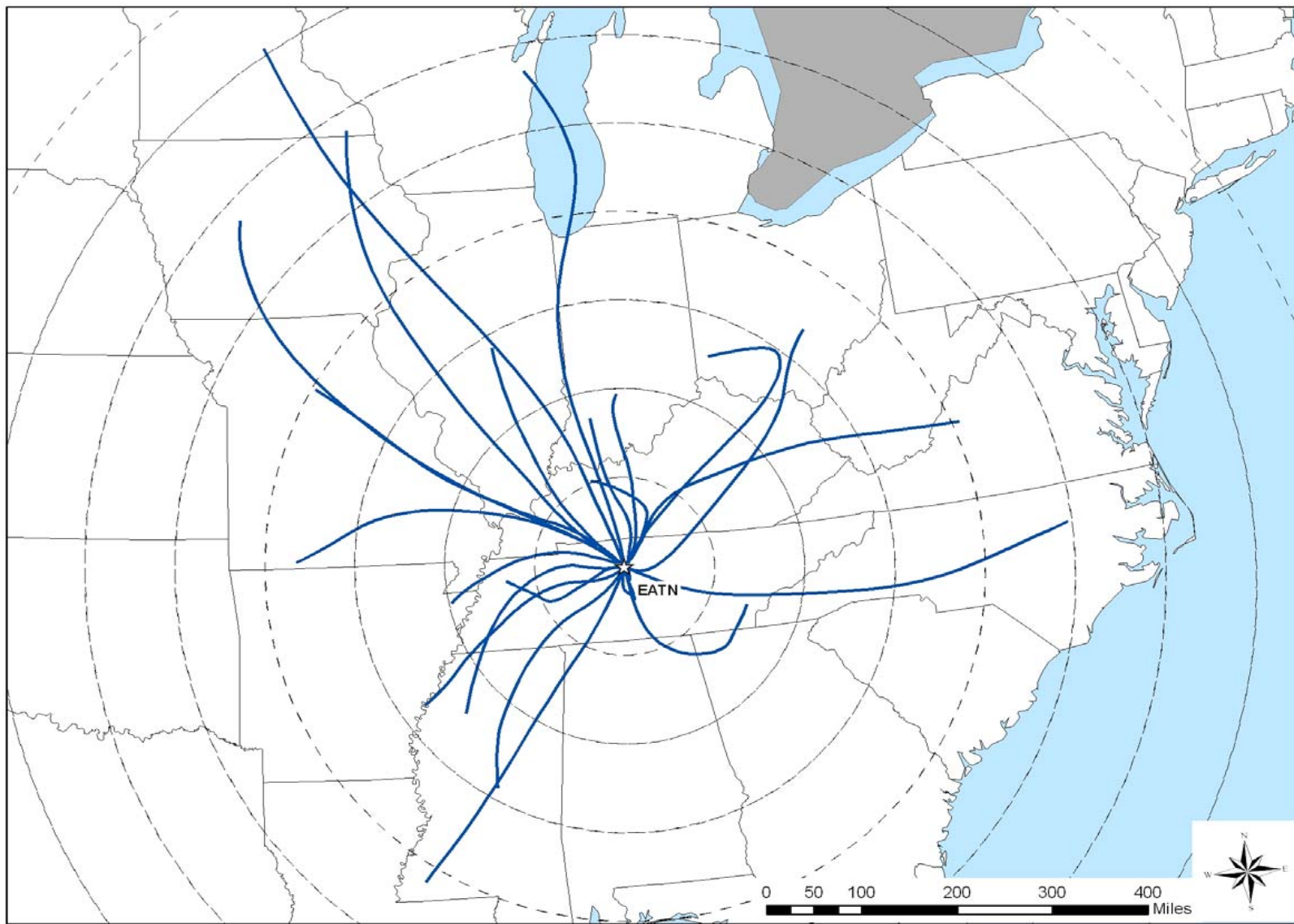


Figure 18-12. Composite Back Trajectory Map for KITN

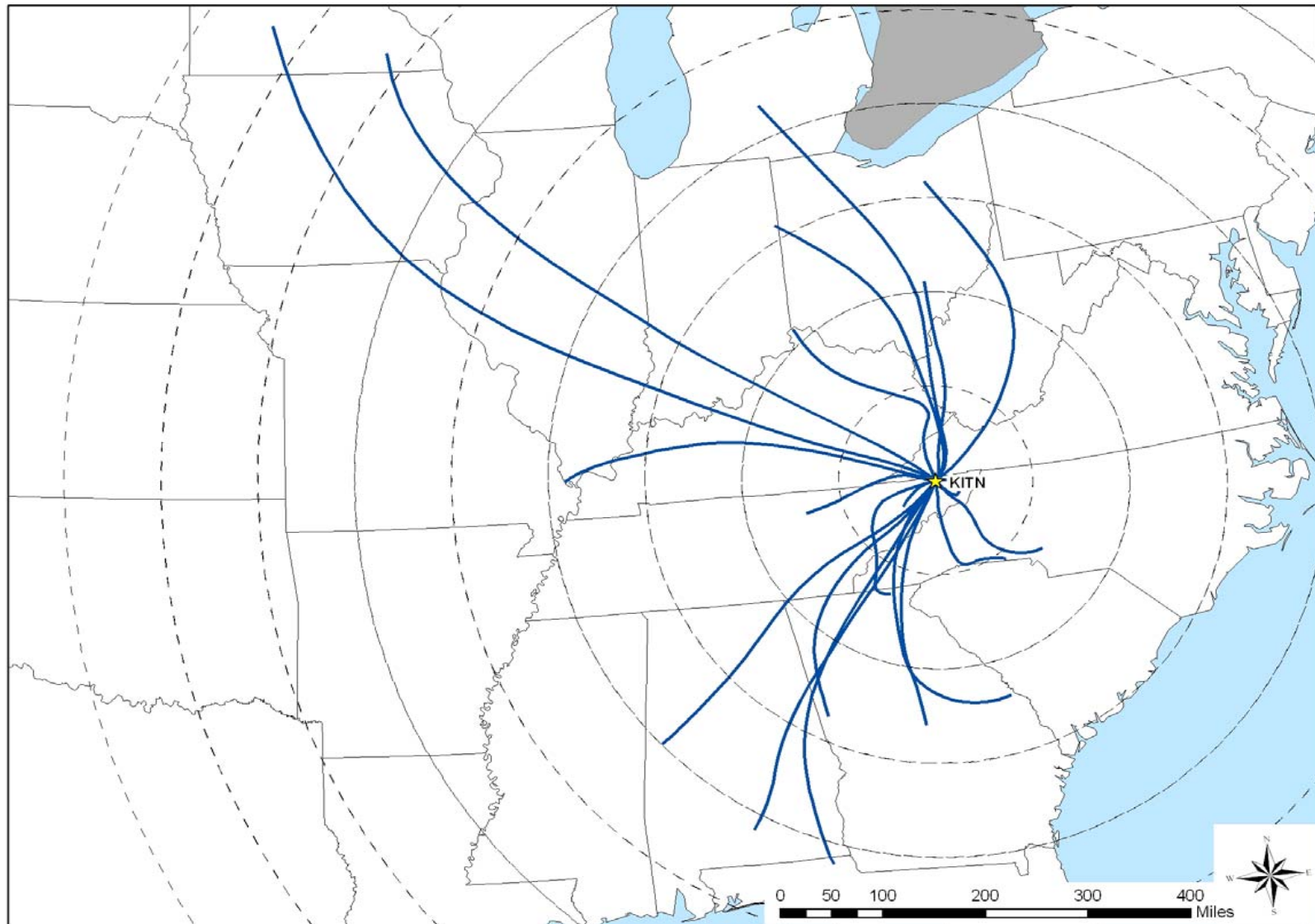


Figure 18-13. Composite Back Trajectory Map for LDTN

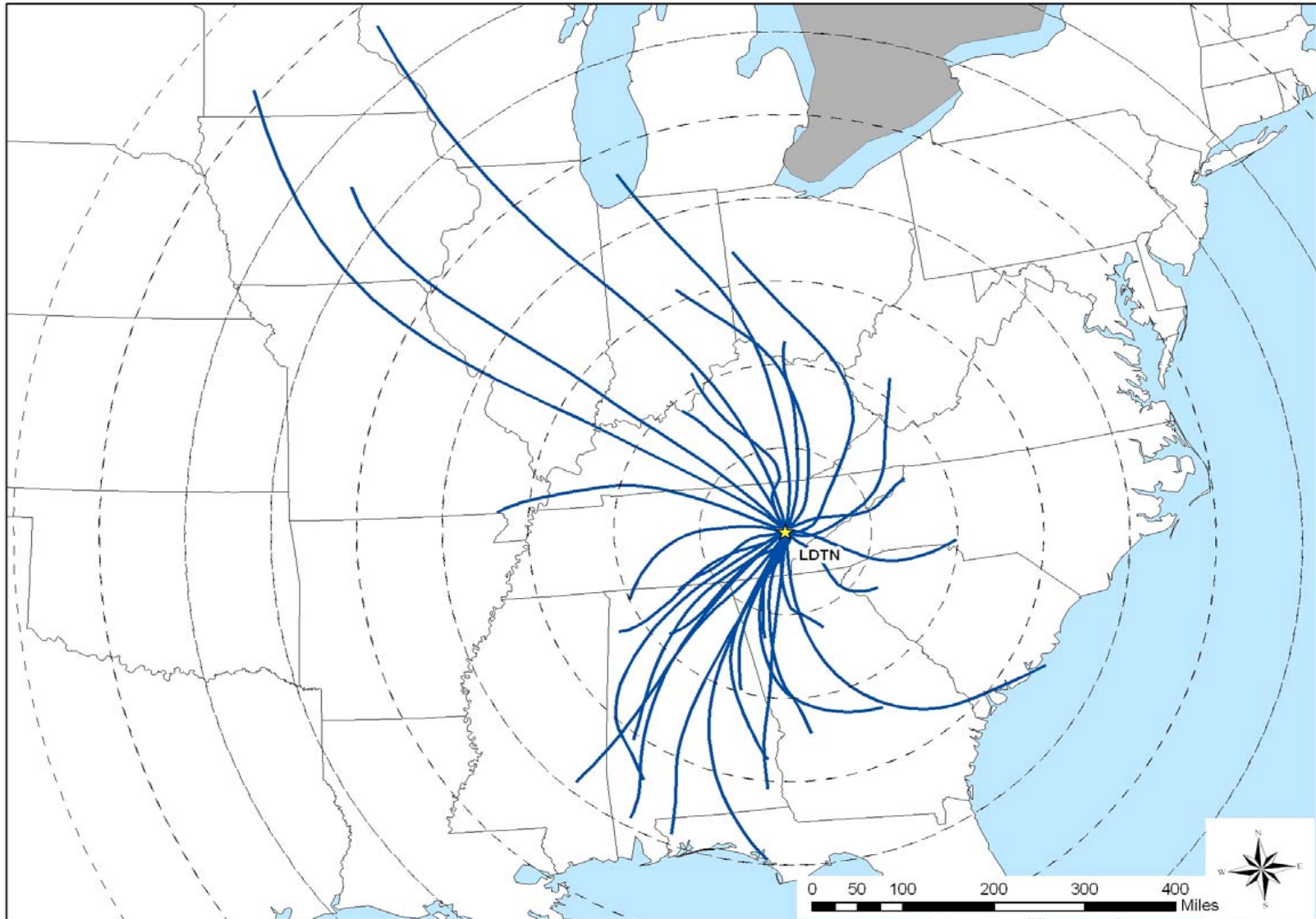


Figure 18-14. Composite Back Trajectory Map for LOTN

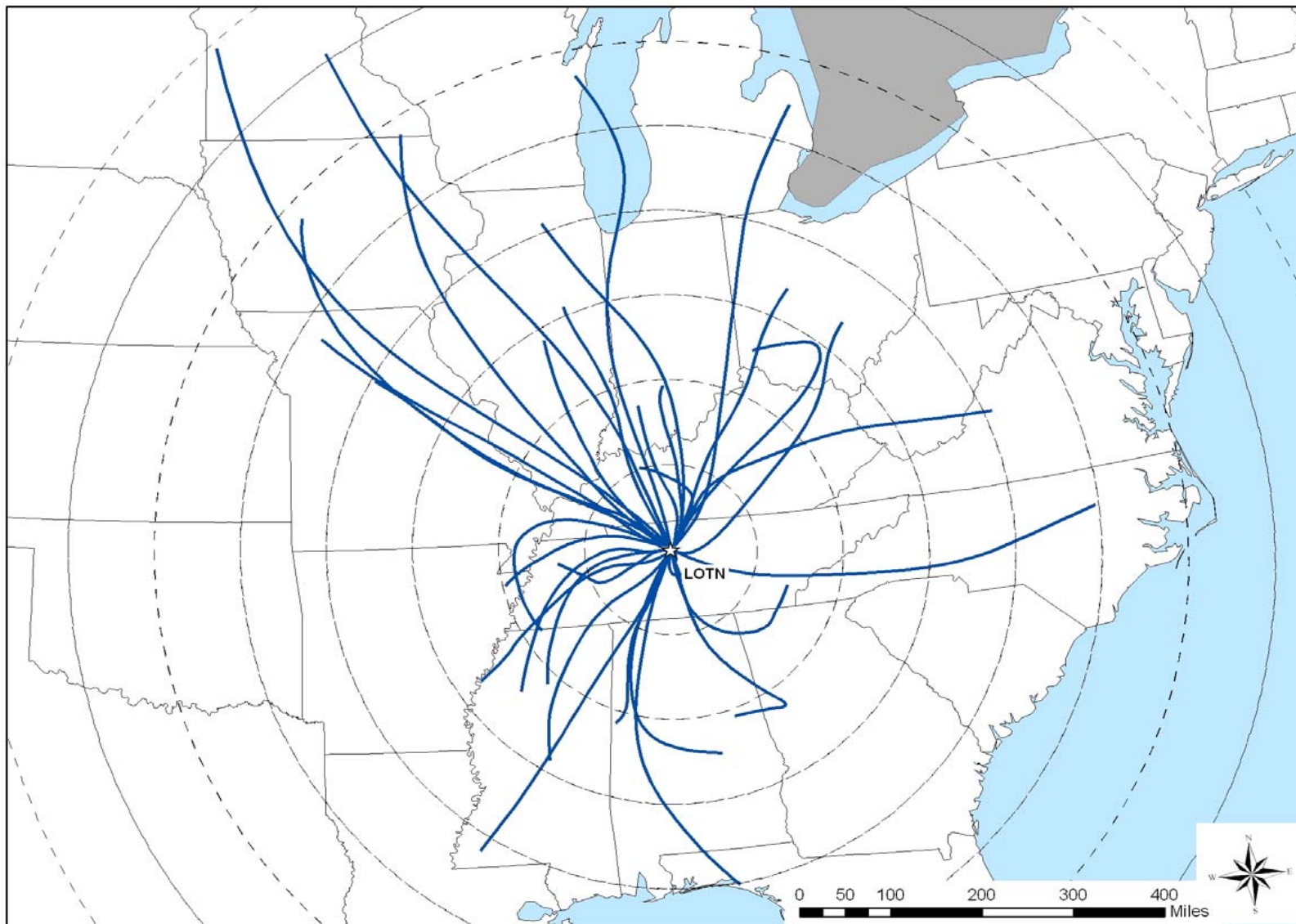


Table 18-1. Average Concentration and Meteorological Parameters for the Sites in Tennessee

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
DITN	All 2004		67.93 (± 1.70)	58.08 (± 1.65)	48.11 (± 1.79)	52.92 (± 1.59)	72.38 (± 1.23)	1018.51 (± 0.61)	0.75 (± 0.32)	0.40 (± 0.45)
	sample day	36.41 (± 11.17)	60.17 (± 7.82)	50.55 (± 7.44)	40.69 (± 7.83)	45.88 (± 7.02)	71.69 (± 4.72)	1021.20 (± 3.19)	0.06 (± 1.64)	0.59 (± 1.94)
EATN	All 2004		69.00 (± 1.63)	60.03 (± 1.61)	48.43 (± 1.75)	53.98 (± 1.53)	68.43 (± 1.27)	1018.72 (± 0.60)	0.57 (± 0.29)	0.43 (± 0.48)
	sample day	43.91 (± 8.94)	69.23 (± 6.63)	59.67 (± 6.38)	45.97 (± 6.92)	52.67 (± 5.98)	63.59 (± 4.36)	1019.49 (± 2.20)	0.79 (± 1.06)	-0.95 (± 1.50)
KITN	All 2004		66.57 (± 1.64)	55.97 (± 1.57)	46.73 (± 1.75)	51.25 (± 1.53)	73.91 (± 1.10)	1018.71 (± 0.62)	1.69 (± 0.30)	0.26 (± 0.17)
	sample day	38.73 (± 9.82)	68.47 (± 7.05)	57.71 (± 6.71)	47.35 (± 7.25)	52.27 (± 6.46)	71.10 (± 3.77)	1017.33 (± 2.33)	2.65 (± 1.41)	0.34 (± 0.63)
LDTN	All 2004		68.34 (± 1.60)	59.05 (± 1.55)	49.02 (± 1.75)	53.84 (± 1.51)	72.09 (± 1.29)	1018.44 (± 0.60)	1.57 (± 0.37)	-0.23 (± 0.35)
	sample day	48.45 (± 8.35)	69.63 (± 5.27)	60.28 (± 5.14)	48.42 (± 5.91)	54.16 (± 5.00)	67.87 (± 4.43)	1019.00 (± 1.81)	1.94 (± 1.35)	0.18 (± 1.33)
LOTN	All 2004		69.00 (± 1.63)	60.03 (± 1.61)	48.43 (± 1.75)	53.98 (± 1.53)	68.43 (± 1.27)	1018.72 (± 0.60)	0.57 (± 0.29)	0.43 (± 0.48)
	sample day	36.12 (± 5.44)	66.94 (± 5.72)	57.57 (± 5.49)	44.74 (± 5.79)	51.09 (± 5.09)	65.36 (± 4.04)	1019.16 (± 2.14)	0.96 (± 0.93)	-0.49 (± 1.37)

Table 18-2. Summary of the Toxic Cancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Cancer Risk (Out of 1 Million)
Dickson, Tennessee - DITN						
Carbon Tetrachloride	8.61 E-06	37.95	37.95	0.57	14	8.61
Benzene	7.28 E-06	32.07	70.02	0.93	17	7.28
Acetaldehyde	2.64 E-06	11.62	81.63	1.20	18	2.64
Tetrachloroethylene	2.10 E-06	9.26	90.89	0.36	2	2.10
<i>trans</i> -1,3-Dichloropropene	1.82 E-06	8.00	98.89	0.45	3	1.82
Dichloromethane	2.40 E-07	1.06	99.95	0.51	5	0.24
Formaldehyde	1.09 E-08	0.05	100.00	1.98	18	0.01
Nashville Site 1, Tennessee - EATN						
Acrylonitrile	2.18 E-05	31.59	31.59	0.32	2	21.77
Benzene	1.02 E-05	14.81	46.40	1.31	13	10.20
Carbon Tetrachloride	8.60 E-06	12.48	58.89	0.57	11	8.60
Tetrachloroethylene	6.94 E-06	10.07	68.96	1.18	6	6.94
1,3-Butadiene	6.60 E-06	9.57	78.53	0.22	8	6.60
Arsenic Compounds	6.20 E-06	9.01	87.53	<0.00	28	6.20
Acetaldehyde	4.35 E-06	6.31	93.84	1.98	12	4.35
Ethyl Acrylate	3.44 E-06	4.99	98.84	0.25	1	3.44
Cadmium Compounds	3.71 E-07	0.54	99.38	<0.00	28	0.37
Dichloromethane	3.38 E-07	0.49	99.87	0.72	9	0.34
Beryllium Compounds	6.93 E-08	0.10	99.97	<0.00	28	0.07
Formaldehyde	2.33 E-08	0.03	100.00	4.24	12	0.02
Kingsport, Tennessee - KITN						
Acrylonitrile	1.33 E-05	28.03	28.03	0.20	1	13.28
Benzene	8.84 E-06	18.66	46.69	1.13	19	8.84
Carbon Tetrachloride	7.60 E-06	16.05	62.74	0.51	17	7.60

Table 18-2. Summary of the Toxic Cancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Cancer Risk (Out of 1 Million)
1,3-Butadiene	5.28 E-06	11.15	73.89	0.18	9	5.28
<i>p</i> -Dichlorobenzene	3.97 E-06	8.37	82.27	0.36	1	3.97
Acetaldehyde	3.83 E-06	8.08	90.35	1.74	19	3.83
Tetrachloroethylene	2.60 E-06	5.49	95.84	0.44	4	2.60
<i>trans</i> -1,3-Dichloropropene	1.45 E-06	3.07	98.90	0.36	1	1.45
Dichloromethane	5.03 E-07	1.06	99.96	1.07	5	0.50
Formaldehyde	1.72 E-08	0.04	100.00	3.13	19	0.02
Loudon, Tennessee - LDTN						
Acrylonitrile	3.87 E-05	52.19	52.19	0.57	4	38.74
Benzene	9.32 E-06	12.56	64.74	1.19	31	9.32
Carbon Tetrachloride	8.24 E-06	11.10	75.84	0.55	29	8.24
Acetaldehyde	6.99 E-06	9.42	85.27	3.18	31	6.99
1,3-Butadiene	5.75 E-06	7.75	93.02	0.19	3	5.75
Tetrachloroethylene	2.40 E-06	3.23	96.25	0.41	1	2.40
<i>trans</i> -1,3-Dichloropropene	2.31 E-06	3.12	99.37	0.58	1	2.31
Dichloromethane	4.25 E-07	0.57	99.94	0.90	5	0.42
Formaldehyde	4.38 E-08	0.06	100.00	7.97	31	0.04
Nashville Site 2, Tennessee - LOTN						
Benzene	9.13 E-06	22.42	22.42	1.17	25	9.13
Carbon Tetrachloride	9.06 E-06	22.27	44.69	0.60	24	9.06
1,3-Butadiene	7.04 E-06	17.30	61.99	0.23	9	7.04
Arsenic Compounds	6.81 E-06	16.74	78.74	<0.00	28	6.81
Acetaldehyde	4.06 E-06	9.98	88.72	1.85	23	4.06
Tetrachloroethylene	2.40 E-06	5.90	94.62	0.41	4	2.40
<i>trans</i> -1,3-Dichloropropene	1.51 E-06	3.72	98.33	0.38	3	1.51
Cadmium Compounds	3.78 E-07	0.93	99.26	<0.00	28	0.38
Dichloromethane	1.90 E-07	0.47	99.73	0.40	19	0.19

Table 18-2. Summary of the Toxic Cancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Beryllium Compounds	8.50 E-08	0.21	99.94	<0.00	28	0.09
Formaldehyde	2.44 E-08	0.06	100.00	4.44	23	0.02

Table 18-3. Summary of the Toxic Noncancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Dickson, Tennessee - DITN						
Acetonitrile	2.31 E-01	33.50	33.50	13.86	6	0
Formaldehyde	2.02 E-01	29.36	62.86	1.98	18	0
Acetaldehyde	1.33 E-01	19.31	82.17	1.20	18	0
Benzene	3.11 E-02	4.51	86.68	0.93	17	0
<i>trans</i> -1,3-Dichloropropene	2.27 E-02	3.29	89.97	0.45	3	0
Xylenes	2.01 E-02	2.91	92.88	2.01	17	0
Toluene	1.57 E-02	2.28	95.16	6.29	17	0
Carbon Tetrachloride	1.44 E-02	2.08	97.25	0.57	14	0
Chloromethane	1.36 E-02	1.97	99.21	1.22	17	0
Tetrachloroethylene	1.32 E-03	0.19	99.40	0.36	2	0
Methyl Ethyl Ketone	9.42 E-04	0.14	99.54	4.71	15	0
Methyl Isobutyl Ketone	9.27 E-04	0.13	99.68	2.78	9	0
Styrene	7.49 E-04	0.11	99.78	0.75	11	0
Chloroethane	6.28 E-04	0.09	99.88	6.28	1	0
Dichloromethane	5.11 E-04	0.07	99.95	0.51	5	0
Ethylbenzene	3.45 E-04	0.05	100.00	0.35	15	0
Nashville Site 1, Tennessee - EATN						
Formaldehyde	4.32 E-01	28.50	28.50	4.24	12	0
Manganese Compounds	2.79 E-01	18.37	46.87	0.01	28	0
Acetaldehyde	2.20 E-01	14.48	61.35	1.98	12	0
Acrylonitrile	1.60 E-01	10.55	71.90	0.32	2	0
1,3-Butadiene	1.10 E-01	7.25	79.14	0.22	8	0
Acetonitrile	1.01 E-01	6.63	85.77	6.03	10	0
Arsenic Compounds	4.81 E-02	3.17	88.94	<0.00	28	0
Benzene	4.36 E-02	2.87	91.82	1.31	13	0
Xylenes	4.35 E-02	2.87	94.68	4.35	13	0

Table 18-3. Summary of the Toxic Noncancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Carbon Tetrachloride	1.43 E-02	0.94	95.63	0.57	11	0
Chloromethane	1.31 E-02	0.86	96.49	1.17	13	0
Cadmium Compounds	1.03 E-02	0.68	97.17	<0.00	28	0
Nickel Compounds	9.02 E-03	0.59	97.76	<0.00	28	0
Toluene	8.00 E-03	0.53	98.29	3.20	13	0
Cobalt Compounds	5.73 E-03	0.38	98.67	0.00	28	0
Chloroform	5.02 E-03	0.33	99.00	0.49	1	0
Tetrachloroethylene	4.35 E-03	0.29	99.29	1.18	6	0
Lead Compounds	4.35 E-03	0.29	99.57	0.01	28	0
Styrene	2.60 E-03	0.17	99.74	2.60	10	0
Beryllium Compounds	1.44 E-03	0.10	99.84	<0.00	28	0
Ethylbenzene	8.50 E-04	0.06	99.90	0.85	13	0
Dichloromethane	7.19 E-04	0.05	99.94	0.72	9	0
Methyl Ethyl Ketone	4.31 E-04	0.03	99.97	2.16	10	0
Methyl <i>tert</i> -Butyl Ether	1.84 E-04	0.01	99.98	0.55	6	0
Methyl Isobutyl Ketone	1.35 E-04	0.01	99.99	0.40	4	0
Mercury Compounds	6.90 E-05	0.00	100.00	<0.00	13	0
Selenium Compounds	4.60 E-05	0.00	100.00	<0.00	28	0
Kingsport, Tennessee - KITN						
Formaldehyde	3.20 E-01	37.67	37.67	3.13	19	0
Acetaldehyde	1.93 E-01	22.80	60.47	1.74	19	0
Acrylonitrile	9.77 E-02	11.51	71.99	0.20	1	0
1,3-Butadiene	8.81 E-02	10.38	82.37	0.18	9	0
Benzene	3.78 E-02	4.46	86.83	1.13	19	0
Xylenes	3.65 E-02	4.31	91.13	3.65	18	0
Acetonitrile	1.82 E-02	2.15	93.28	1.09	11	0
<i>trans</i> -1,3-Dichloropropene	1.82 E-02	2.14	95.42	0.36	1	0

Table 18-3. Summary of the Toxic Noncancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Chloromethane	1.44 E-02	1.70	97.12	1.30	18	0
Carbon Tetrachloride	1.27 E-02	1.49	98.62	0.51	17	0
Toluene	5.87 E-03	0.69	99.31	2.35	19	0
Tetrachloroethylene	1.63 E-03	0.19	99.50	0.44	4	0
Methyl Ethyl Ketone	1.13 E-03	0.13	99.64	5.65	16	0
Dichloromethane	1.07 E-03	0.13	99.76	1.07	5	0
Ethylbenzene	5.07 E-04	0.06	99.82	0.51	18	0
<i>p</i> -Dichlorobenzene	4.51 E-04	0.05	99.87	0.36	1	0
Methyl Isobutyl Ketone	4.09 E-04	0.05	99.92	1.23	11	0
Styrene	3.99 E-04	0.05	99.97	0.40	10	0
Chloroethane	1.74 E-04	0.02	99.99	1.74	1	0
Methyl <i>tert</i> -Butyl Ether	8.41 E-05	0.01	100.00	0.25	1	0
Loudon, Tennessee - LDTN						
Formaldehyde	8.13 E-01	48.23	48.23	7.97	31	8
Acetaldehyde	3.53 E-01	20.96	69.18	3.18	31	0
Acrylonitrile	2.85 E-01	16.90	86.08	0.57	4	0
1,3-Butadiene	9.59 E-02	5.69	91.76	0.19	3	0
Benzene	3.98 E-02	2.36	94.13	1.19	31	0
<i>trans</i> -1,3-Dichloropropene	2.89 E-02	1.72	95.84	0.58	1	0
Xylenes	2.54 E-02	1.51	97.35	2.54	30	0
Chloromethane	1.44 E-02	0.86	98.21	1.30	29	0
Carbon Tetrachloride	1.37 E-02	0.81	99.02	0.55	29	0
Toluene	6.18 E-03	0.37	99.39	2.47	31	0
Chloroform	4.44 E-03	0.26	99.65	0.43	16	0
Methyl Ethyl Ketone	1.55 E-03	0.09	99.74	7.77	29	0
Tetrachloroethylene	1.51 E-03	0.09	99.83	0.41	1	0
Dichloromethane	9.03 E-04	0.05	99.89	0.90	5	0

Table 18-3. Summary of the Toxic Noncancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration ($\mu\text{g}/\text{m}^3$)	# Detects	Adverse Health Concentrations
Styrene	7.42 E-04	0.04	99.93	0.74	27	0
Methyl Isobutyl Ketone	4.49 E-04	0.03	99.96	1.35	18	0
Ethylbenzene	4.28 E-04	0.03	99.98	0.43	29	0
Methyl <i>tert</i> -Butyl Ether	2.36 E-04	0.01	100.00	0.71	3	0
Chloroethane	3.69 E-05	0.00	100.00	0.37	2	0
Nashville Site 2, Tennessee - LOTN						
Formaldehyde	4.53 E-01	34.05	34.05	4.44	23	0
Manganese Compounds	2.11 E-01	15.91	49.96	0.01	28	0
Acetaldehyde	2.05 E-01	15.44	65.40	1.85	23	0
Acetonitrile	1.28 E-01	9.60	75.00	7.66	20	0
1,3-Butadiene	1.17 E-01	8.83	83.83	0.23	9	0
Arsenic Compounds	5.28 E-02	3.97	87.80	<0.00	28	0
Benzene	3.90 E-02	2.93	90.74	1.17	25	0
Xylenes	3.39 E-02	2.55	93.29	3.39	24	0
<i>trans</i> -1,3-Dichloropropene	1.89 E-02	1.42	94.71	0.38	3	0
Carbon Tetrachloride	1.51 E-02	1.14	95.85	0.60	24	0
Chloromethane	1.32 E-02	0.99	96.84	1.19	25	0
Cadmium Compounds	1.05 E-02	0.79	97.63	<0.00	28	0
Nickel Compounds	8.48 E-03	0.64	98.27	<0.00	28	0
Toluene	6.22 E-03	0.47	98.74	2.49	25	0
Cobalt Compounds	5.05 E-03	0.38	99.12	<0.00	28	0
Lead Compounds	3.92 E-03	0.29	99.41	0.01	28	0
Chloroform	2.11 E-03	0.16	99.57	0.21	5	0
Beryllium Compounds	1.77 E-03	0.13	99.70	<0.00	28	0
Tetrachloroethylene	1.51 E-03	0.11	99.82	0.41	4	0
Ethylbenzene	5.00 E-04	0.04	99.86	0.50	24	0
Methyl Ethyl Ketone	4.26 E-04	0.03	99.89	2.13	18	0

Table 18-3. Summary of the Toxic Noncancer Compounds at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Monitoring Sites (Continued)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Dichloromethane	4.05 E-04	0.03	99.92	0.40	19	0
1,1,1-Trichloroethane	3.00 E-04	0.02	99.94	0.30	2	0
Styrene	2.56 E-04	0.02	99.96	0.26	12	0
Methyl Isobutyl Ketone	2.49 E-04	0.02	99.98	0.75	4	0
Methyl <i>tert</i> -Butyl Ether	1.67 E-04	0.01	99.99	0.50	11	0
Mercury Compounds	7.41 E-05	0.01	100.00	<0.00	14	0
Selenium Compounds	4.51 E-05	0.00	100.00	<0.00	28	0

Table 18-4. Average Metal Concentrations Measured by the Nashville Monitoring Sites

Monitoring Site	Average Metals Concentration (ng/m³)
EATN	30.44
LOTN	26.03

Table 18-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Sites

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Dickson, Tennessee - DITN								
Acetaldehyde	0.06	-0.03	-0.04	-0.04	0.02	-0.06	-0.42	0.21
Acetonitrile	-0.94	-0.90	-0.80	-0.86	-0.04	0.63	-0.17	-0.40
Benzene	-0.19	-0.21	-0.12	-0.16	0.31	0.04	-0.28	-0.10
Carbon Tetrachloride	0.28	0.26	0.33	0.30	0.43	-0.33	-0.57	-0.30
Formaldehyde	0.58	0.56	0.47	0.51	-0.12	-0.14	-0.09	0.30
Tetrachloroethylene	NA							
Toluene	-0.03	0.00	0.09	0.05	0.35	-0.06	-0.53	0.09
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	0.06	0.03	0.10	0.07	0.35	-0.05	-0.38	-0.09
Nashville Site 1, Tennessee - EATN								
1,3-Butadiene	-0.20	-0.30	-0.34	-0.34	-0.15	0.61	-0.23	0.52
Acetaldehyde	0.17	0.12	0.00	0.05	-0.32	0.19	-0.46	0.03
Acetonitrile	0.24	0.23	0.36	0.28	0.55	0.05	-0.12	0.22
Acrylonitrile	NA							
Arsenic Compounds	0.01	-0.01	-0.08	-0.03	-0.23	0.48	-0.19	0.12
Benzene	0.30	0.21	0.22	0.20	0.19	0.22	0.00	0.38
Carbon Tetrachloride	-0.28	-0.23	-0.14	-0.20	0.22	0.02	0.08	-0.19
Ethyl Acrylate	NA							
Formaldehyde	0.90	0.91	0.89	0.91	0.17	-0.51	-0.11	0.73
Manganese Compounds	0.13	0.09	-0.03	0.04	-0.37	0.26	0.09	0.20
Tetrachloroethylene	0.31	0.28	0.14	0.18	-0.09	-0.76	0.29	0.20
Xylenes	0.54	0.44	0.43	0.43	0.18	0.12	-0.07	0.47
Kingsport, Tennessee - KITN								
1,3-Butadiene	-0.25	-0.24	-0.18	-0.21	0.21	0.13	-0.08	0.02
Acetaldehyde	0.47	0.36	0.26	0.30	-0.18	0.10	-0.42	0.41
Acetonitrile	0.46	0.47	0.52	0.50	0.73	-0.34	0.00	0.49
Acrylonitrile	NA							
Benzene	0.04	0.02	0.03	0.03	0.07	-0.08	-0.09	0.46

Table 18-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Dickson, Nashville Site 1, Kingsport, Loudon, and Nashville Site 2, Tennessee Sites (Continued)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i> -component of wind	<i>v</i> -component of wind
Carbon Tetrachloride	0.48	0.47	0.49	0.48	0.41	-0.06	-0.46	0.19
Formaldehyde	0.52	0.48	0.39	0.43	-0.13	-0.11	-0.11	0.32
<i>p</i> -Dichlorobenzene	NA							
Tetrachloroethylene	-0.97	-0.93	-0.93	-0.93	0.65	0.60	-0.43	-0.44
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	0.10	0.02	0.05	0.03	0.22	0.22	-0.38	0.53
Loudon, Tennessee - LDTN								
1,3-Butadiene	NA							
Acetaldehyde	-0.03	-0.07	-0.17	-0.13	-0.38	0.07	0.36	0.43
Acrylonitrile	0.63	0.45	0.28	0.40	0.19	-0.63	-0.30	-0.33
Benzene	0.08	0.09	0.11	0.11	0.10	0.30	-0.15	-0.13
Carbon Tetrachloride	0.34	0.27	0.27	0.27	0.12	-0.02	-0.29	-0.15
Formaldehyde	-0.12	-0.14	-0.21	-0.18	-0.27	-0.01	0.22	0.26
Tetrachloroethylene	NA							
<i>trans</i> -1,3-Dichloropropene	NA							
Nashville Site 2, Tennessee - LOTN								
1,3-Butadiene	0.12	0.04	-0.06	-0.02	-0.38	0.07	-0.11	-0.05
Acetaldehyde	0.08	0.05	-0.09	-0.03	-0.42	0.30	-0.06	0.12
Acetonitrile	-0.14	-0.09	-0.09	-0.09	-0.07	0.11	0.02	-0.24
Arsenic Compounds	0.12	0.16	0.09	0.14	-0.18	0.00	0.18	0.02
Benzene	0.15	0.09	0.05	0.06	-0.08	0.24	-0.01	0.26
Carbon Tetrachloride	0.17	0.19	0.16	0.18	-0.06	-0.04	-0.30	-0.52
Formaldehyde	0.75	0.77	0.69	0.74	-0.11	-0.19	0.04	0.34
Manganese Compounds	0.22	0.21	0.06	0.15	-0.39	-0.02	0.34	0.09
Tetrachloroethylene	0.02	0.06	0.11	0.08	0.17	-0.37	0.22	-0.07
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	0.36	0.32	0.27	0.29	-0.07	0.16	-0.04	0.31

Table 18-6. Motor Vehicle Information vs. Daily Concentration for the Tennessee Monitoring Sites

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicle per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
DITN	44,935	40,593	0.90	29,214	26,293	4,420	36.41 \pm 11.17
EATN	569,842	575,087	1.01	516,083	521,244	38,450	43.91 \pm 8.94
KITN	153,050	156,360	1.02	130,473	133,082	300	38.73 \pm 9.82
LDTN	41,624	41,458	1.00	46,750	46,750	13,360	48.45 \pm 8.35
LOTN	569,842	575,087	1.01	464,804	469,452	3,000	36.12 \pm 5.44

19.0 Site in Utah

This section presents meteorological, concentration, and spatial trends for the UATMP site in Utah (BTUT), located in Bountiful, just north of Salt Lake City. Figure 19-1 is a topographical map showing the monitoring site in its urban location. Figure 19-2 identifies facilities within 10 miles of the sites that reported to the 2002 NEI. The map shows that the nearby industrial facilities are involved in a variety of industries. The facilities are located mostly to the south and southwest. Hourly meteorological data were retrieved for all of 2004 at Salt Lake City International Airport's weather station (WBAN 24127) near the site for calculating correlations of meteorological data with ambient air concentration measurements.

Table 19-1 highlights the average UATMP concentration at the site, along with the temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*- components of the wind) for the entire year and on days samples were taken. The Salt Lake City area has a semi-arid continental climate, with large seasonal variations. The area is dry, located on the west side of the Wasatch Mountains, and the Great Salt Lake tends to have a moderating influence on the city's temperature. Moderate winds flow out of the southeast on average. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

19.1 Prevalent Compounds at the Utah Site

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at this site. Table 19-2 summarizes the cancer weighting scores and Table 19-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

Table 19-2 shows that many of the prevalent cancer compounds reflect the nationwide prevalent cancer compound list, which is listed in Section 3 of this report. However, this site

sampled metal compounds and SNMOC in addition to carbonyls and VOC. As a result, arsenic, beryllium, and cadmium compounds also appear in Table 19-2. For the noncancer compounds summarized in Table 19-3, many compounds detected were not listed among the nationwide noncancer list. However, the majority of the prevalent noncancer compounds at BTUT are also nationwide noncancer prevalent compounds. Only manganese compounds, arsenic compounds, and *trans*-1,3-dichloropropene are considered prevalent at BTUT but are not nationwide noncancer prevalent compounds.

Prevalent toxic compounds not detected at the Bountiful site were: *cis*-1,3-dichloropropene; 1,2-dichloroethane; 1,2-dichloropropane; bromomethane; vinyl chloride; chloroprene; and ethyl acrylate.

19.2 Toxicity Analysis

Acrylonitrile, benzene, and *p*-dichlorobenzene contributed to nearly 60% of the total cancer toxicity, although *p*-dichlorobenzene and acrylonitrile were detected fewer times than most of the prevalent cancer compounds. Arsenic compounds contributed to less than 12% of the site's total cancer toxicity, even though it was detected the most. Metal compounds account for 13% of the cancer toxicity at BTUT. Formaldehyde and acetaldehyde contributed to 51% of the noncancer toxicity, and were each detected 59 times. Benzene and total xylenes were each detected 60 times but together only account for less than 5% of the total noncancer toxicity. Metal compounds account for less than 15% of the noncancer toxicity at BTUT.

The acrylonitrile and *p*-dichlorobenzene cancer risk at BTUT were the highest at 30.14 and 18.52 in a million, respectively. For the compounds that may lead to adverse noncancer health effects, the average formaldehyde toxicity at BTUT was 0.51 (over 1 indicates a significant chance of a noncancer health effect). Of the 7 adverse health concentrations measured at the Utah site, four were formaldehyde, two were acetaldehyde, and one was arsenic compounds.

19.3 Meteorological and Concentration Averages at the Utah Site

Carbonyl compounds and VOC were measured at this site, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration at this site is presented in Table 19-1. Table 19-1 also lists the averages for selected meteorological parameters from January 2004 to December 2004, and for days on which samples were taken. This site also opted to have total and speciated nonmethane organic compounds (TNMOC/SNMOC) sampled during air toxic sampling. These compounds are of particular interest because of their role in ozone formation. Readers are encouraged to review EPA's *2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program, Final Report* (EPA, 2002) for more information on SNMOC/NMOC trends and concentrations. The average total NMOC value for BTUT was 187.02 ppbC, of which nearly 71% could be identified through speciation. Of the speciated compounds, propane measured the highest concentration (100.00 ppbC). This information can be found in Table 19-4. The Utah site opted to sample metal compounds in addition to carbonyls, VOC, and SNMOC. The average metal compound concentration is listed in Table 19-4.

Table 19-5 summarizes calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report.

Several of the compounds (1,3-butadiene, acrylonitrile, arsenic compounds, benzene, tetrachloroethylene, and total xylenes) exhibited moderately strong to strong negative correlations with average maximum temperature, average temperature, dew point, and wet bulb temperature. Interestingly, these same compounds had moderately strong to strong positive correlations with relative humidity (except tetrachloroethylene). Both 1,3-butadiene and benzene had strong positive correlations with sea level pressure (0.62 and 0.61, respectively). The strongest correlation with the wind components occurred between manganese compounds and the *v*-component of the wind (0.39). Pearson correlations could not be computed for *p*-dichlorobenzene due to the low number of detects (fewer than 4).

Figure 19-3 shows the composite back trajectory for the BTUT site for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in Figure 19-3, the back trajectories generally originated from a northwesterly or southerly direction from the site. Each circle around the site in Figure 19-3 represents 100 miles; 63% of the trajectories originated within 200 miles, and 92% within 400 miles from the BTUT site. The 24-hour airshed domain is somewhat smaller than other sites. Back trajectories originated less than 500 miles away.

19.4 Spatial Analysis

County-level vehicle registration and population in Davis County, UT, were obtained from the Utah State Tax Commission and the U.S. Census Bureau, and are summarized in Table 19-6. Table 19-6 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of the each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitor and the vehicle registration ratio. Table 19-6 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to the site on a daily basis. This information is compared to the average daily UATMP concentration at the Utah site in Table 19-6.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. BTUT resembles the roadside study, although its toluene-ethylbenzene ratio is higher, and its benzene-ethylbenzene and xylenes-ethylbenzene ratios are closer together.

BTUT sampled for SNMOC in addition to VOC and carbonyl compounds. Acetylene and ethylene are SNMOCs that are primarily emitted from mobile sources. Tunnel studies conducted on mobile source emissions have found that ethylene and acetylene are typically detected in a 1.7 to 1 ratio. For more information, please refer to Section 3.4.4. Listed in Table 19-4 is the ethylene-acetylene ratio for BTUT and what percent of the expected 1.7 ratio it represents. As shown, BTUT's ethylene-acetylene ratio is only within 50% of the expected

1.7 ratio (0.85). This would indicate that the emissions near BTUT may not be primarily from mobile sources.

19.5 NATTS Site Analysis

The Bountiful site is an EPA-designated NATTS site. A description of the NATTS program is provided in Section 3.6. A regulation analysis and an emission tracer analysis for each of the NATTS sites was conducted. Details on each type of analysis are also provided in Section 3.6.

19.5.1 Regulation Analysis

Table 3-10 summarizes the reduction of emissions that is expected from the promulgation of regulations applicable to facilities located within 10 miles of the monitoring site. This analysis includes only regulations implemented after 2002 (regulations implemented prior to 2003 would already be in effect at the time of the 2002 National Emissions Inventory and no further reduction would be expected). As indicated in Table 3-10, fifteen future regulations would be applicable to the facilities located within 10 miles of BTUT. Based on analysis, the regulations shown are expected to achieve an 11% reduction in emissions of carbonyl compounds, a 5% reduction of metal compounds, and a 10% reduction of VOC. Individual pollutant concentrations are expected to be reduced between less than 1% (beryllium compounds, chromium compounds, cobalt compound, benzene, and dichloromethane) and 64% (methyl methacrylate). These reductions are expected to occur over the next few years as the last compliance date for the applicable regulations is September 2007.

19.5.2 Emission Tracer Analysis

The highest acetaldehyde and formaldehyde noncancer toxicity scores were further examined. Figures 19-4 and 19-5 are the pollution roses for acetaldehyde and formaldehyde at BTUT. The highest concentration of acetaldehyde and formaldehyde occurred on August 31, 2004 and winds on that day point to possible emission sources southeast of the monitor. Figures 19-6 and 19-7 are back trajectory maps for this date, which shows air originating to the east of the monitor. Acetaldehyde and formaldehyde stationary emission sources near this site

and in the general direction of the back trajectory are also plotted in Figures 19-6 and 19-7. According to the 2002 NEI, there are no acetaldehyde stationary sources air would have passed over. There are a few formaldehyde sources air would have passed over prior to arriving at BTUT, and one in particular is very near the monitoring site.

The highest arsenic compound noncancer toxicity score was further examined. Figure 19-8 is the pollution rose for arsenic compounds at BTUT. The highest concentration of arsenic compounds occurred on February 15, 2004 and winds on that day point to possible emission sources south of the monitor. Figure 19-9 is the back trajectory map for this date, which shows air originating to the south and southwest of the monitor. Arsenic compound stationary emission sources near this site and in the general direction of the back trajectory are also plotted in Figure 19-9. According to the 2002 NEI, there are several arsenic compound sources air would have likely passed over.

19.6 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

19.6.1 Site-Specific Trends Analyses

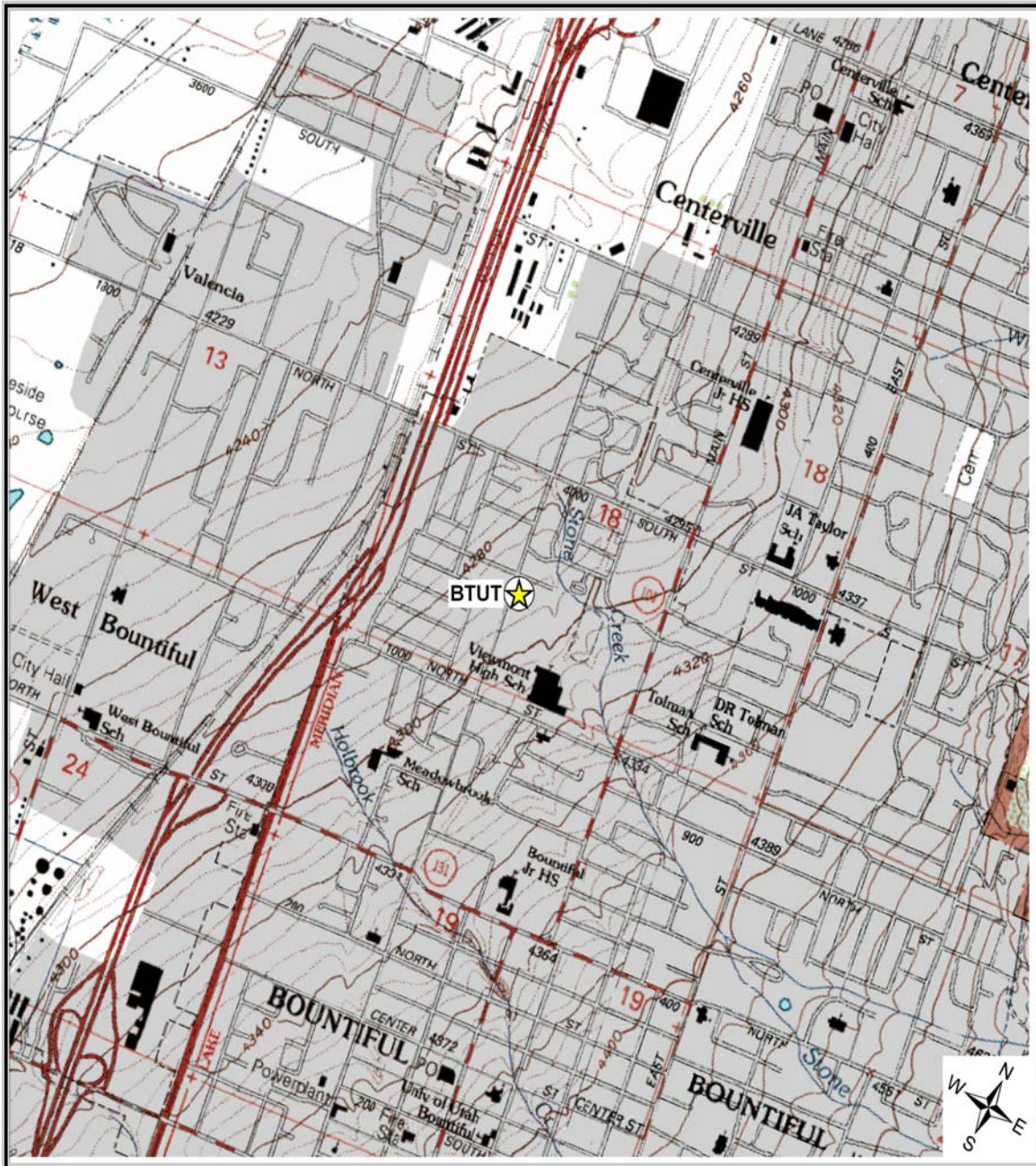
BTUT has been a participant in the UATMP since 2003. Therefore, a site-specific trends analysis was not conducted.

19.6.2 MSA-Specific Trends Analyses

BTUT resides in the Ogden-Clearfield, UT MSA. The Ogden MSA has experienced a 33.3% increase in population and a 149.8% increase in vehicle miles traveled (VMT) from 1990 to 2003. VOC and carbonyl compound emissions have decreased between 5% and 60% respectively, between 1990 and 2002. While mercury emissions have decreased over 50% over

the period, cadmium emissions have changed little, and lead emissions have increased over 53%. The 2004 concentrations of these compounds, calculated from the UATMP site representing this MSA (BTUT), have either decreased significantly or remained unchanged compared to the 2002-2003 time period. Trends for these and other compounds of interest can be found in Table 3-13. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

Figure 19-1. Bountiful, Utah (BTUT) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 19-2. Facilities Located Within 10 Miles of BTUT

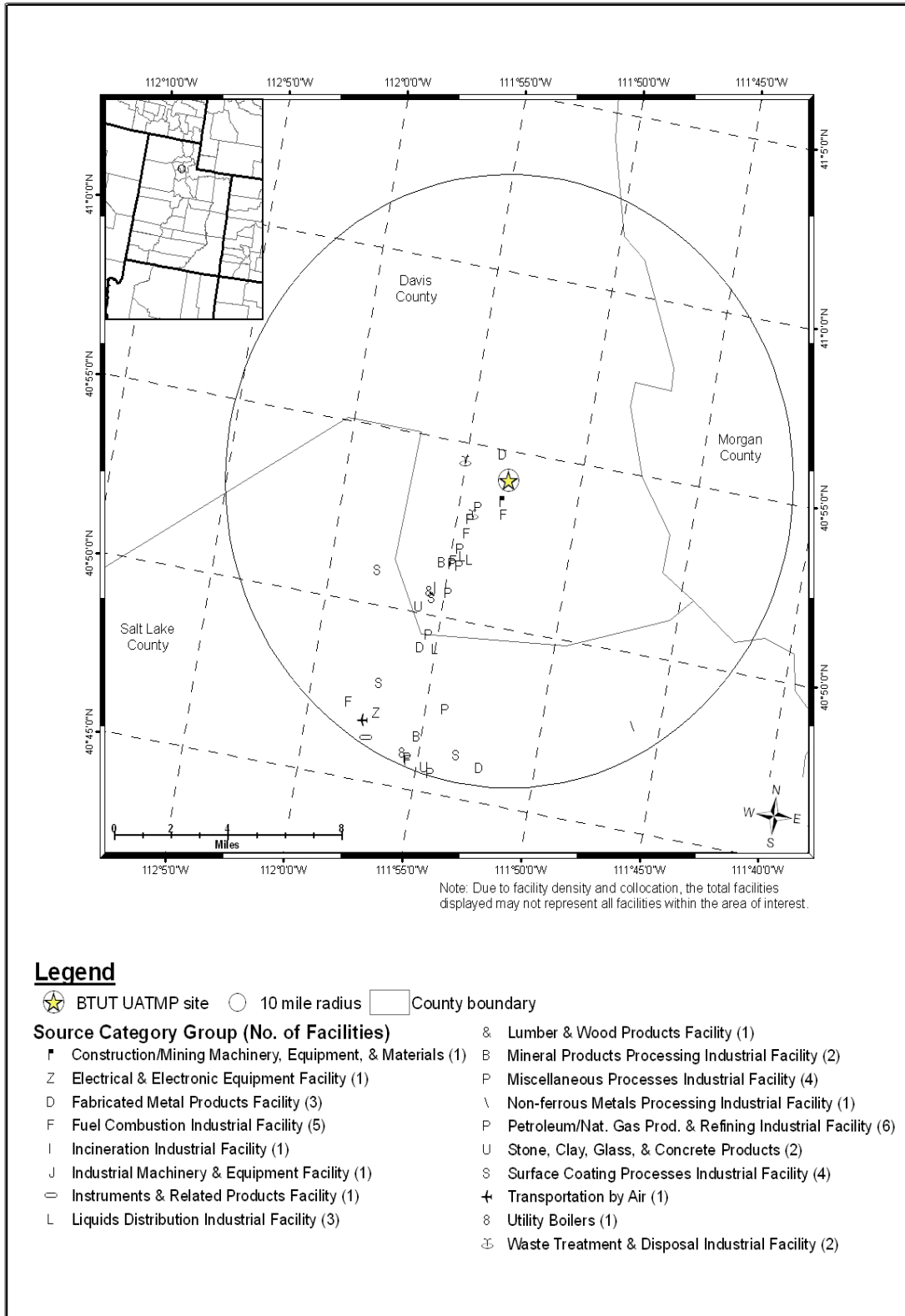


Figure 19-3. Composite Back Trajectory Map for BTUT

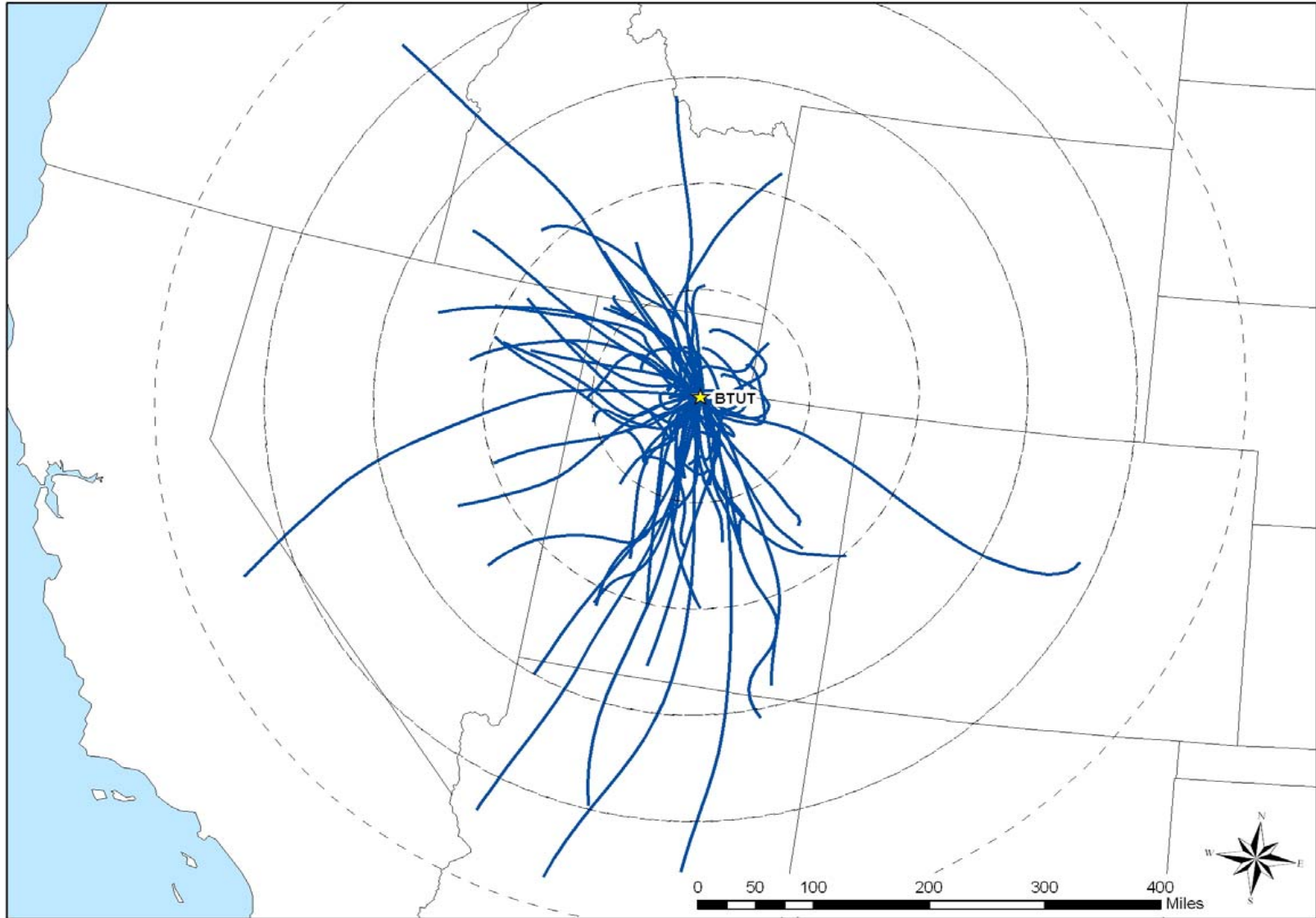


Figure 19-4. Acetaldehyde Pollution Rose for BTUT

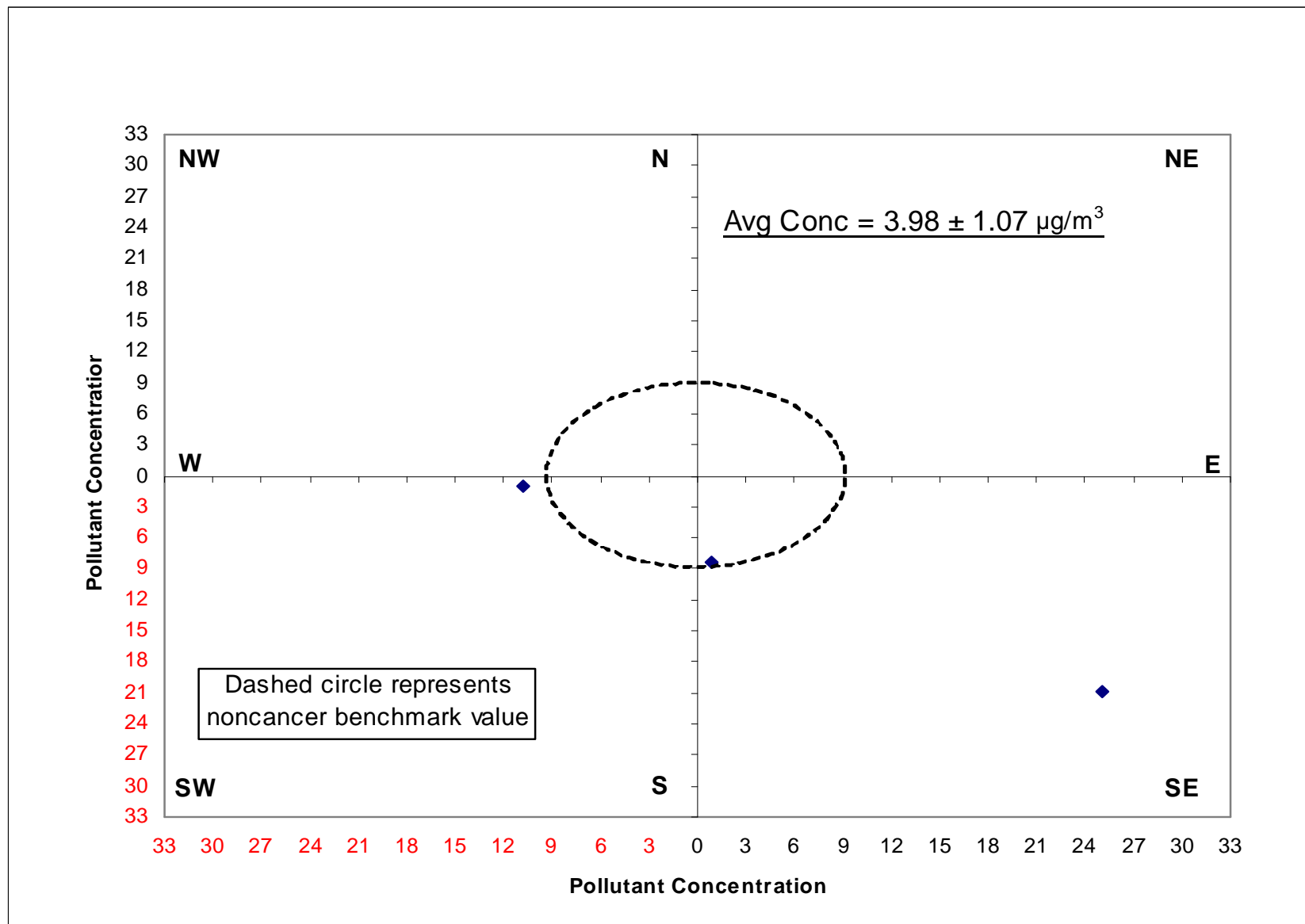


Figure 19-5. Formaldehyde Pollution Rose for BTUT

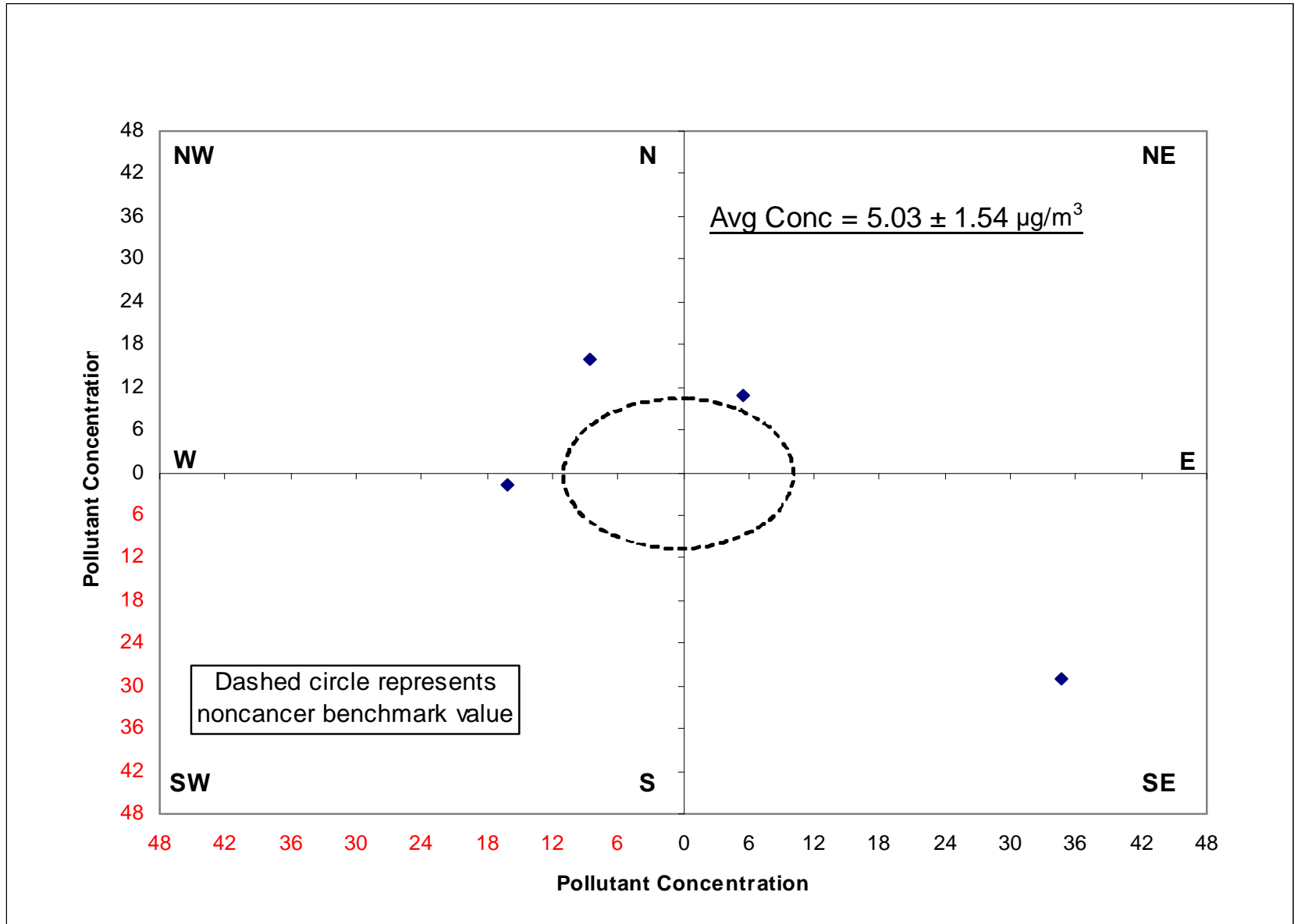
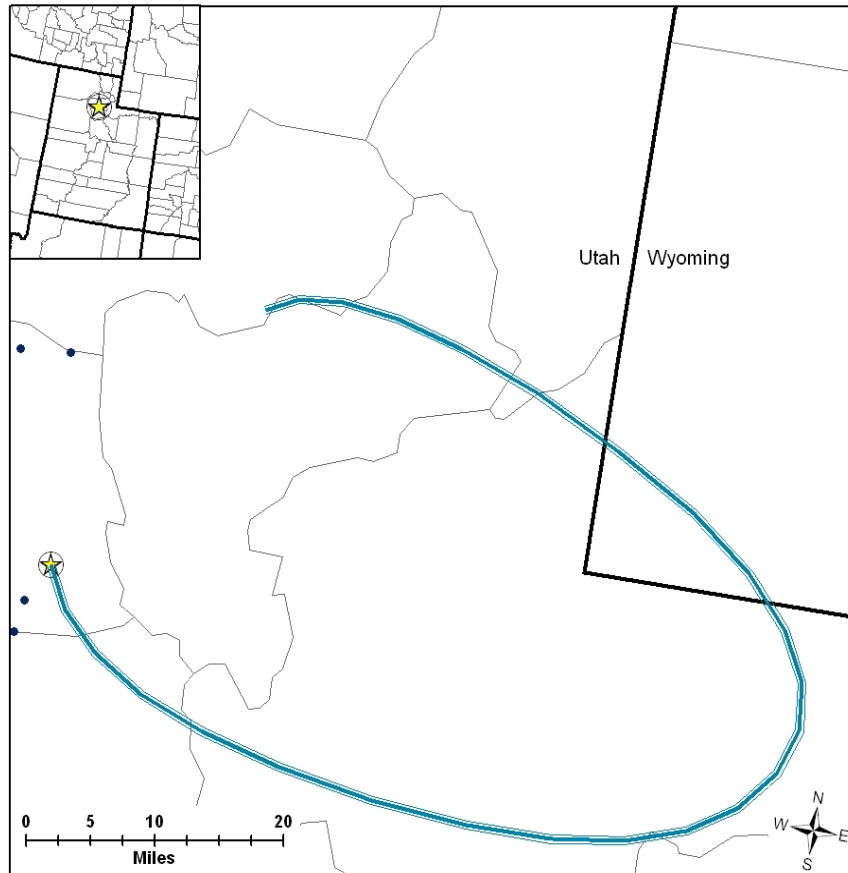


Figure 19-6. Acetaldehyde Sources Along the August 31, 2004 Back Trajectory at BTUT

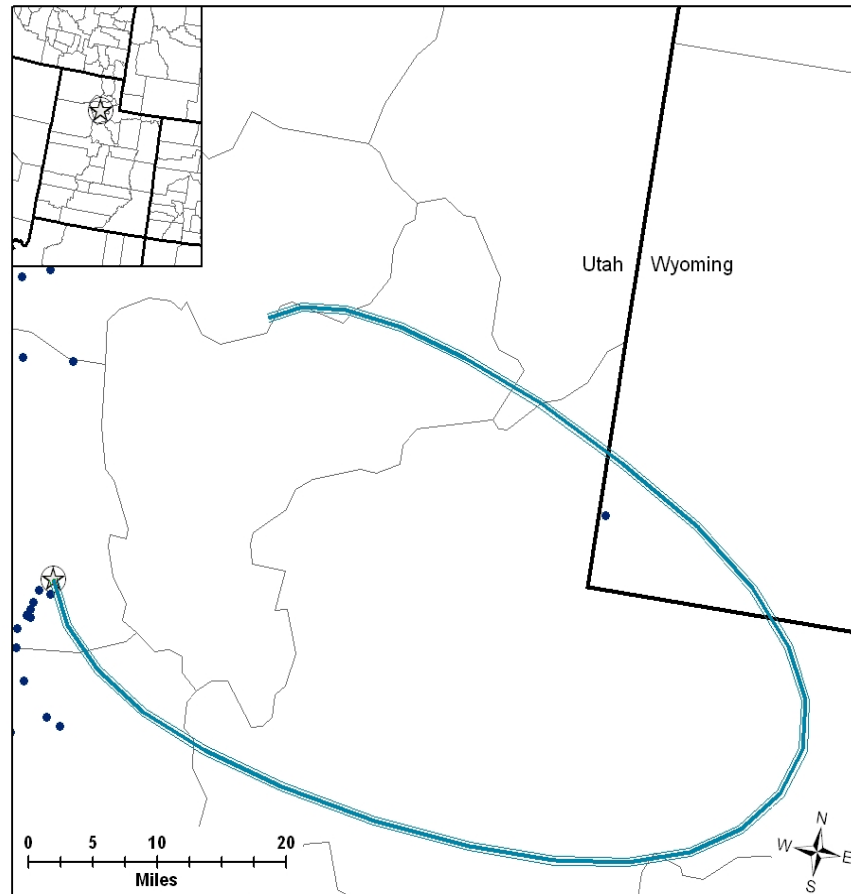


Note: Due to facility density and collocation, the total facilities displayed may not represent all facilities within the area of interest.

Legend

- ★ BTUT UATMP site
- Facilities emitting Acetaldehyde
- 24 Hour Back Trajectory 8/31/04
- County boundary
- State boundary

Figure 19-7. Formaldehyde Sources Along the August 31, 2004 Back Trajectory at BTUT



Note: Due to facility density and collocation, the total facilities displayed may not represent all facilities within the area of interest.

Legend

- ☆ BTUT UATMP site
- Facilities emitting Formaldehyde
- 24 Hour Back Trajectory 8/31/04
- County boundary
- State boundary

Figure 19-8. Arsenic Compound Pollution Rose for BTUT

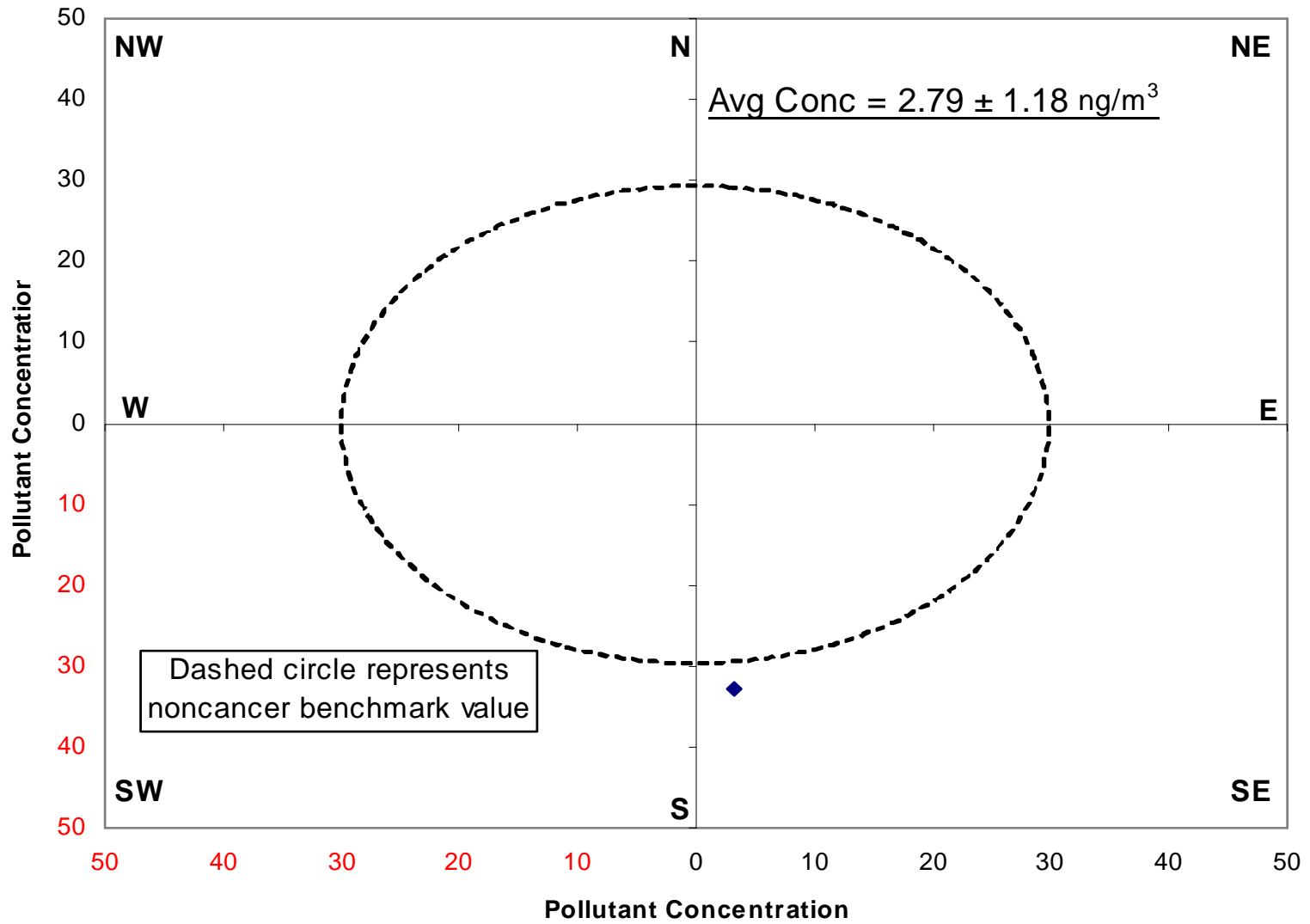


Figure 19-9. Arsenic Compound Sources Along the December 5, 2004 Back Trajectory

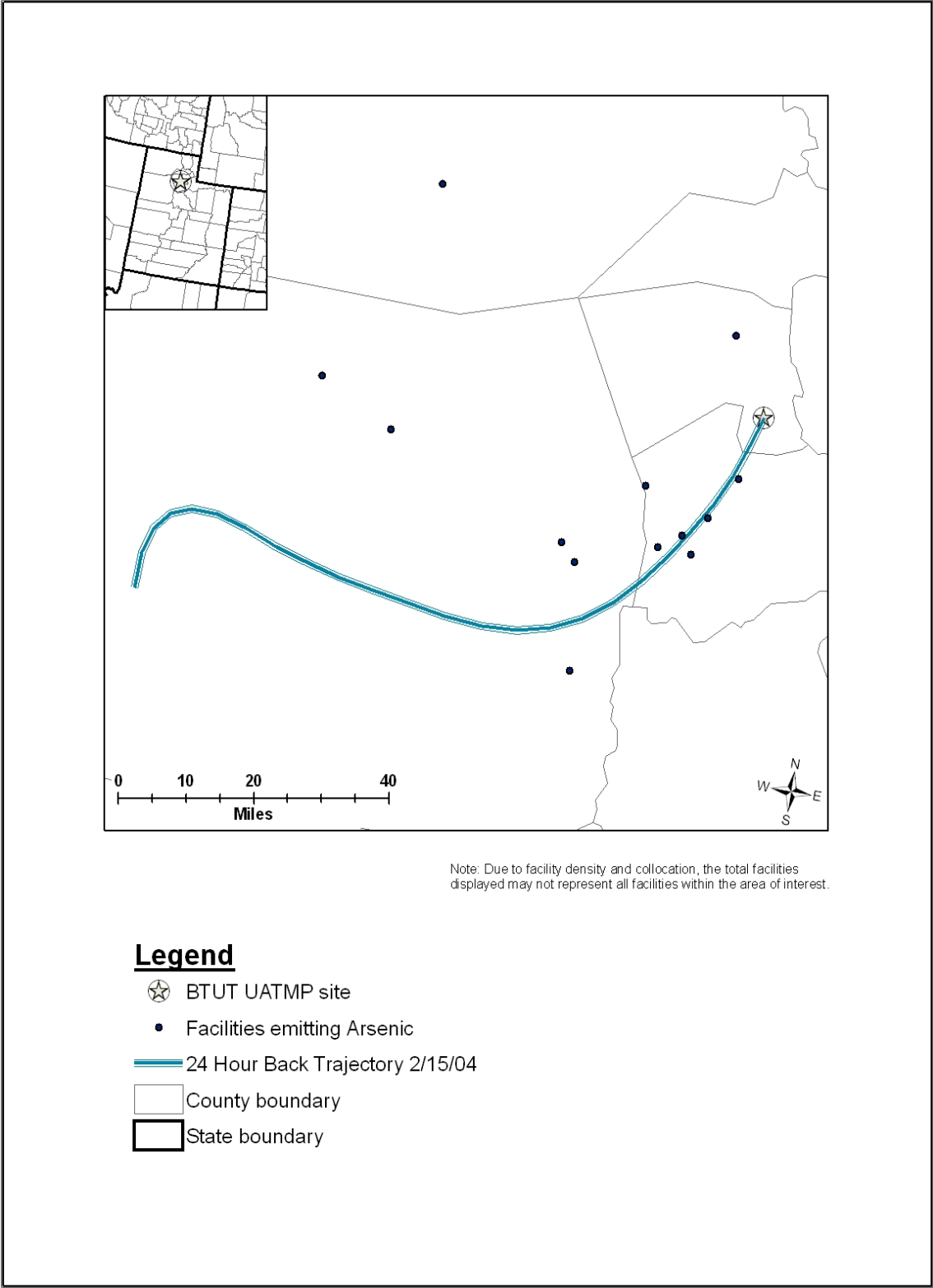


Table 19-1. Average Concentration and Meteorological Parameters for the Site in Utah

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
BTUT	All 2004	/ / / / / / / /	61.67 (± 2.26)	52.29 (± 1.98)	32.93 (± 1.01)	42.43 (± 1.32)	55.58 (± 2.18)	1015.84 (± 0.83)	-0.57 (± 0.25)	1.46 (± 0.44)
	sample day	44.30 (± 7.58)	61.79 (± 5.46)	52.65 (± 4.73)	33.89 (± 2.43)	42.95 (± 3.17)	56.48 (± 5.02)	1015.25 (± 2.04)	-0.07 (± 7.58)	0.63 (± 0.91)

Table 19-2. Summary of the Toxic Cancer Compounds at the Bountiful, Utah Monitoring Site - BTUT

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Acrylonitrile	3.01 E-05	28.60	28.60	0.44	12	30.14
<i>p</i> -Dichlorobenzene	1.85 E-05	17.57	46.17	1.68	1	18.52
Benzene	1.31 E-05	12.39	58.56	1.67	60	13.05
Arsenic Compounds	1.20 E-05	11.39	69.95	<0.00	63	12.00
Acetaldehyde	8.75 E-06	8.30	78.25	3.98	59	8.75
Carbon Tetrachloride	8.05 E-06	7.64	85.89	0.54	51	8.05
1,3-Butadiene	8.05 E-06	7.64	93.52	0.27	17	8.05
Tetrachloroethylene	4.59 E-06	4.36	97.88	0.78	8	4.59
<i>trans</i> -1,3-Dichloropropene	1.63 E-06	1.55	99.43	0.41	1	1.63
Cadmium Compounds	3.08 E-07	0.29	99.72	<0.00	49	0.31
Dichloromethane	2.22 E-07	0.21	99.93	0.47	32	0.22
Beryllium Compounds	4.27 E-08	0.04	99.97	<0.00	29	0.04
Formaldehyde	2.77 E-08	0.03	100.00	5.03	59	0.03

Table 19-3. Summary of the Toxic Noncancer Compounds at the Bountiful, Utah Monitoring Site - BTUT

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m ³)	# Detects	Adverse Health Concentrations
Formaldehyde	5.14 E-01	27.52	27.52	5.03	59	4
Acetaldehyde	4.42 E-01	23.67	51.19	3.98	59	2
Acrylonitrile	2.22 E-01	11.87	63.06	0.44	12	0
Manganese Compounds	1.79 E-01	9.60	72.66	0.01	63	0
1,3-Butadiene	1.24 E-01	6.66	79.33	0.25	17	0
Arsenic Compounds	9.30 E-02	4.98	84.31	<0.00	63	1
Acetonitrile	9.07 E-02	4.86	89.17	5.44	18	0
Benzene	5.58 E-02	2.99	92.16	1.67	60	0
Xylenes	4.03 E-02	2.16	94.32	4.03	60	0
<i>trans</i> -1,3-Dichloropropene	2.04 E-02	1.09	95.41	0.41	1	0
Chloromethane	1.40 E-02	0.75	96.17	1.26	60	0
Carbon Tetrachloride	1.34 E-02	0.72	96.88	0.54	51	0
Nickel Compounds	1.16 E-02	0.62	97.50	<0.00	63	0
Toluene	1.07 E-02	0.57	98.08	4.29	60	0
<i>n</i> -Hexane	1.06 E-02	0.57	98.64	2.11	60	0
Cadmium Compounds	8.55 E-03	0.46	99.10	<0.00	49	0
Lead Compounds	4.42 E-03	0.24	99.34	0.01	63	0
Tetrachloroethylene	2.88 E-03	0.15	99.49	0.78	8	0
<i>p</i> -Dichlorobenzene	2.10 E-03	0.11	99.61	1.68	1	0
Chloroform	2.01 E-03	0.11	99.71	0.20	1	0
Cobalt Compounds	1.87 E-03	0.10	99.81	<0.00	58	0
Beryllium Compounds	8.89 E-04	0.05	99.86	<0.00	29	0
Ethylbenzene	6.62 E-04	0.04	99.90	0.66	59	0
Dichloromethane	4.73 E-04	0.03	99.92	0.47	32	0
Methyl Ethyl Ketone	4.38 E-04	0.02	99.95	2.19	48	0
Styrene	4.33 E-04	0.02	99.97	0.43	41	0
1,1,1-Trichloroethane	2.73 E-04	0.01	99.98	0.27	1	0
Methyl Isobutyl Ketone	1.87 E-04	0.01	99.99	0.56	3	0

Table 19-3. Summary of the Toxic Noncancer Compounds at the Bountiful, Utah Monitoring Site - BTUT (Cont.)

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Mercury Compounds	5.80 E-05	0.00	100.00	<0.00	4	0
Selenium Compounds	1.42 E-04	0.00	100.00	<0.00	49	0

Table 19-4. TNMOC and Metal Compounds Measured by the Bountiful, Utah (BTUT) Monitoring Site

Site	Average Metals Concentration (ng/m³)	Average TNMOC speciated (ppbC)	Average TNMOC w/ unknown (ppbC)	% TNMOC Identified	SNMOC Compound with the Highest Concentration (ppbC)	Ethylene to Acetylene Ratio	% of Expected Ratio
BTUT	26.93	132.70	187.02	71%	Propane (100.00)	0.85	50%

Table 19-5. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Bountiful, Utah Site (BTUT)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
1,3-Butadiene	-0.40	-0.44	-0.47	-0.47	0.30	0.62	0.11	-0.17
Acetaldehyde	0.18	0.15	-0.05	0.08	-0.21	0.08	-0.09	-0.03
Acetonitrile	0.34	0.34	0.16	0.26	-0.36	-0.07	0.02	-0.01
Acrylonitrile	-0.43	-0.44	-0.44	-0.46	0.39	0.29	0.04	-0.10
Arsenic Compounds	-0.38	-0.41	-0.40	-0.43	0.34	0.37	0.07	-0.09
Benzene	-0.59	-0.61	-0.54	-0.62	0.58	0.61	0.22	-0.23
Carbon Tetrachloride	0.06	0.04	0.05	0.03	0.03	0.08	-0.02	0.09
Formaldehyde	0.25	0.22	0.04	0.16	-0.26	-0.01	-0.07	-0.04
Manganese Compounds	0.46	0.46	0.25	0.39	-0.46	-0.30	-0.24	0.39
<i>p</i> -Dichlorobenzene	NA							
Tetrachloroethylene	-0.34	-0.35	-0.70	-0.48	0.10	-0.14	0.01	-0.26
<i>trans</i> -1,3-Dichloropropene	NA							
Xylenes	-0.41	-0.43	-0.40	-0.45	0.40	0.38	0.16	-0.18

Table 19-6. Motor Vehicle Information vs. Daily Concentration for the Utah Monitoring Site

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicles per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
BTUT	255,597	182,209	0.71	243,462	172,858	33,310	44.30 \pm 7.58

20.0 Site in Wisconsin

This section presents meteorological, concentration, and spatial trends for the UATMP site in Wisconsin (MAWI), located in Madison. Figure 20-1 is a topographical map showing the monitoring site in its urban location. Figure 20-2 identifies facilities within ten miles of the sites that reported to the 2002 NEI. The map shows that nearby industrial facilities, of which the majority are fuel combustion facilities, are scattered around the monitor. Hourly meteorological data were retrieved for all of 2004 at Dane County Regional Traux Field Airport's weather station (WBAN 14837) near the site for calculating correlations of meteorological data with ambient air concentration measurements.

Table 20-1 highlights the average UATMP concentration at the site, along with the temperature (average maximum and average), moisture (average dew point temperature, average wet-bulb temperature, and average relative humidity), pressure (average sea level pressure), and wind information (average *u*- and *v*- components of the wind) for the entire year and on days samples were taken. Madison is wedged between Lake Mendota and Lake Monona, in south-central Wisconsin. Its Great Lakes location ensures that the area experiences frequent weather systems, fairly typical of a continental climate. Temperatures can fluctuate drastically with potent weather systems, and the frozen lakes offer little moderating effects in the winter. Spring and summer tend to bring the most precipitation, but Madison receives its fair share of snow. Average wind direction depends on season. Summer and fall tend to bring southerly winds, while northwesterly winds are mostly common in the winter and spring. This information can be found in The Weather Almanac, fifth edition (Ruffner and Bair, 1987).

20.1 Prevalent Compounds at the Wisconsin Site

Using the toxicity weighting factors (URE and RfC), cancer and noncancer weighting scores were computed for each compound at this site. Table 20-2 summarizes the cancer weighting scores and Table 20-3 summarizes the noncancer weighting scores. For a compound to be considered prevalent at a site, its toxicity score must contribute to the top 95% of the total site score. In the aforementioned tables, compounds that are shaded are considered prevalent for each site.

Table 20-2 shows that all of the prevalent cancer compounds for MAWI reflect the nationwide prevalent cancer compound list, which is listed in Section 3 of this report. For the noncancer compounds summarized in Table 20-3, only two of the prevalent noncancer compounds for MAWI were not listed among the nationwide noncancer prevalent list (chloromethane and carbon tetrachloride).

Nationwide prevalent toxic compounds not detected at the Madison site were: acrylonitrile; 1,2-dichloroethane; *p*-dichlorobenzene; 1,2-dichloropropane; ethyl acrylate; vinyl chloride; *cis*-1,3-dichloropropane; acetonitrile; bromomethane; and chloroprene.

20.2 Toxicity Analysis

Of the prevalent cancer compounds, carbon tetrachloride and benzene contributed most to the site's total cancer toxicity, and were each detected fifteen times at MAWI. Concentrations of 1,3-butadiene contributed to nearly 15% of the total toxicity, although it was detected only once. The carbon tetrachloride and benzene cancer risks at MAWI were two to three times higher than for the remaining cancer compounds (16.9 and 12.2 in a million, respectively).

Of the prevalent noncancer compounds, acetaldehyde, formaldehyde, and 1,3-butadiene contributed to nearly 75% of the site's total noncancer toxicity. While acetaldehyde and formaldehyde were each detected fourteen times at MAWI, 1,3-butadiene was only detected once. No adverse health concentrations were measured at MAWI.

20.3 Meteorological and Concentration Averages at the Wisconsin Site

Carbonyl compounds and VOC were measured at this site, as indicated in Tables 3-3 and 3-4. The average total UATMP daily concentration at this site is presented in Table 20-1. Table 20-1 also lists the averages for selected meteorological parameters from January 2004 to December 2004, and for days on which sampling occurred.

Table 20-4 summarizes calculated Pearson Correlation coefficients for each of the prevalent compounds and selected meteorological parameters. Identification of the prevalent compounds is discussed in Section 3 of this report.

A low number of detects can lead to unusually high correlations, therefore, tetrachloroethylene and 1,3-butadiene's correlations will not be considered here. Chloromethane had the strongest correlations with the temperature parameters (0.86 and 0.87). All of the compounds exhibited positive correlations with the temperature parameters, which indicates that concentrations of the prevalent compounds tend to increase as temperature increases.

Both carbon tetrachloride and chloromethane exhibited strong to very strong correlations with the dew point temperature and the wet bulb temperature. In fact, all of the compounds had positive correlations with these two parameters, indicating that as the amount of moisture in the atmosphere increases, concentration increases as well. However, this trend does not hold true with the relative humidity.

Acetaldehyde had the strongest correlation with the u -component of the wind (-0.50) while chloromethane had the strongest correlation with the v -component of the wind (0.41). Interestingly, all of the correlations between the u -component of the wind and the prevalent compounds are negative, while all of the correlations with the v -component of the wind and the prevalent compounds are positive. This indicates that concentrations increase as winds increase out of the north or south, and decrease as winds increase from the east or west. Chloromethane and carbon tetrachloride also had the strongest correlations with the sea level pressure (-0.58 and -0.42, respectively). However, all the remaining correlations were moderate and positive.

Figure 20-3 shows the composite back trajectory for the MAWI site for the days on which sampling occurred. Each line represents the 24-hour trajectory along which a parcel of air traveled toward the monitoring site on a sampling day. As shown in Figure 20-3, the back trajectories originated predominantly from the west, northwest, and north of the site. Each circle around the site in Figure 20-3 represents 100 miles; 53% of the trajectories originated within

400 miles, and 93% within 700 miles from the MAWI site. The 24-hour airshed domain is large. Back trajectories originated over 700 miles away.

20.4 Spatial Analysis

County-level vehicle registration and population in Dane County, WI, were obtained from the Wisconsin Department of Transportation and the U.S. Census Bureau, and are summarized in Table 20-6. Table 20-6 also includes a vehicle registration to county population ratio (vehicles per person). In addition, the population within 10 miles of the each site is presented. An estimation of 10-mile vehicle registration was computed using the 10-mile population surrounding the monitors and the vehicle registration ratio. Table 20-6 also contains traffic information, which represents the average number of cars passing the monitoring sites on the nearest roadway to the site on a daily basis. This information is compared to the average daily UATMP concentration at the Wisconsin site in Table 20-6.

Figure 3-2 depicts the average concentration ratios of the roadside study and compares them to the concentration ratios at each of the monitoring sites. At MAWI, the toluene-ethylbenzene ratio is the highest, like that of the roadside study. However, the benzene-ethylbenzene ratio is higher than the xylenes-ethylbenzene ratio, unlike those of the roadside study. Also, the difference between these two ratios is much less than it is for the roadside study.

20.5 Trends Analysis

For sites that participated in the UATMP prior to 2003 and are still participating in the 2004 program year (i.e., minimum 3 years), a site-specific trends analysis was conducted. Details on how this analysis was conducted can be found in Section 3.8. For sites that are located in metropolitan statistical areas (MSAs), an MSA-specific trends analysis was performed. Details on this analysis are discussed in Section 3.9.

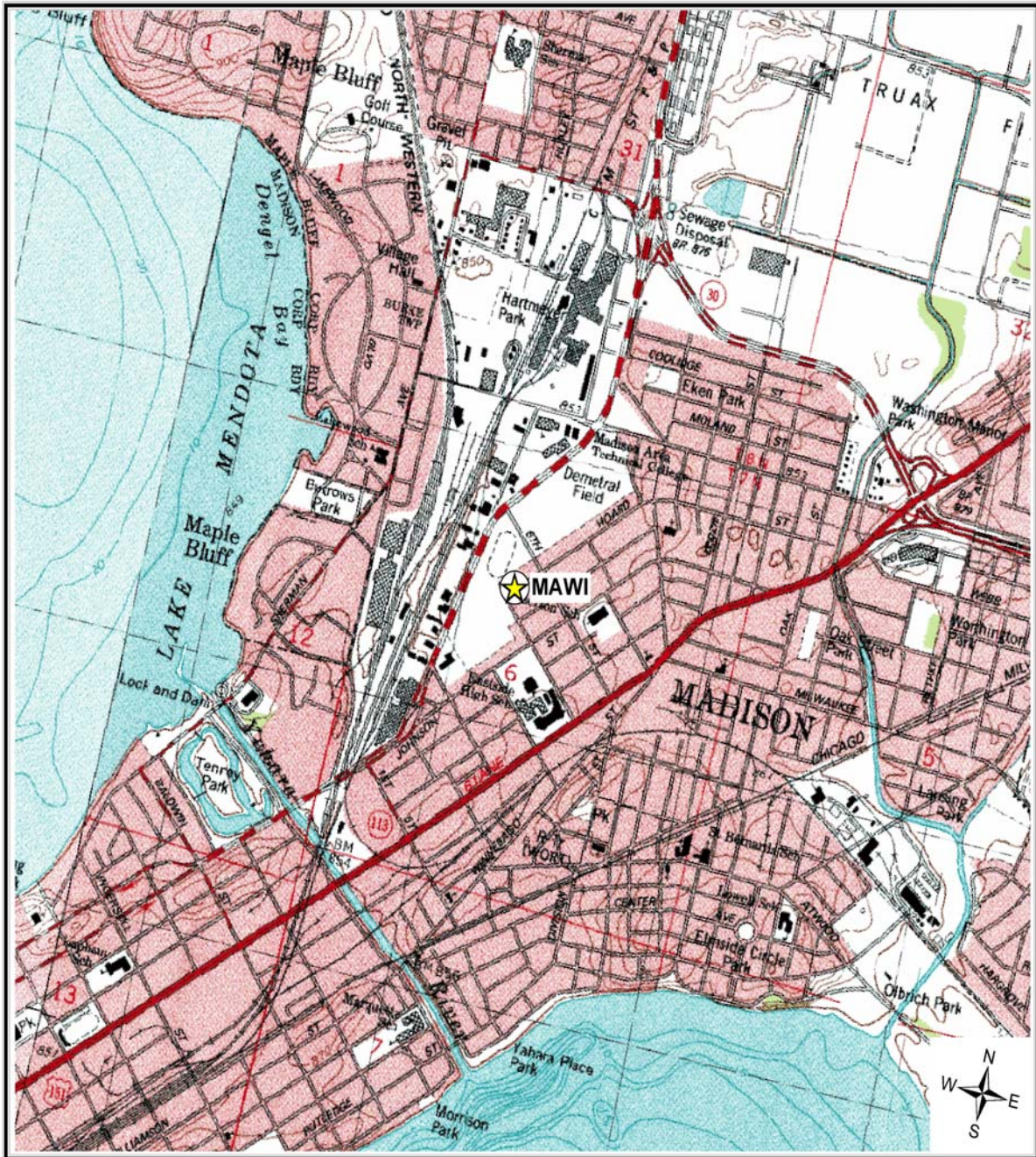
20.5.1 Site-Specific Trends Analyses

MAWI is new to the UATMP this year. Therefore, a site-specific trends analysis was not conducted.

20.5.2 MSA-Specific Trends Analyses

MAWI resides in the Madison, WI MSA. The Madison, WI MSA has experienced a 21.8% increase in population and a 82.5% increase in vehicle miles traveled (VMT) from 1990 to 2003. Carbonyl and VOC emissions have decreased between 1990 and 2003, ranging from a 19% and 63% decrease. Although 1990-1994 concentrations are not available, VOC and carbonyl concentrations decrease slightly between 2002-2003 and 2004, with the exception of acetaldehyde and formaldehyde, based on the UATMP site representing the Madison MSA (MAWI). Carbonyl compound concentrations tend to be unchanged. Trends for these and other compounds of interest can be found in Table 3-13. This MSA does not participate in either the winter oxygenated program or the reformulated gasoline program.

Figure 20-1. Madison, Wisconsin (MAWI) Monitoring Site



Source: USGS 7.5 Minute Series. Map Scale: 1:24,000.

Figure 20-2. Facilities Located Within 10 Miles of MAWI

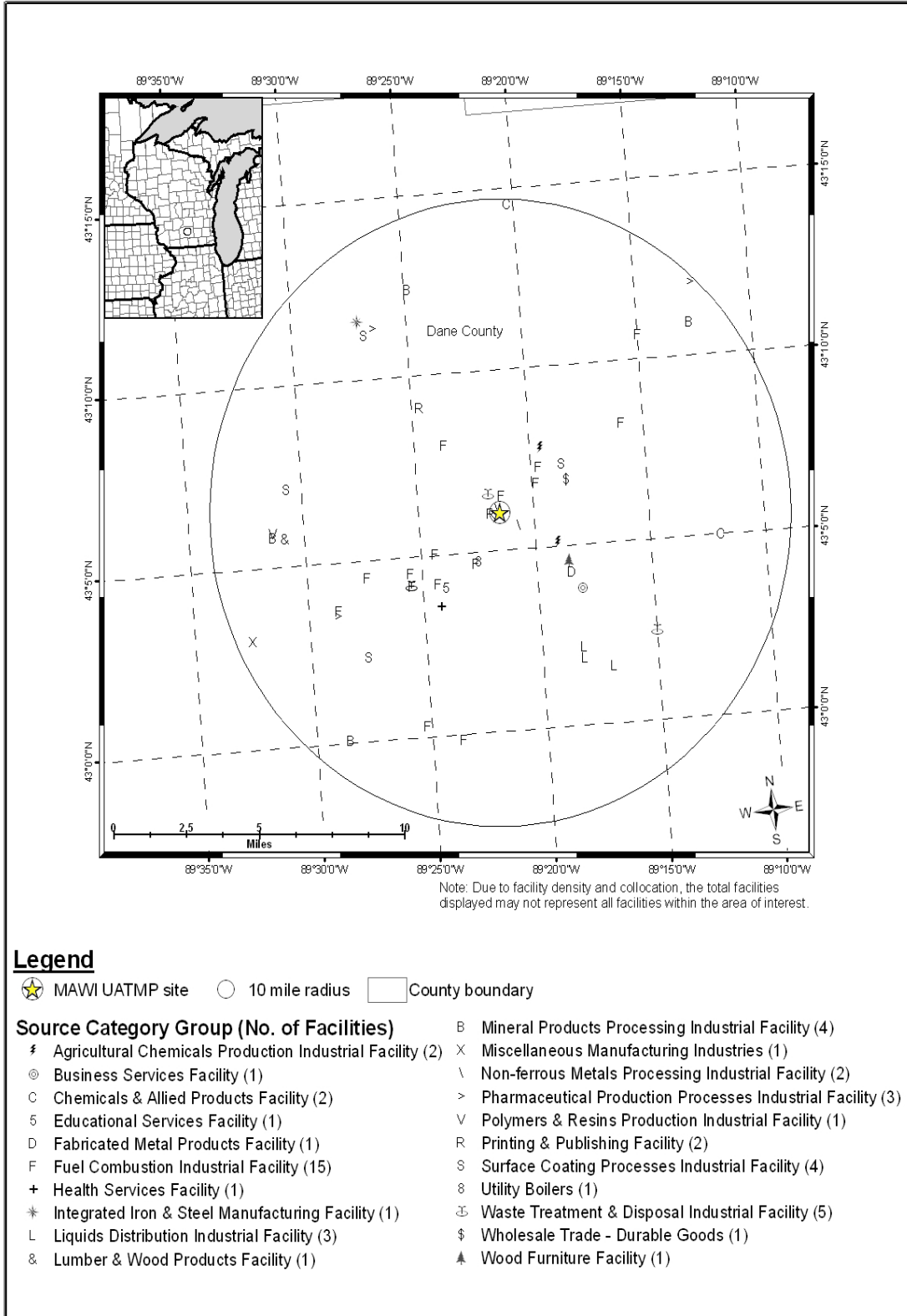


Figure 20-3. Composite Back Trajectory Map for MAWI

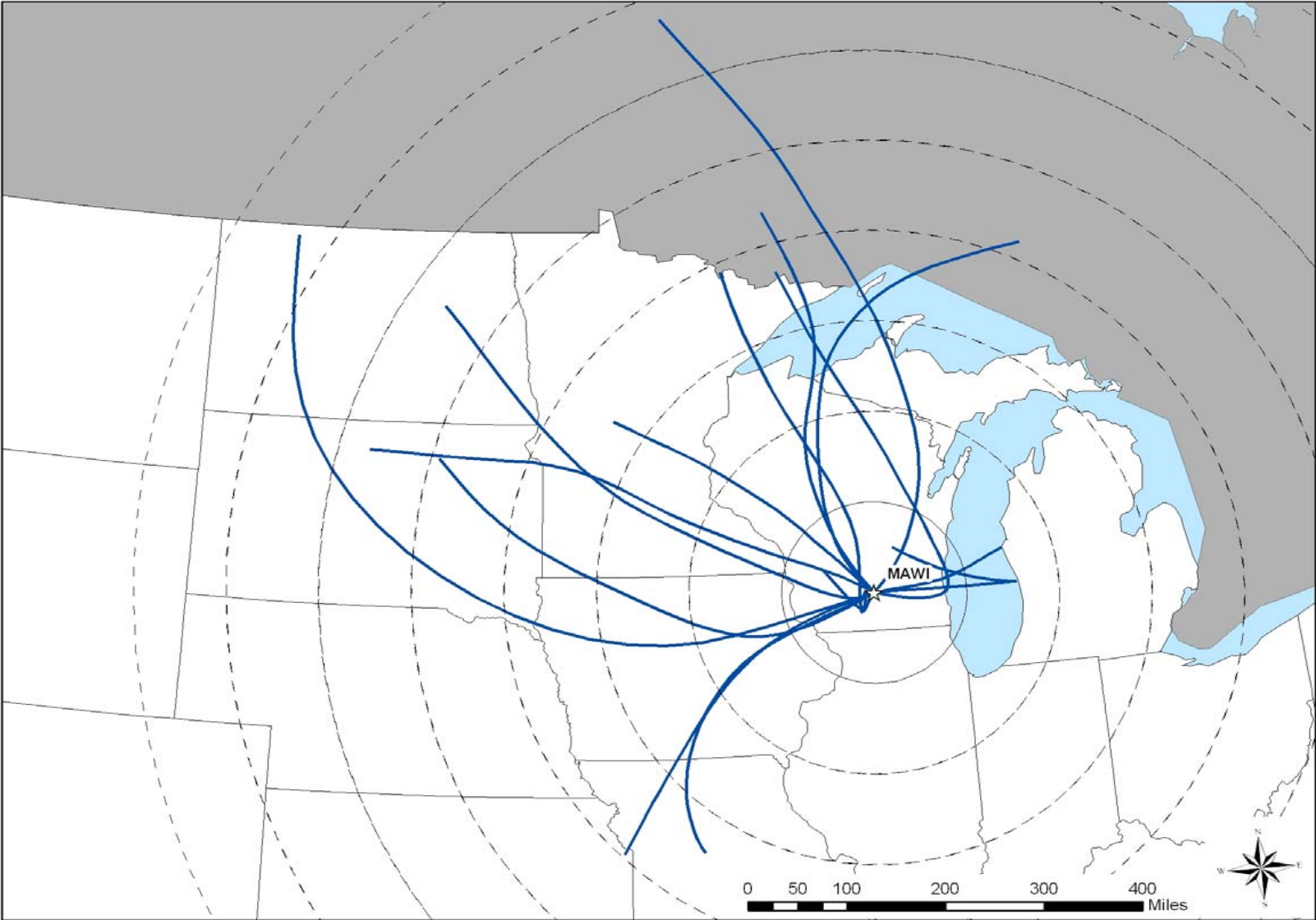


Table 20-1. Average Concentration and Meteorological Parameters for the Site in Wisconsin

Site Name	Type	Average UATMP Concentration ($\mu\text{g}/\text{m}^3$)	Average Maximum Temperature ($^{\circ}\text{F}$)	Average Temperature ($^{\circ}\text{F}$)	Average Dewpoint Temperature ($^{\circ}\text{F}$)	Average Wet Bulb Temperature ($^{\circ}\text{F}$)	Average Relative Humidity (%)	Average Sea Level Pressure (mb)	Average <i>u</i> -component of the Wind (kts)	Average <i>v</i> -component of the Wind (kts)
MAWI	All 2004	/ / / / / / / /	55.89 (± 2.11)	47.56 (± 1.98)	37.84 (± 2.01)	43.10 (± 1.85)	71.37 (± 1.20)	1017.28 (± 0.74)	0.66 (± 0.40)	0.60 (± 0.47)
	sample day	29.49 (± 4.25)	47.67 (± 8.28)	39.50 (± 7.28)	29.99 (± 7.16)	35.61 (± 6.71)	70.82 (± 5.85)	1017.90 (± 4.16)	1.24 (± 2.30)	-00.39 (± 1.93)

Table 20-2. Summary of the Toxic Cancer Compounds at the Madison, Wisconsin Monitoring Site - MAWI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Cancer Risk (Out of 1 Million)
Carbon Tetrachloride	1.69 E-05	42.37	42.37	1.12	15	16.9
Benzene	1.22 E-05	30.74	73.11	1.57	15	12.2
1,3-Butadiene	5.75 E-06	14.45	87.57	0.19	1	5.75
Acetaldehyde	2.57 E-06	6.45	94.02	1.17	14	2.57
Tetrachloroethylene	2.13 E-06	5.36	99.38	0.36	3	2.13
Dichloromethane	2.39 E-07	0.60	99.98	0.51	7	0.24
Formaldehyde	6.60 E-09	0.02	100.00	1.20	14	0.01

Table 20-3. Summary of the Toxic Noncancer Compounds at the Madison, Wisconsin Monitoring Site - MAWI

Compound	Average Toxicity	% Contribution	Cumulative % Contribution	Average Concentration (µg/m³)	# Detects	Adverse Health Concentrations
Acetaldehyde	1.30 E-01	26.28	26.28	1.17	14	0
Formaldehyde	1.22 E-01	24.81	51.10	1.20	14	0
1,3-Butadiene	9.59 E-02	19.42	70.52	0.19	1	0
Benzene	5.23 E-02	10.59	81.11	1.57	15	0
Xylenes	3.26 E-02	6.60	87.71	3.26	15	0
Carbon Tetrachloride	2.81 E-02	5.69	93.40	1.12	15	0
Chloromethane	1.91 E-02	3.86	97.27	1.72	15	0
Toluene	7.36 E-03	1.49	98.76	2.95	15	0
Chloroform	2.01 E-03	0.41	99.16	0.20	1	0
Tetrachloroethylene	1.34 E-03	0.27	99.44	0.36	3	0
1,1,1-Trichloroethane	1.17 E-03	0.24	99.67	1.17	14	0
Ethylbenzene	5.41 E-04	0.11	99.78	0.54	15	0
Dichloromethane	5.07 E-04	0.10	99.88	0.51	7	0
Styrene	2.27 E-04	0.05	99.93	0.23	3	0
Methyl Ethyl Ketone	2.14 E-04	0.04	99.97	1.07	8	0
Methyl Isobutyl Ketone	1.30 E-04	0.03	100.00	0.39	1	0

Table 20-4. Prevalent Compound Concentration Correlations with Selected Meteorological Parameters at the Madison, Wisconsin Site (MAWI)

Compound	Maximum Temperature	Average Temperature	Dew Point Temperature	Wet Bulb Temperature	Relative Humidity	Sea Level Pressure	<i>u</i>-component of wind	<i>v</i>-component of wind
1,3-Butadiene	NA							
Acetaldehyde	0.36	0.31	0.33	0.31	0.23	0.11	-0.50	0.10
Benzene	0.13	0.12	0.18	0.14	0.24	0.33	-0.29	0.06
Carbon Tetrachloride	0.55	0.58	0.55	0.58	-0.05	-0.42	-0.15	0.24
Chloromethane	0.86	0.87	0.75	0.84	-0.25	-0.58	-0.00	0.41
Formaldehyde	0.28	0.22	0.16	0.19	-0.08	0.25	-0.36	0.10
Tetrachloroethylene	NA							
Xylenes	0.34	0.31	0.33	0.31	0.14	0.28	-0.36	0.05

Table 20-5. Motor Vehicle Information vs. Daily Concentration for the Wisconsin Monitoring Site

Monitoring Site	Estimated County Population	Estimated County Number of Vehicles Owned	Vehicle per Person (Registration: Population)	Population within 10 Miles	Estimated 10-Mile Vehicle Registration	Traffic Data (Daily Average)	Average Daily UATMP Concentration ($\mu\text{g}/\text{m}^3$)
MAWI	449,378	401,588	0.89	356,676	317,442	23,750	29.49 (± 4.25)

21.0 Data Quality

This section discusses the data quality for the ambient air concentrations. In accordance with the Quality Assurance Project Plan (QAPP), the following data calculations were performed: precision, accuracy (also called bias), and completeness. Completeness statistics are in Section 3 of this report. The QAPP goal of 85% completeness was met by most sites. As indicators of the reliability and representativeness of experimental measurements, both precision and bias are considered when interpreting ambient air monitoring data. The quality assessment presented in this section show that the UATMP monitoring data are of a known and high quality, particularly for the most prevalent program-wide compounds in urban air. All calculations are based on sample concentrations detected above the method detection limits (MDLs) for each compound. The overall precision level (the average for all sites) meets the UATMP data quality objectives and adheres to the guidelines in the Compendium Methods (US EPA, 1999a; US EPA, 1999b), which are 15 percent coefficient of variation.

Method precision for the UATMP is determined by repeated analyses of duplicate samples. A duplicate sample is a sample collected simultaneously with a primary sample using the same sampling system (i.e., two separate samples through the same sampling system at the same time). This simultaneous collection is typically achieved by teeing the line from the sampler to each of the two canisters and doubling the flow rate applied to achieve integration over the 24-hour collection period. Ten percent of all sample collections were duplicate samples.

Exceptions to this approach were collocated samples collected in Arizona, Illinois, Massachusetts, Michigan, North Carolina, Tennessee, and Wisconsin. At these sites, collocated samples were collected and analyzed in replicate. Collocated samples are samples that are collected simultaneously using two completely separate collection systems.

Both approaches provide valuable, but different, assessments of method precision:

- Replicate analysis of duplicate samples provides information on the potential for variability (or precision) expected from a single collection system, but does not

provide information on the variability expected between different collection systems (intra-system assessment).

- Replicate analysis of collocated samples provide information on the potential for variability (or precision) expected between different collection systems, but does not provide information on the variability expected from single collection systems (intra-system assessment).

21.1 Precision

Precision refers to the agreement between independent measurements performed according to identical protocols and procedures. To quantify “analytical precision” (i.e., how precisely the analytical methods measure ambient air concentrations), concentrations measured during analysis of duplicate samples are replicated. To quantify “sampling and analytical precision” (i.e., how precisely the sampling and analytical methods measure ambient air concentrations), concentrations measured during replicate analyses of duplicate samples are compared. Two types of precision will be discussed: Analytical Precision and Sampling Precision.

Applied to ambient air monitoring data, precision is a measurement of random errors inherent to the process of sampling and analyzing ambient air.

21.1.1 Analytical Precision

Analytical precision is a measurement of random errors associated with the process of analyzing environmental samples. These errors may result from various factors, but typically originate from random “noise” inherent to analytical instruments. Laboratories can easily evaluate analytical precision by comparing concentrations measured during replicate analysis of the same ambient air samples. This report uses three parameters to quantify random errors indicated by replicate analyses of UATMP samples:

- *Average concentration difference* simply quantifies how duplicate or replicate analytical results differ, on average, for each compound and each sample. When interpreting central tendency estimates for specific compounds sampled during the

UATMP, participating agencies are encouraged to compare central tendencies to the average concentration differences. If a compound's average concentration difference exceeds or nearly equals its central tendency, the analytical method may not be capable of precisely characterizing annual concentrations. Therefore, data interpretation for these compounds should be made with caution. Average concentration differences are calculated by subtracting the first analytical result from the second analytical result and averaging the difference for each compound.

- **Relative percent difference (RPD)** expresses average concentration differences relative to the average concentrations detected during replicate analyses. The RPD is calculated as follows:

$$RPD = \frac{|X_1 - X_2|}{\bar{X}} \times 100 \quad (1)$$

Where:

X_1 is the ambient air concentration of a given compound measured in one sample;

X_2 is the concentration of the same compound measured during replicate analysis; and

X is the arithmetic mean of X_1 and X_2 .

As this equation shows, replicate analyses with low variability have lower RPDs (and better precision), and replicate analyses with high variability have higher RPDs (and poorer precision).

- **Coefficient of Variation (CV)** provides a relative measure of data dispersion compared to the mean.

$$CV = \frac{\sigma}{\bar{X}} \times 100 \quad (2)$$

Where:

σ is the standard deviation of the sets of duplicate or replicate results;

X is the arithmetic mean of the sets of duplicate or replicate results;

The CV is used to measure the imprecision in survey estimates introduced from analysis. A coefficient of 1 percent would indicate that the analytical results could vary slightly due to sampling error, while a variation of 50 percent means that the results are more imprecise.

The following approach was employed to estimate how precisely the central laboratory analyzed UATMP samples:

- CVs, RPDs and concentration differences were calculated for every replicate analyses performed during the program. In cases where compounds were not detected during replicate analyses, these parameters were not calculated.
- To make an overall estimate of method precision, program-average CVs, RPDs, and absolute concentration differences were calculated for each compound by averaging the values from the individual replicate analyses.

Tables 21-1, 21-2, and 21-3 use absolute average concentration differences, RPDs, and CVs to characterize the analytical precision for all sites sampling for VOC, representing all replicate analyses of duplicate and collocated samples, of collocated samples, and of duplicate samples, respectively.

In Table 21-1, the replicate analyses of duplicate and collocated samples show that laboratory VOC analysis precision was within the control limits of 15 percent for CV. The method is most precise when measuring air concentrations for the prevalent compounds program-wide (i.e., compounds consistently found at levels exceeding their detection limits). In terms of overall average concentration difference, the precision of the VOC analytical method ranges from 0.001 ppbv for 1,1-dichloroethane, dibromochloromethane, and chlorobenzene to 0.56 ppbv for acetonitrile. The overall compound by compound average variability is 4.28 percent.

Table 21-2 shows the results from replicate analyses of collocated VOC samples taken at MCAZ, PSAZ, NBIL, DEMI, MAWI, KITN, EATN, LDTN, LOTN, and DITN. The replicate results from collocated samples shows variation for the compounds ranging from 0.17 to 9.01 percent. The overall estimate of method precision, using program-average CVs, RPDs, and absolute concentration differences, is within the program's objectives. The overall compound-by-compound average variability is 4.94 percent.

Table 21-3 shows the results from replicate analyses of duplicate VOC samples. The replicate results from duplicate samples variation ranges from 0.19 to 11.16 percent. The CVs are within the control limits of 15 percent. The overall compound-by-compound average variability is 4.85 percent.

Tables 21-4 through 21-9 present results from VOC replicate analyses for all of the duplicate and collocated samples at the NATTS sites (DEMI, GPCO, NBIL, PSAZ, BTUT, and S4MO). Table 21-10 presents the average CV per compound and per site. The replicate results from duplicate samples show low to mid-level variability among the sites, ranging from 3.86 to 11.64 percent, with an average of 7.61 percent. This is within the NATTS requested 15 percent overall CV per site.

Table 21-11 presents replicate analytical data for all duplicate SNMOC samples. The CVs are within the control limits of 15 percent. The average concentration differences observed for replicate analyses of SNMOC compounds ranges from 0.004 to 1.81 ppbC. The total speciated and total hydrocarbons (speciated and unspeciated) show greater average concentration differences, 24.28 and 28.82 ppbC, respectively, but low-to mid-range variability at 10.07 and 8.28 percent. The overall compound-by-compound average variability is 7.39 percent.

Tables 21-12 through 21-14 present results from SNMOC replicate analyses for all of the duplicate and collocated samples at the NATTS sites (NBIL, BTUT, and S4MO). Table 21-15 presents the average CV per compound and per site. The replicate results from duplicate samples show low- to mid-level variability among the sites, ranging from 4.84 to 14.18 percent, with an average of 9.28 percent.

In Table 21-16, the replicate analyses for duplicate and collocated samples show that laboratory carbonyl analysis precision is within the control limits of 15 percent CV. In terms of average concentration difference, the precision of the carbonyl analytical method ranges from 0.002 ppbv for valeraldehyde and 2,5-dimethylbenzaldehyde to 0.068 ppbv for formaldehyde. The overall compound-by-compound average variability is 3.37 percent.

Table 21-17 shows the results from replicate analyses of collocated carbonyl samples taken at DEMI, CANC, RTPNC, KITN, EATN, LDTN, LOTN, and DITN. The replicate results from collocated samples show variation for the compounds ranging from 0.96 to 4.44 percent. The overall compound-by-compound average variability is 2.86 percent.

Table 21-18 shows the results from replicate analyses of duplicate carbonyl samples. The replicate results from duplicate samples vary little for the majority of the compounds, ranging from 0.76 to 6.59 percent. The overall compound by compound average variability was 3.61 percent.

Tables 21-19 through 21-23 present results from carbonyl replicate analyses for all of the duplicate and collocated samples at the NATTS sites (SYFL, DEMI, GPCO, BTUT, and S4MO). Table 21-24 presents the average CV per compound and per site. The replicate results from duplicate samples show low-level variability among the sites, ranging from 1.97 to 6.94 percent, and an average of 3.72 percent. This is within the NATTS requested 15 percent overall CV per site.

Overall, replicate analyses, both duplicate and collocated, of VOC, SNMOC, and carbonyl compounds suggest the analytical precision level is within the UATMP data quality objectives and guidelines in the Compendium Methods.

21.1.2 Sampling and Analytical Precision

Sampling and analytical precision quantifies random errors associated not only with analyzing ambient air samples in the laboratory but also with collecting the samples. This type of precision is most easily evaluated by comparing concentrations measured in duplicate samples collected from the same air parcel. During the UATMP, duplicate and collocated samples were collected at least 10 percent of the scheduled sampling days. Most of these samples were analyzed in replicate.

To calculate sampling and analytical precision, data analysts compared the concentrations between the two replicates with each respective duplicate or collocated sample. Also, the CV for two duplicate samples was calculated for each compound and each site with the target recovery being 15 percent, similar to the replicate analyses. Tables 21-25 through 21-33, 21-35 through 21-38, 21-40 through 21-47, 21-49, and 21-50 present average concentration differences, RPDs, and CVs as estimates of duplicate and collocated sampling and analytical variability for VOC, SNMOC, carbonyls, and metal compounds, respectively. Tables 21-34, 21-39, and 21-48 present the average CVs per compound and per site. The number of observations from Tables 21-1 through 21-24, in comparison to the respective tables listed for duplicate analyses in Tables 21-25 through 21-48, is approximately twice as high.

Table 21-25 presents the sampling and analytical data precision for duplicates and collocated VOC samples. Four out of 58 VOCs show greater variation than the target 15 percent. The average concentration differences observed for duplicate and collocated analyses of VOC compounds range from 0.001 to 3.26 ppbv. To present the distribution associated with some of the compounds with higher CVs (CVs over 15 percent and total number detected over 30 percent), scatter plots are presented to show the distribution for each of the compounds. Toluene (15.83 percent CV, 100 percent detected), dichloromethane (17.83 percent CV, 53 percent detected), acetonitrile (17.90 percent CV, 60 percent detected), and methyl ethyl ketone (MEK, 27.26 percent CV, 78 percent detected) scatter plots are shown in Figures 21-1 through 21-4, respectively. As the percent CV increases, the outliers can be identified in clearer detail in these figures. An outlier is defined as a data point that emanates from a different model than the rest of the data. The data shown in all of the individual graphs appear to come from linear models with a given variation except for the outliers, which appear to have been affected by the sampling generation procedures. Figure 21-2 shows a close correlation for the duplicate comparisons for methylene chloride, whereas Figure 21-1 shows a wider scatter for the duplicate sample comparisons for acetonitrile.

The collocated VOC sampling and analytical data are presented in Table 21-26, and the duplicate samples are shown in Table 21-27. Again, average CVs greater than 15 percent are

present for each collection type (duplicate and collocated). This shows that the CVs in Table 21-25 were affected by both sampling techniques. However, more compounds in the collocated comparisons had CVs greater than 15 percent than those presented in the duplicate comparisons. Acetylene (18.48 percent), propylene (20.54 percent), acetonitrile (19.86 percent), trichlorofluoromethane (18.24 percent), methylene chloride (21.59 percent), methyl ethyl ketone (28.81 percent), chloroform (17.55 percent), carbon tetrachloride (15.39 percent), methyl isobutyl ketone (15.03 percent), toluene (23.40 percent), ethylbenzene (21.09 percent), *m,p*-xylene (21.49 percent), *o*-xylene (19.03 percent) and 1,2,4-trimethylbenzene (19.36 percent) were above the 15 percent program objective.

Tables 21-28 through 21-33 present the results from VOC duplicate analysis for all of the NATTS sites (DEMI, GPCO, NBIL, PSAZ, BTUT, and S4MO). Table 21-34 presents the average CV per compound and per site. The results from duplicate samples show low to high-level variability among sites, ranging from 5.14 to 76.05 percent, with an average of 15.79 percent. This is slightly higher than the NATTS requested 15 percent overall CV per site. Exclusion of the NBIL site CV from the variability produces an average of 13.28 percent variability.

The SNMOC precision for duplicate samples is presented in Table 21-35. Coefficient of variation for duplicate samples ranged from 0.15 percent for 1-dodecene to 41.67 percent for *n*-decane. The compounds with the highest variation are ones with a non-target peak eluting very close to the elution time of the target peak, which can interfere with the correct concentration determination for that analyte. For example, a target analyte, 2-methyl-2-butene, has methylene chloride, a non-target analyte, eluting in close proximity which can interfere with the integration of the analyte peak. The VOC and SNMOC sampling and analytical precision data differs from the analytical precision data as presented in tables above. This difference suggests that limitations associated with laboratory analysis of the VOC and SNMOC samples during the UATMP did not affect random errors associated with sampling procedures.

Tables 21-36 through 21-38 present the results from SNMOC duplicate analysis for all of the NATTS sites (NBIL, BTUT, and S4MO). Table 21-39 presents the average CV per compound and per site. The results from duplicate samples show mid to high-level variability among sites, ranging from 5.13 to 71.27 percent, with an average of 22.18 percent. This is higher than the NATTS requested 15 percent overall CV per site. Exclusion of the NBIL site CV from the variability produces an average of 12.36 percent variability.

Table 21-40, presenting the sampling and analytical data for carbonyl compounds, shows that the total duplicate and collocated samples precision was within the control limits of 15 percent CV. The average concentration difference ranged from 0.002 ppbv for 2,5-dimethylbenzaldehyde to 0.183 ppbv for formaldehyde.

The collocated carbonyl sampling and analytical data are presented in Table 21-41, and the duplicate samples results are shown in Table 21-42. Propionaldehyde exceeded the 15 percent criterion for the collocated samples and tolualdehydes exceeded the 15 percent criterion for the duplicate samples.

Tables 21-43 through 21-47 present results from carbonyl duplicate sample analyses for the NATTS sites (SYFL, DEMI, GPCO, BTUT, and S4MO). Table 21-48 presents the average CV per compound and per site. The duplicate sample results show low to high level variability among the sites, ranging from 5.69 to 26.13 percent, with an average of 11.35 percent. The carbonyl sampling and analytical precision data differs from the analytical replicate precision data as presented in tables above. This difference suggests that limitations associated with laboratory analysis of the carbonyl samples during the UATMP did not affect random errors associated with sampling procedures.

The sampling and analytical variation for collocated metals samples are presented in Tables 21-49. The average CV values, as well as the average RPD values, show low to high-level variability among the sites, with CVs ranging from 7.10 to 23.58 percent, with an average at 13.80 percent. This is within the NATTS requested 15 percent overall CV per site. Table 21-50

presents the results from collocated metals sample analyses for the NATTS site (BOMA). No replicate samples were collected at this site.

Duplicate/collocated and replicate samples were not collected for semi-volatile compounds (SVOC) due to sampling occurring at only three sites. Therefore, precision for SVOC is not discussed in this section.

21.2 Accuracy

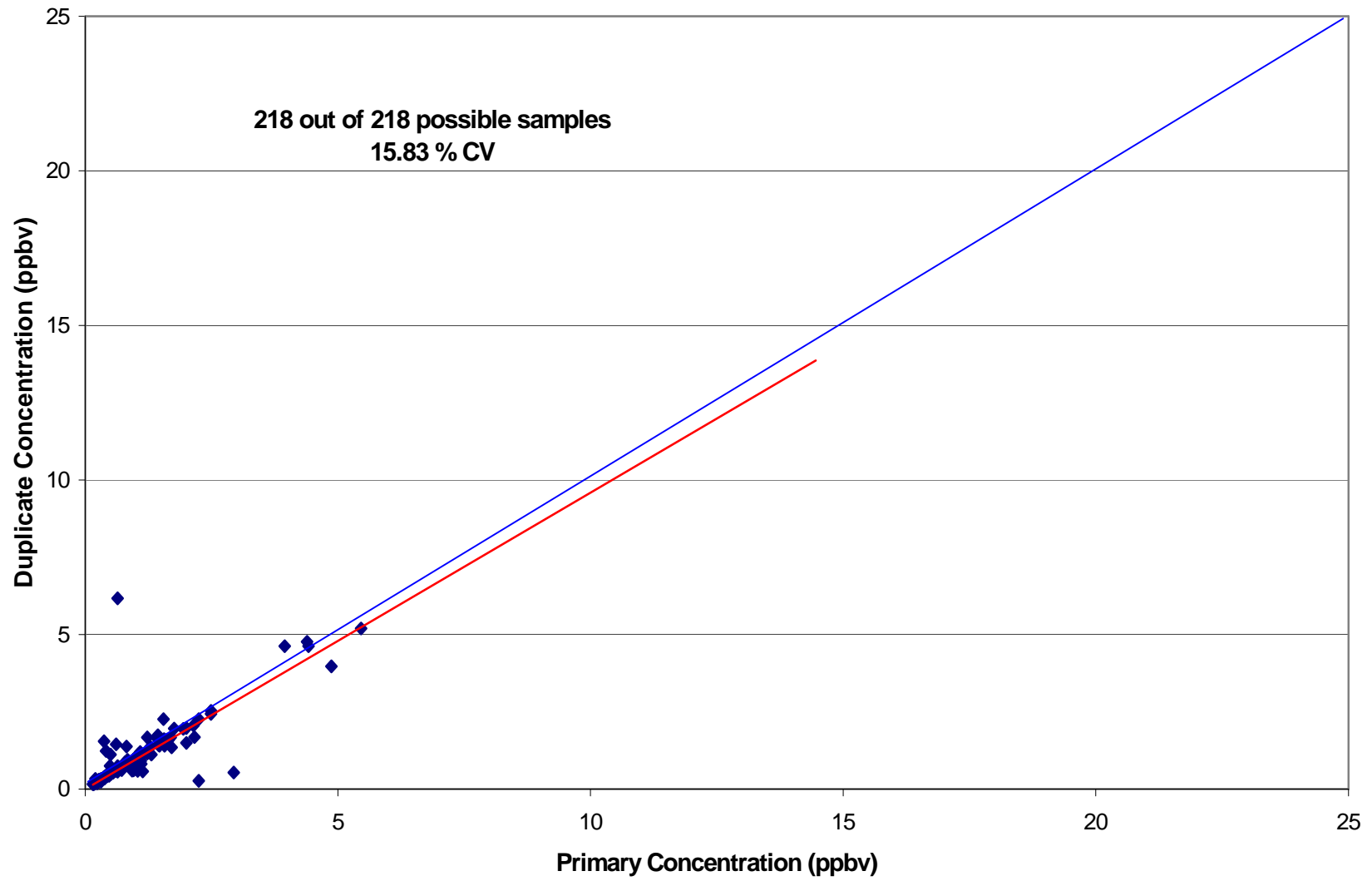
Laboratories typically evaluate their accuracy by analyzing external audit samples and comparing the measured concentrations obtained to the known concentrations of the audit samples.

Accuracy indicates the extent to which experimental measurements represent their corresponding “true” or “actual” values.

The accuracy of the UATMP monitoring data can also be assessed qualitatively by reviewing the accuracy of the monitoring methods and how they were implemented:

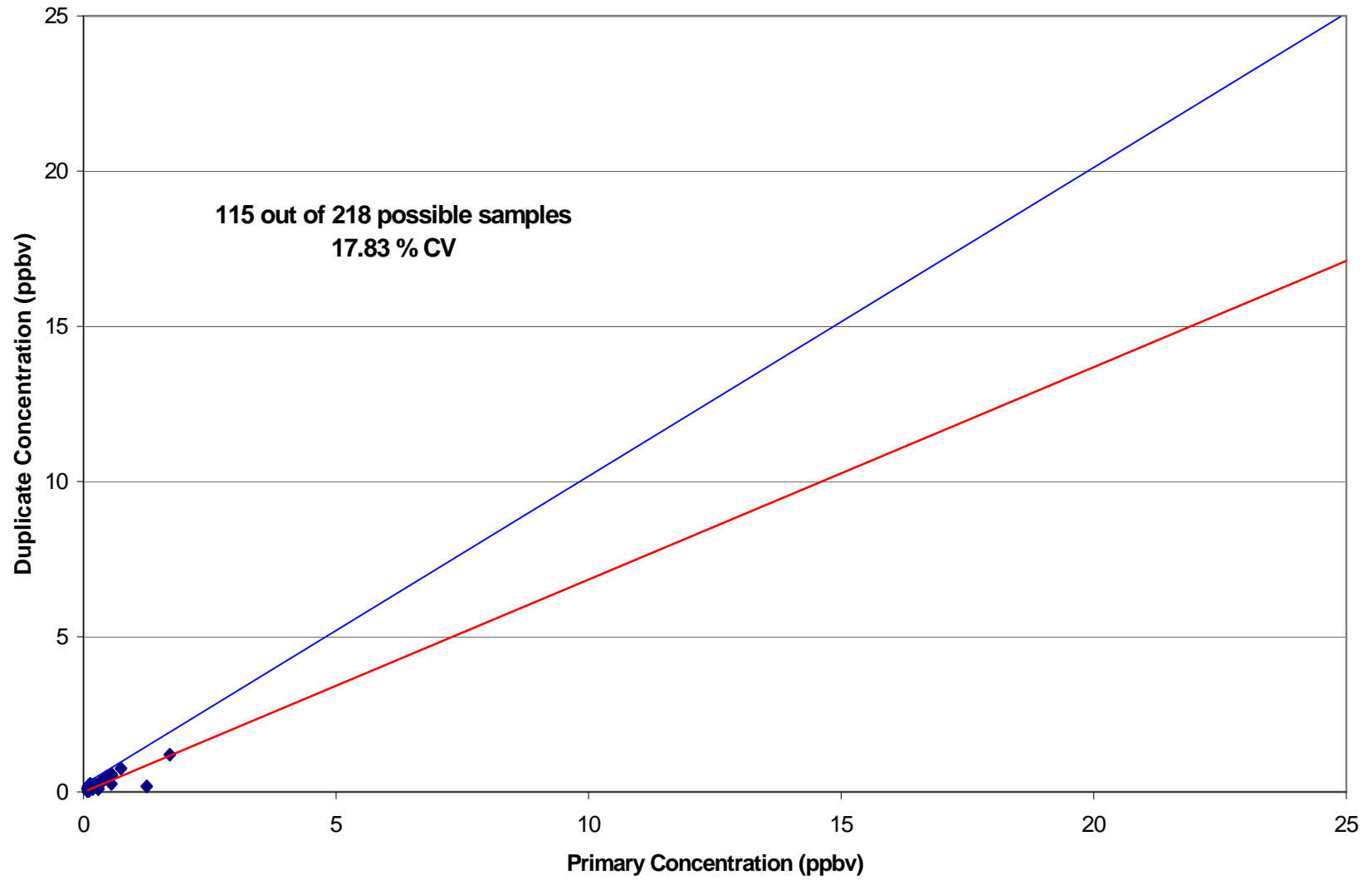
- The sampling and analytical methods used in the UATMP (i.e., Compendium Methods TO-11A and TO-15) have been approved by EPA for accurately measuring ambient levels of VOC and carbonyl compounds, respectively—an approval that is based on many years of research into the development of ambient air monitoring methodologies.
- When collecting and analyzing ambient air samples, all field sampling staff and laboratory analysts strictly followed quality control and quality assurance guidelines detailed in the respective monitoring methods. This strict adherence to the well-documented sampling and analytical methods suggests, though certainly does not prove, that the UATMP monitoring data accurately represent ambient air quality.

Figure 21-1. Concentration Distribution of Toluene



21-11

Figure 21-2. Concentration Distribution of Dichloromethane



21-12

Figure 21-3. Concentration Distribution of Acetonitrile

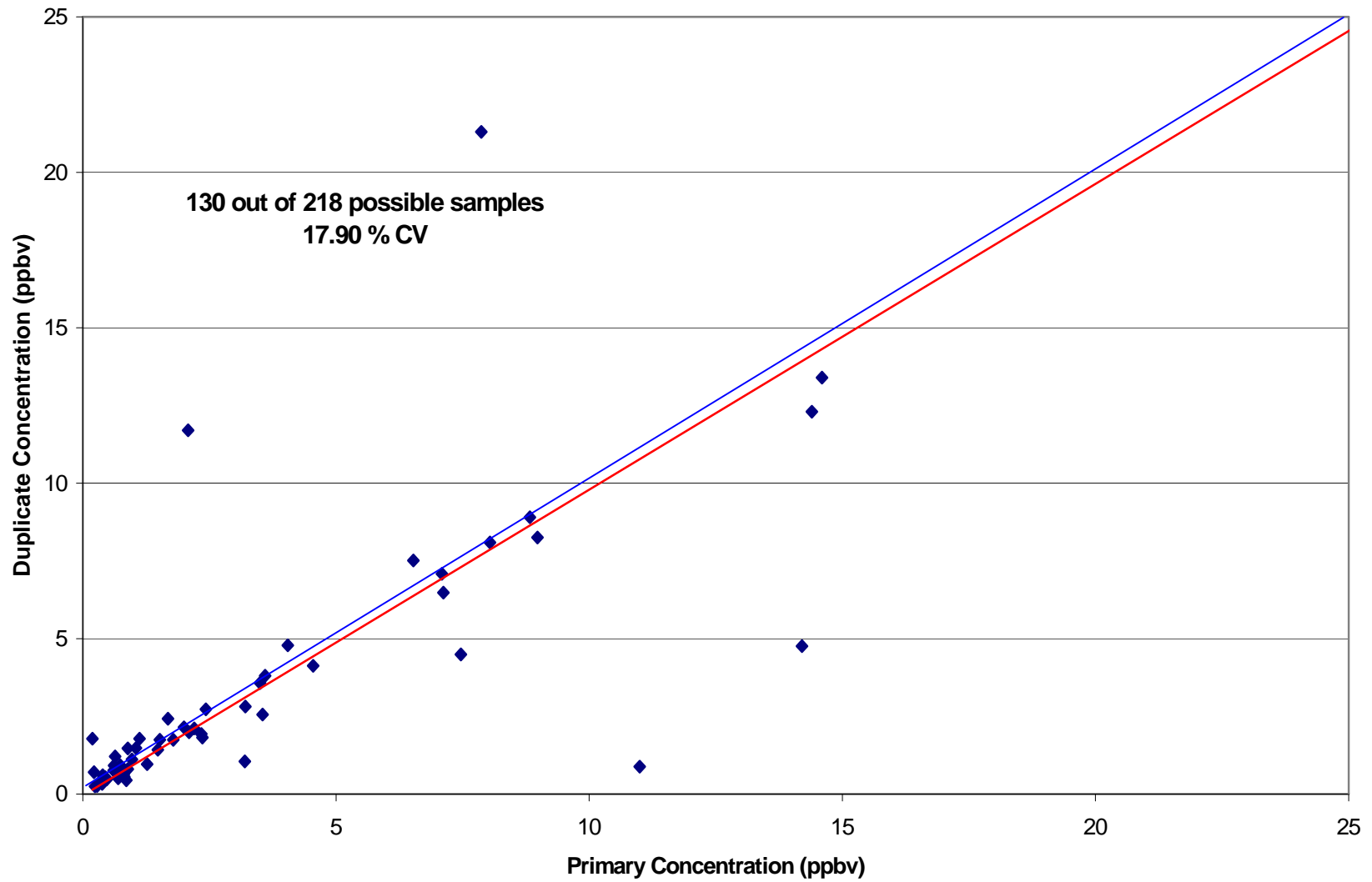
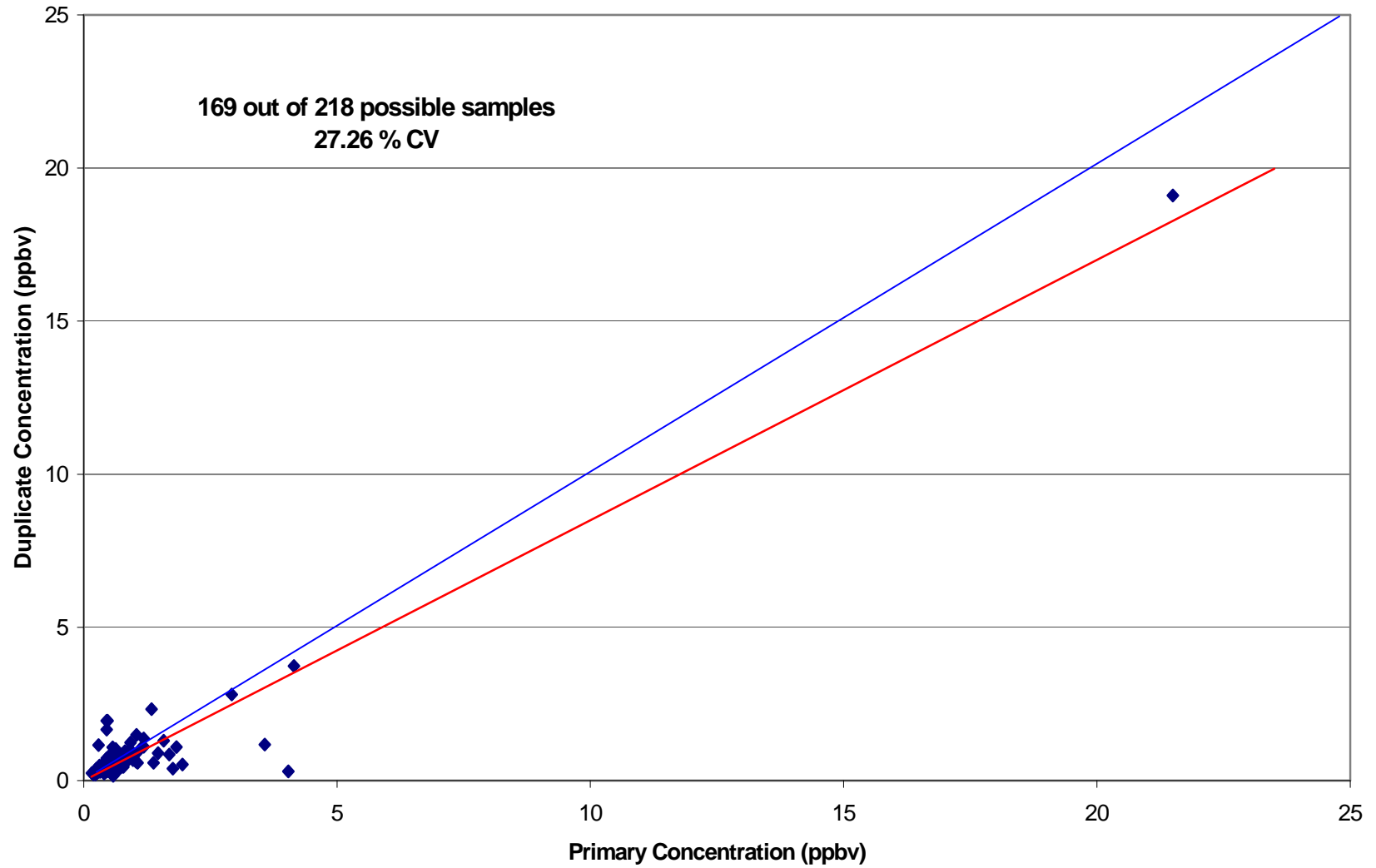


Figure 21-4. Concentration Distribution of Methyl Ethyl Ketone



21-14

**Table 21-1. VOC Analytical Precision:
480 Replicate Analyses for all Duplicate and Collocated Samples**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	468	9.97	0.14	6.85
Propylene	476	8.70	0.06	6.24
Dichlorodifluoromethane	478	6.15	0.05	4.72
Chloromethane	478	11.26	0.06	5.87
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	163	7.33	0.03	4.98
Bromomethane	8	2.00	0.01	1.13
Chloroethane	3	0.80	0.003	0.51
Acetonitrile	276	11.65	0.56	7.41
Trichlorofluoromethane	478	8.85	0.03	6.27
Acrylonitrile	46	2.01	0.15	1.47
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	256	10.49	0.04	7.39
Trichlorotrifluoroethane	401	9.27	0.01	6.78
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	2	0.67	0.001	0.44
Methyl <i>tert</i> -Butyl Ether	158	5.43	0.03	4.14
Methyl Ethyl Ketone	366	11.37	0.13	7.94
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	71	4.37	0.04	2.61
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	25	0.60	0.01	0.46
Benzene	479	7.64	0.03	5.44
Carbon Tetrachloride	447	10.28	0.01	7.29
<i>tert</i> -Amyl Methyl Ether	4	0.89	0.002	0.57
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	4	0.13	0.01	0.09
Trichloroethylene	16	1.34	0.01	0.96
Methyl Methacrylate	14	1.22	0.01	0.86
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	94	4.25	0.03	3.04
<i>trans</i> -1,3-Dichloropropene	16	1.96	0.002	1.35
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-1. VOC Analytical Precision:
480 Replicate Analyses for all Duplicate and Collocated Samples (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	480	7.29	0.07	5.32
Dibromochloromethane	4	0.17	0.001	0.12
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	165	6.28	0.07	4.34
Tetrachloroethylene	204	5.62	0.01	3.98
Chlorobenzene	2	0.67	0.001	0.44
Ethylbenzene	475	9.76	0.01	6.69
<i>m,p</i> -Xylene	478	8.69	0.03	6.13
Bromoform	0	NA	NA	NA
Styrene	348	14.06	0.02	9.01
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	476	9.88	0.01	7.00
1,3,5-Trimethylbenzene	302	12.29	0.02	7.97
1,2,4-Trimethylbenzene	389	15.36	0.03	10.08
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	35	3.28	0.01	2.30
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-2. VOC Analytical Precision:
190 Replicate Analyses for all Collocated Samples**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	180	12.06	0.23	7.66
Propylene	187	7.00	0.05	5.05
Dichlorodifluoromethane	189	6.30	0.07	4.42
Chloromethane	189	6.94	0.07	4.92
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	75	8.80	0.02	6.15
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	91	7.15	0.21	4.95
Trichlorofluoromethane	189	7.22	0.03	5.15
Acrylonitrile	9	0.24	0.25	0.17
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	108	10.83	0.04	7.69
Trichlorotrifluoroethane	154	10.29	0.02	7.48
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	2	1.67	0.003	1.09
Methyl <i>tert</i> -Butyl Ether	24	7.33	0.03	6.14
Methyl Ethyl Ketone	143	11.67	0.15	8.07
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	50	10.09	0.08	5.89
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	22	1.50	0.01	1.15
Benzene	190	7.86	0.03	5.42
Carbon Tetrachloride	188	11.28	0.01	7.96
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	4	0.33	0.03	0.24
Trichloroethylene	8	0.75	0.003	0.49
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	61	7.00	0.04	5.10
<i>trans</i> -1,3-Dichloropropene	12	4.48	0.005	3.10
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-2. VOC Analytical Precision:
190 Replicate Analyses for all Collocated Samples (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	190	6.93	0.10	4.90
Dibromochloromethane	4	0.43	0.004	0.29
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	58	4.23	0.12	3.17
Tetrachloroethylene	139	7.65	0.02	5.44
Chlorobenzene	2	1.67	0.002	1.09
Ethylbenzene	190	10.26	0.02	6.76
<i>m,p</i> -Xylene	190	9.66	0.04	6.62
Bromoform	0	NA	NA	NA
Styrene	123	12.71	0.02	8.46
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	190	9.57	0.02	6.72
1,3,5-Trimethylbenzene	129	14.18	0.02	9.01
1,2,4-Trimethylbenzene	173	12.41	0.03	8.45
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	15	5.29	0.01	3.66
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-3. VOC Analytical Precision:
290 Replicate Analyses for all Duplicate Samples**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	288	8.57	0.08	6.31
Propylene	289	9.84	0.07	7.04
Dichlorodifluoromethane	289	6.06	0.04	4.91
Chloromethane	289	14.14	0.05	6.50
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	88	6.34	0.03	4.20
Bromomethane	5	3.33	0.01	1.89
Chloroethane	2	1.33	0.01	0.86
Acetonitrile	185	14.65	0.80	9.04
Trichlorofluoromethane	289	9.94	0.03	7.02
Acrylonitrile	37	3.20	0.08	2.33
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	148	10.26	0.03	7.19
Trichlorotrifluoroethane	247	8.60	0.01	6.31
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	134	4.16	0.02	2.81
Methyl Ethyl Ketone	223	11.17	0.12	7.85
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	21	0.56	0.01	0.43
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	0	NA	NA	NA
Benzene	289	7.49	0.02	5.46
Carbon Tetrachloride	259	9.62	0.01	6.85
<i>tert</i> -Amyl Methyl Ether	2	1.48	0.003	0.94
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	8	1.73	0.01	1.28
Methyl Methacrylate	13	2.04	0.01	1.44
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	33	2.41	0.02	1.66
<i>trans</i> -1,3-Dichloropropene	4	0.28	0.0003	0.19
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-3. VOC Analytical Precision:
290 Replicate Analyses for all Duplicate Samples (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	290	7.53	0.06	5.60
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	107	7.64	0.04	5.12
Tetrachloroethylene	65	4.26	0.01	3.01
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	285	9.43	0.01	6.65
<i>m,p</i> -Xylene	288	8.05	0.03	5.81
Bromoform	0	NA	NA	NA
Styrene	225	14.96	0.02	9.37
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	286	10.09	0.01	7.19
1,3,5-Trimethylbenzene	173	11.03	0.02	7.27
1,2,4-Trimethylbenzene	216	17.32	0.03	11.16
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	20	1.95	0.02	1.39
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-4. VOC Analytical Precision:
110 Replicate Analyses for Collocated Samples in Detroit, MI (DEMI)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	101	9.45	0.33	6.96
Propylene	108	7.59	0.08	6.41
Dichlorodifluoromethane	110	7.44	0.07	5.68
Chloromethane	110	7.43	0.06	5.50
Dichlorotetrafluoroethane	11	NA	0.02	NA
Vinyl Chloride	1	NA	NA	NA
1,3-Butadiene	40	10.07	0.04	6.93
Bromomethane	1	NA	NA	NA
Chloroethane	1	NA	NA	NA
Acetonitrile	62	18.38	0.46	14.26
Trichlorofluoromethane	109	7.19	0.04	5.36
Acrylonitrile	3	NA	2.14	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	62	8.46	0.05	6.18
Trichlorotrifluoroethane	100	12.59	0.02	9.04
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	2	16.67	0.03	10.88
Methyl <i>tert</i> -Butyl Ether	2	25.00	0.05	20.20
Methyl Ethyl Ketone	77	10.51	0.15	7.32
Chloroprene	1	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	3	NA	0.08	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	14	13.68	0.04	10.70
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	1	NA	NA	NA
1,1,1-Trichloroethane	11	4.17	0.03	3.21
Benzene	110	8.61	0.04	5.92
Carbon Tetrachloride	110	12.92	0.01	8.85
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	8	7.49	0.03	4.92
Methyl Methacrylate	1	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	31	13.64	0.06	10.35
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-4. VOC Analytical Precision:
110 Replicate Analyses for Collocated Samples in Detroit, MI (DEMI) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	110	5.22	0.08	3.76
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	28	NA	0.07	NA
Tetrachloroethylene	108	7.60	0.05	5.65
Chlorobenzene	2	16.67	0.02	10.88
Ethylbenzene	110	7.03	0.01	4.98
<i>m,p</i> -Xylene	110	6.86	0.04	4.88
Bromoform	0	NA	NA	NA
Styrene	60	9.20	0.02	6.26
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	110	7.89	0.02	5.50
1,3,5-Trimethylbenzene	75	8.13	0.01	5.77
1,2,4-Trimethylbenzene	99	11.75	0.03	8.59
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	6	14.29	0.03	10.88
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-5. VOC Analytical Precision:
18 Replicate Analyses for all Duplicate Samples in Grand Junction, CO (GPCO)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	18	9.78	0.11	7.41
Propylene	18	12.17	0.05	10.67
Dichlorodifluoromethane	18	8.05	0.04	6.71
Chloromethane	18	9.69	0.05	7.80
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	12	11.71	0.02	7.98
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	0	NA	NA	NA
Trichlorofluoromethane	18	9.74	0.02	7.89
Acrylonitrile	3	NA	0.14	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	6	12.50	0.07	8.32
Trichlorotrifluoroethane	18	11.10	0.01	9.17
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	17	30.14	0.17	21.17
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	0	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	0	NA	NA	NA
Benzene	18	9.90	0.04	8.04
Carbon Tetrachloride	12	14.86	0.01	10.51
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	7	19.36	0.10	13.66
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	6	20.22	0.02	12.99
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-5. VOC Analytical Precision:
18 Replicate Analyses for all Duplicate Samples in Grand Junction, CO (GPCO) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	18	8.95	0.07	7.41
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	8	6.25	0.04	4.16
Tetrachloroethylene	6	21.43	0.03	13.55
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	18	12.18	0.02	10.48
<i>m,p</i> -Xylene	18	9.98	0.04	8.37
Bromoform	0	NA	NA	NA
Styrene	18	10.74	0.02	8.95
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	18	10.12	0.02	8.47
1,3,5-Trimethylbenzene	17	21.52	0.02	14.88
1,2,4-Trimethylbenzene	18	13.81	0.03	10.42
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	0	NA	NA	NA
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-6. VOC Analytical Precision:
Eight Replicate Analyses for Collocated Samples in North Brook, IL (NBIL)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	8	18.69	0.27	13.47
Propylene	8	8.50	0.05	6.29
Dichlorodifluoromethane	8	6.52	0.06	4.70
Chloromethane	8	3.69	0.04	2.69
Dichlorotetrafluoroethane	1	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	0	NA	NA	NA
Bromomethane	2	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	4	11.80	0.96	8.69
Trichlorofluoromethane	8	8.97	0.09	6.52
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	6	5.39	0.05	3.80
Trichlorotrifluoroethane	8	7.03	0.01	4.79
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	8	10.02	0.21	7.39
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	1	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	8	49.66	0.65	20.96
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	2	NA	NA	NA
Benzene	8	10.61	0.03	7.55
Carbon Tetrachloride	8	9.00	0.03	6.49
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	4	3.27	0.25	2.35
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	4	6.73	0.07	5.10
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-6. VOC Analytical Precision:
Eight Replicate Analyses for Collocated Samples in North Brook, IL (NBIL) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	8	7.19	0.09	4.97
Dibromochloromethane	4	4.29	0.04	2.93
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	2	NA	0.13	NA
Tetrachloroethylene	5	10.00	0.02	6.43
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	8	15.58	0.03	10.10
<i>m,p</i> -Xylene	8	16.59	0.06	10.50
Bromoform	2	NA	NA	NA
Styrene	4	20.00	0.03	12.86
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	8	16.16	0.03	10.67
1,3,5-Trimethylbenzene	6	2.78	0.003	1.89
1,2,4-Trimethylbenzene	6	17.06	0.03	10.88
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	0	NA	NA	NA
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-7. VOC Analytical Precision:
Four Replicate Analyses for Collocated Samples in Phoenix, AZ (PSAZ)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	4	3.75	0.09	2.70
Propylene	4	1.63	0.02	1.16
Dichlorodifluoromethane	4	3.54	0.02	2.57
Chloromethane	4	6.34	0.04	4.63
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	4	5.00	0.01	3.72
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	4	8.16	0.18	6.02
Trichlorofluoromethane	4	4.74	0.02	3.30
Acrylonitrile	2	2.35	0.04	1.68
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	4	10.93	0.04	8.41
Trichlorotrifluoroethane	4	15.00	0.02	11.58
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	1	NA	NA	NA
Methyl Ethyl Ketone	2	7.91	0.14	5.82
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	3	20.00	0.03	15.71
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	4	1.72	0.01	1.20
Benzene	4	1.80	0.01	1.27
Carbon Tetrachloride	4	14.09	0.02	10.44
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	2	NA	NA	NA
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-7. VOC Analytical Precision:
Four Replicate Analyses for Collocated Samples in Phoenix, AZ (PSAZ) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	4	8.79	0.14	6.53
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	3	NA	0.04	NA
Tetrachloroethylene	4	16.67	0.02	13.00
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	4	4.00	0.01	2.95
<i>m,p</i> -Xylene	4	7.70	0.05	5.71
Bromoform	0	NA	NA	NA
Styrene	4	6.25	0.01	4.16
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	4	3.70	0.01	2.67
1,3,5-Trimethylbenzene	4	NA	NA	NA
1,2,4-Trimethylbenzene	4	7.05	0.02	5.18
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	3	14.29	0.04	10.88
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-8. VOC Analytical Precision:
24 Replicate Analyses for all Duplicate Samples in Bountiful, UT (BTUT)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	24	19.49	0.22	12.61
Propylene	24	9.99	0.09	7.24
Dichlorodifluoromethane	24	11.24	0.07	8.92
Chloromethane	23	5.64	0.08	4.13
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	15	23.37	0.03	14.56
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	12	13.50	0.08	8.65
Trichlorofluoromethane	24	17.67	0.05	11.23
Acrylonitrile	11	8.14	0.03	5.90
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	9	10.27	0.04	7.17
Trichlorotrifluoroethane	20	19.65	0.02	14.16
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	13	13.33	0.07	8.41
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	0	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	2	NA	NA	NA
Benzene	20	6.25	0.04	4.29
Carbon Tetrachloride	0	NA	NA	NA
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	1	NA	NA	NA
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-8. VOC Analytical Precision:
24 Replicate Analyses for all Duplicate Samples in Bountiful, UT (BTUT) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	24	6.66	0.08	4.61
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	19	11.98	0.02	7.53
Tetrachloroethylene	4	6.25	0.01	4.71
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	24	8.61	0.01	5.83
<i>m,p</i> -Xylene	24	7.06	0.04	4.80
Bromoform	0	NA	NA	NA
Styrene	23	13.34	0.01	8.86
1,1,1,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	24	7.05	0.02	4.94
1,3,5-Trimethylbenzene	16	16.88	0.01	10.39
1,2,4-Trimethylbenzene	24	9.51	0.01	6.69
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	0	NA	NA	NA
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-9. VOC Analytical Precision:
Four Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	4	3.07	0.06	2.12
Propylene	4	1.94	0.01	1.37
Dichlorodifluoromethane	4	NA	NA	NA
Chloromethane	4	9.74	0.05	7.02
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	2	NA	0.07	NA
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	4	73.66	0.25	34.41
Trichlorofluoromethane	4	7.14	0.02	5.29
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	4	8.61	0.02	5.77
Trichlorotrifluoroethane	0	NA	NA	NA
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	2	NA	0.69	NA
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	0	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	0	NA	NA	NA
Benzene	4	8.06	0.04	5.98
Carbon Tetrachloride	2	22.22	0.02	17.68
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	0	NA	NA	NA
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-9. VOC Analytical Precision:
Four Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	4	5.26	0.04	3.87
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	0	NA	NA	NA
Tetrachloroethylene	0	NA	NA	NA
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	4	9.09	0.01	6.44
<i>m,p</i> -Xylene	4	9.22	0.03	6.85
Bromoform	0	NA	NA	NA
Styrene	0	NA	NA	NA
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	4	5.00	0.01	3.72
1,3,5-Trimethylbenzene	0	NA	NA	NA
1,2,4-Trimethylbenzene	2	22.22	0.02	17.68
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	4	11.11	0.01	8.32
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites**

Compound	Average	Bountiful, UT (BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Grand Junction, CO (GPCO)	Grenada, MS (GRMS)	Gulfport, MS (GPMS)
Acetylene	6.85	12.61	5.96	10.68	5.64	6.96	4.38	5.47	7.41	5.58	6.81
Propylene	6.24	7.24	6.48	15.45	6.89	6.41	8.29	5.37	10.67	10.91	7.09
Dichlorodifluoromethane	4.91	8.92	3.54	10.87	13.56	5.68	6.76	3.83	6.71	4.02	3.20
Chloromethane	5.87	4.13	7.15	13.38	12.10	5.50	6.96	4.44	7.80	5.13	2.36
Dichlorotetrafluoroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	10.38	14.56	14.56	NA	NA	6.93	NA	7.23	7.98	NA	15.54
Bromomethane	28.28	NA	NA	NA	28.28	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	12.86	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	9.26	8.65	1.86	17.38	10.21	14.26	NA	5.60	NA	8.56	3.70
Trichlorofluoromethane	6.27	11.23	9.30	11.02	14.17	5.36	9.44	4.34	7.89	4.05	4.53
Acrylonitrile	6.12	5.90	7.44	NA	5.66	NA	NA	7.07	NA	8.95	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	8.44	7.17	9.35	3.33	12.69	6.18	16.97	4.76	8.32	21.61	3.66
Trichlorotrifluoroethane	7.45	14.16	5.96	3.45	11.05	9.04	12.57	4.68	9.17	7.61	5.51
<i>trans</i> - 1,2 - Dichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	NA	NA	NA	NA	NA	10.88	NA	NA	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	9.94	NA	4.29	4.60	5.36	20.20	NA	4.34	NA	NA	NA
Methyl Ethyl Ketone	8.40	8.41	7.91	7.40	8.81	7.32	12.94	4.57	21.17	10.16	4.23
Chloroprene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Bountiful, UT (BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Grand Junction, CO (GPCO)	Grenada, MS (GRMS)	Gulfport, MS (GPMS)
Chloroform	8.70	NA	NA	NA	NA	10.70	NA	NA	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2 - Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1 - Trichloroethane	3.83	NA	NA	NA	NA	3.21	NA	NA	NA	NA	NA
Benzene	5.58	4.70	5.55	8.76	6.24	5.92	10.90	4.57	8.04	7.91	2.74
Carbon Tetrachloride	7.74	8.04	8.03	5.41	4.89	8.85	14.68	6.97	10.51	8.90	3.86
<i>tert</i> -Amyl Methyl Ether	NA	NA	14.14	NA	NA	NA	NA	NA	NA	NA	NA
1,2 - Dichloropropane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	8.79	NA	13.69	NA	NA	4.92	NA	NA	NA	5.44	NA
Methyl Methacrylate	9.27	NA	NA	NA	NA	NA	NA	7.87	13.66	NA	NA
<i>cis</i> -1,3 - Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	7.26	NA	NA	NA	NA	10.35	6.64	6.05	12.99	NA	NA
<i>trans</i> - 1,3 - Dichloropropene	8.46	NA	NA	2.83	7.86	NA	NA	NA	NA	NA	NA
1,1,2 - Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	5.49	4.61	4.97	8.24	13.45	3.76	5.92	3.85	7.41	5.44	2.48
Dibromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>n</i> -Octane	8.86	7.53	9.73	NA	8.32	NA	NA	4.19	4.16	NA	NA
Tetrachloroethylene	7.77	4.71	4.32	NA	3.72	5.65	12.86	6.68	13.55	NA	NA
Chlorobenzene	10.88	NA	NA	NA	NA	10.88	NA	NA	NA	NA	NA
Ethylbenzene	6.87	5.83	3.41	12.53	4.27	4.98	17.82	3.93	10.48	8.98	7.06
<i>m,p</i> - Xylene	6.30	4.80	4.29	10.01	4.96	4.88	11.01	5.09	8.37	5.86	2.06

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Bountiful, UT (BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Grand Junction, CO (GPCO)	Grenada, MS (GRMS)	Gulfport, MS (GPMS)
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	9.85	8.86	9.71	12.86	5.88	6.26	NA	3.80	8.95	8.32	16.95
1,1,2,2 - Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>o</i> - Xylene	7.20	4.94	5.01	12.81	7.79	5.50	9.00	4.43	8.47	9.07	8.61
1,3,5-Trimethylbenzene	10.36	10.39	5.33	NA	NA	5.77	28.28	5.09	14.88	NA	20.90
1,2,4-Trimethylbenzene	10.43	6.69	5.04	20.20	0.73	8.59	14.14	5.21	10.42	42.43	11.53
<i>m</i> - Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>p</i> - Dichlorobenzene	8.48	NA	3.77	NA	NA	10.88	NA	NA	NA	NA	NA
<i>o</i> - Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	8.45	7.91	7.17	10.06	8.81	7.71	11.64	5.18	9.96	9.94	6.99

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Jackson, MS (JAMS)	Kingsport, TN (KITN)	North Brook, IL (NBIL)	Nashville, TN (EATN)	Nashville, TN (LDTN)	Nashville, TN (LOTN)	Madison, WI (MAWI)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Phoenix, AZ (Site 1 - PAZ)
Acetylene	6.85	8.57	2.18	13.47	6.77	4.35	14.12	8.13	2.67	3.29	2.70
Propylene	6.24	3.05	6.12	6.29	3.61	4.75	2.24	8.29	4.87	4.33	1.16
Dichlorodifluoromethane	4.91	2.54	4.57	4.70	3.49	4.54	3.34	5.77	3.15	2.61	2.57
Chloromethane	5.87	1.99	5.95	2.69	4.16	5.54	3.99	6.25	2.43	2.98	4.63
Dichlorotetrafluoroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	10.38	3.16	20.20	NA	5.66	16.91	NA	NA	NA	NA	3.72
Bromomethane	28.28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	9.26	4.39	NA	8.69	0.65	NA	10.83	NA	4.90	5.59	6.02
Trichlorofluoromethane	6.27	1.95	3.29	6.52	5.00	1.20	7.63	6.67	11.51	2.73	3.30
Acrylonitrile	6.12	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.68
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	8.44	4.67	NA	3.80	13.44	NA	8.48	9.18	6.06	2.36	8.41
Trichlorotrifluoroethane	7.45	14.06	6.15	4.79	6.43	6.65	5.53	8.87	4.93	2.63	11.58
<i>trans</i> - 1,2 - Dichloroethylene	NA	5.13	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	9.94	NA	NA	NA	35.36	NA	NA	NA	5.58	NA	NA
Methyl Ethyl Ketone	8.40	NA	4.72	7.39	3.89	12.47	9.97	9.61	8.35	5.61	5.82
Chloroprene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromochloromethane	NA	2.09	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	8.70	4.31	NA	20.96	6.43	2.35	NA	NA	6.43	NA	15.71
Ethyl <i>tert</i> -Butyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Jackson, MS (JAMS)	Kingsport, TN (KITN)	North Brook, IL (NBIL)	Nashville, TN (EATN)	Nashville, TN (LDTN)	Nashville, TN (LOTN)	Madison, WI (MAWI)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Phoenix, AZ (Site 1 - PAZ)
1,2 - Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1 - Trichloroethane	3.83	NA	NA	NA	NA	NA	NA	7.07	NA	NA	1.20
Benzene	5.58	NA	3.09	7.55	6.50	6.85	4.04	5.88	5.97	4.35	1.27
Carbon Tetrachloride	7.74	NA	NA	6.49	11.68	3.74	9.36	6.43	7.05	1.12	10.44
tert-Amyl Methyl Ether	NA	5.86	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2 - Dichloropropane	NA	1.82	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	2.35	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	8.79	11.11	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	9.27	6.29	NA	NA	NA	NA	NA	NA	NA	NA	NA
cis -1,3 - Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	7.26	2.48	10.93	5.10	8.32	NA	NA	7.44	NA	NA	NA
trans - 1,3 - Dichloropropene	8.46	NA	NA	NA	13.71	NA	NA	NA	NA	NA	9.43
1,1,2 - Trichloroethane	NA	8.41	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	5.49	6.11	2.32	4.97	6.94	4.32	2.49	7.11	6.95	3.58	6.53
Dibromochloromethane	NA	3.85	NA	2.93	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Octane	8.86	NA	17.68	NA	6.50	NA	NA	NA	10.88	4.42	NA
Tetrachloroethylene	7.77	NA	NA	6.43	11.79	NA	NA	NA	5.93	NA	13.00
Chlorobenzene	10.88	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	6.87	NA	7.79	10.10	10.67	0.94	2.53	6.06	6.85	4.83	2.95
m,p - Xylene	6.30	NA	2.69	10.50	13.73	4.20	2.22	7.20	6.07	4.20	5.71
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Jackson, MS (JAMS)	Kingsport, TN (KITN)	North Brook, IL (NBIL)	Nashville, TN (EATN)	Nashville, TN (LDTN)	Nashville, TN (LOTN)	Madison, WI (MAWI)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Phoenix, AZ (Site 1 - PAZ)
Styrene	9.85	NA	15.71	12.86	14.90	3.53	5.29	14.28	13.54	7.33	4.16
1,1,2,2 - Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>o</i> - Xylene	7.20	NA	7.23	10.67	12.69	3.63	5.50	7.07	5.95	3.65	2.67
1,3,5-Trimethylbenzene	10.36	3.86	7.86	1.89	20.40	6.43	3.63	11.79	3.21	5.03	NA
1,2,4-Trimethylbenzene	10.43	2.11	1.54	10.88	12.40	5.10	9.28	9.82	6.58	2.62	5.18
<i>m</i> - Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>p</i> - Dichlorobenzene	8.48	2.18	NA	NA	NA	NA	NA	NA	NA	NA	10.88
<i>o</i> - Dichlorobenzene	NA	8.72	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloro-1,3- Butadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	8.45	4.95	7.22	7.48	9.80	5.42	6.14	8.05	6.36	3.86	5.86

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Phoenix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)	Spirit Lake, ND (SLND)	Tupelo, MS (TUMS)
Acetylene	6.85	13.55	2.12	5.32	4.12	8.43
Propylene	6.24	3.37	1.37	8.53	5.62	7.68
Dichlorodifluoromethane	4.91	2.79	NA	4.10	2.65	3.98
Chloromethane	5.87	3.56	7.02	6.35	2.01	18.23
Dichlorotetrafluoroethane	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA
1,3-Butadiene	10.38	8.08	NA	NA	NA	NA
Bromomethane	28.28	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA
Acetonitrile	9.26	9.11	34.41	7.02	15.10	8.22
Trichlorofluoromethane	6.27	3.13	5.29	5.64	2.89	8.69
Acrylonitrile	6.12	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA
Methylene Chloride	8.44	10.46	5.77	10.88	NA	8.08
Trichlorotrifluoroethane	7.45	3.17	NA	7.86	9.44	3.49
<i>trans</i> - 1,2 - Dichloroethylene	NA	NA	NA	NA	NA	NA
1,1 - Dichloroethane	NA	NA	NA	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	9.94	5.83	NA	3.93	NA	NA
Methyl Ethyl Ketone	8.40	6.56	NA	10.16	3.51	12.33
Chloroprene	NA	NA	NA	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA	NA
Chloroform	8.70	2.72	NA	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	NA	NA	NA	NA	NA	NA
1,2 - Dichloroethane	NA	NA	NA	NA	NA	NA

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Phoenix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)	Spirit Lake, ND (SLND)	Tupelo, MS (TUMS)
1,1,1 - Trichloroethane	3.83	NA	NA	NA	NA	NA
Benzene	5.58	2.15	5.98	7.09	4.06	3.90
Carbon Tetrachloride	7.74	7.97	17.68	5.04	5.55	5.33
<i>tert</i> -Amyl Methyl Ether	NA	NA	NA	NA	NA	NA
1,2 - Dichloropropane	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA
Trichloroethylene	8.79	NA	NA	NA	NA	NA
Methyl Methacrylate	9.27	NA	NA	NA	NA	NA
<i>cis</i> -1,3 - Dichloropropene	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	7.26	2.27	NA	NA	NA	NA
<i>trans</i> - 1,3 - Dichloropropene	8.46	NA	NA	NA	NA	NA
1,1,2 - Trichloroethane	NA	NA	NA	NA	NA	NA
Toluene	5.49	4.65	3.87	4.63	4.15	8.59
Dibromochloromethane	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA	NA
<i>n</i> -Octane	8.86	7.54	NA	NA	NA	16.53
Tetrachloroethylene	7.77	4.65	NA	NA	NA	NA
Chlorobenzene	10.88	NA	NA	NA	NA	NA
Ethylbenzene	6.87	3.76	6.44	3.43	10.48	8.73
<i>m,p</i> - Xylene	6.30	4.02	6.85	4.66	9.94	7.92
Bromoform	NA	NA	NA	NA	NA	NA
Styrene	9.85	7.58	NA	12.84	10.88	12.26
1,1,2,2 - Tetrachloroethane	NA	NA	NA	NA	NA	NA
<i>o</i> - Xylene	7.20	3.26	3.72	7.88	15.11	8.17

**Table 21-10. VOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Phoenix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)	Spirit Lake, ND (SLND)	Tupelo, MS (TUMS)
1,3,5-Trimethylbenzene	10.36	4.03	NA	15.71	NA	22.44
1,2,4-Trimethylbenzene	10.43	7.60	17.68	10.18	NA	24.26
<i>m</i> - Dichlorobenzene	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	NA	NA	NA	NA	NA	NA
<i>p</i> - Dichlorobenzene	8.48	14.89	8.32	NA	NA	NA
<i>o</i> - Dichlorobenzene	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	NA	NA	NA	NA	NA	NA
Average	8.45	5.87	9.04	7.43	7.03	10.38

**Table 21-11. SNMOC Analytical Precision:
100 Replicate Analyses for all Duplicate Samples**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
Ethylene	96	7.38	0.10	6.53
Acetylene	100	5.29	0.14	4.21
Ethane	98	5.76	0.38	4.57
Propylene	99	4.69	0.05	3.41
Propane	100	4.50	0.50	3.87
Propyne	0	NA	NA	NA
Isobutane	100	5.71	0.15	4.75
Isobutene/1-Butene	93	7.72	0.09	5.63
1,3-Butadiene	3	0.80	0.05	0.56
<i>n</i> -Butane	99	10.14	0.37	5.63
<i>trans</i> -2-Butene	64	22.53	0.06	14.98
<i>cis</i> -2-Butene	55	14.57	0.09	9.66
3-Methyl-1-butene	4	0.97	0.004	0.71
Isopentane	83	5.37	0.26	3.66
1-Pentene	52	21.27	0.18	9.40
2-Methyl-1-butene	14	1.66	0.66	1.21
<i>n</i> -Pentane	100	9.14	0.22	6.30
Isoprene	79	15.92	0.09	11.01
<i>trans</i> -2-Pentene	58	26.51	0.14	16.06
<i>cis</i> -2-Pentene	54	29.15	0.11	15.93
2-Methyl-2-butene	24	11.24	0.11	7.41
2,2-Dimethylbutane	33	12.01	0.16	9.07
Cyclopentene	19	3.76	0.15	2.66
4-Methyl-1-pentene	4	0.87	0.01	0.60
Cyclopentane	71	15.82	0.07	10.91
2,3-Dimethylbutane	66	10.17	0.13	7.60
2-Methylpentane	97	7.02	0.13	5.04
3-Methylpentane	93	14.47	0.27	10.10
2-Methyl-1-pentene	0	NA	NA	NA
1-Hexene	43	17.00	0.18	11.66
2-Ethyl-1-butene	0	NA	NA	NA
<i>n</i> -Hexane	100	6.11	0.08	4.76
<i>trans</i> -2-Hexene	0	NA	NA	NA
<i>cis</i> -2-Hexene	0	NA	NA	NA
Methylcyclopentane	99	7.47	0.06	5.24
2,4-Dimethylpentane	56	15.99	0.13	11.61
Benzene	99	4.31	0.08	3.14
Cyclohexane	41	12.64	0.12	10.20

**Table 21-11. SNMOC Analytical Precision:
100 Replicate Analyses for all Duplicate Samples (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
2-Methylhexane	57	25.13	0.23	12.52
2,3-Dimethylpentane	52	13.80	0.37	10.08
3-Methylhexane	98	14.76	0.16	11.52
1-Heptene	0	NA	NA	NA
2,2,4-Trimethylpentane	84	5.64	0.09	4.03
<i>n</i> -Heptane	86	9.48	0.12	7.29
Methylcyclohexane	89	12.44	0.08	9.17
2,2,3-Trimethylpentane	4	1.71	0.03	1.29
2,3,4-Trimethylpentane	38	7.43	0.06	5.88
Toluene	100	5.37	0.20	4.31
2-Methylheptane	23	1.53	0.15	1.12
3-Methylheptane	28	5.35	0.15	3.60
1-Octene	0	NA	NA	NA
<i>n</i> -Octane	75	11.23	0.07	7.95
Ethylbenzene	95	9.31	0.08	6.52
<i>m,p</i> -Xylene	100	7.16	0.10	5.35
Styrene	38	5.28	0.20	3.83
<i>o</i> -Xylene	98	10.14	0.08	7.59
1-Nonene	5	4.25	0.23	2.65
<i>n</i> -Nonane	74	11.68	0.07	8.32
Isopropylbenzene	20	15.12	0.16	10.57
<i>a</i> -Pinene	66	37.22	0.33	8.56
<i>n</i> -Propylbenzene	63	14.43	0.08	9.99
<i>m</i> -Ethyltoluene	95	8.24	0.06	6.11
<i>p</i> -Ethyltoluene	63	11.75	0.08	8.77
1,3,5-Trimethylbenzene	80	17.66	0.12	11.74
<i>o</i> -Ethyltoluene	82	15.19	0.08	11.24
<i>b</i> -Pinene	31	5.03	0.36	3.90
1,2,4-Trimethylbenzene	86	10.33	0.14	7.44
1-Decene	0	NA	NA	NA
<i>n</i> -Decane	70	13.77	0.21	10.48
1,2,3-Trimethylbenzene	68	25.60	0.16	15.90
<i>m</i> -Diethylbenzene	45	11.96	0.09	8.80
<i>p</i> -Diethylbenzene	53	15.98	0.17	12.44
1-Undecene	0	NA	NA	NA
<i>n</i> -Undecane	41	11.15	0.89	10.12
1-Dodecene	5	2.46	0.07	1.88
<i>n</i> -Dodecane	17	17.91	1.81	16.35

**Table 21-11. SNMOC Analytical Precision:
100 Replicate Analyses for all Duplicate Samples (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
1-Tridecene	0	NA	NA	NA
<i>n</i> -Tridecane	0	NA	NA	NA
TNMOC (speciated)	100	21.47	24.28	10.07
TNMOC (w/ unknowns)	100	12.95	28.82	8.28

**Table 21-12. SNMOC Analytical Precision:
12 Replicate Analyses for Collocated Samples in North Brook, IL (NBIL)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
Ethylene	8	12.02	0.10	7.85
Acetylene	12	8.11	0.09	5.96
Ethane	10	11.01	1.08	7.52
Propylene	12	6.69	0.06	4.94
Propane	12	7.49	0.43	5.42
Propyne	0	NA	NA	NA
Isobutane	12	5.63	0.09	4.17
Isobutene/1-Butene	10	4.58	0.03	3.26
1,3-Butadiene	0	NA	NA	NA
<i>n</i> -Butane	12	6.17	0.16	4.55
<i>trans</i> -2-Butene	3	24.11	0.07	15.21
<i>cis</i> -2-Butene	2	0.00	0.16	0.00
3-Methyl-1-butene	0	NA	NA	NA
Isopentane	6	4.29	0.08	2.87
1-Pentene	2	13.27	0.03	8.80
2-Methyl-1-butene	0	NA	NA	NA
<i>n</i> -Pentane	12	24.28	0.41	12.51
Isoprene	12	7.83	0.11	5.57
<i>trans</i> -2-Pentene	3	3.77	0.16	2.72
<i>cis</i> -2-Pentene	4	34.47	0.06	18.88
2-Methyl-2-butene	0	NA	NA	NA
2,2-Dimethylbutane	5	11.27	0.16	7.35
Cyclopentene	7	7.68	0.12	5.78
4-Methyl-1-pentene	0	NA	NA	NA
Cyclopentane	7	5.82	0.09	4.25
2,3-Dimethylbutane	8	3.82	0.09	2.72
2-Methylpentane	12	12.34	0.15	8.48
3-Methylpentane	12	14.41	0.11	9.93
2-Methyl-1-pentene	0	NA	NA	NA
1-Hexene	3	35.46	0.22	21.30
2-Ethyl-1-butene	0	NA	NA	NA
<i>n</i> -Hexane	12	6.56	0.11	4.66
<i>trans</i> -2-Hexene	0	NA	NA	NA
<i>cis</i> -2-Hexene	0	NA	NA	NA
Methylcyclopentane	12	9.51	0.07	6.38
2,4-Dimethylpentane	8	14.18	0.08	9.68
Benzene	12	7.55	0.12	5.42
Cyclohexane	4	9.18	0.04	6.70

**Table 21-12. SNMOC Analytical Precision:
12 Replicate Analyses for Collocated Samples in North Brook, IL (NBIL) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
2-Methylhexane	8	35.99	0.18	16.33
2,3-Dimethylpentane	8	18.70	0.18	12.03
3-Methylhexane	12	12.74	0.09	8.15
1-Heptene	0	NA	NA	NA
2,2,4-Trimethylpentane	12	5.26	0.09	3.60
<i>n</i> -Heptane	9	9.08	0.21	5.89
Methylcyclohexane	12	14.64	0.07	9.06
2,2,3-Trimethylpentane	0	NA	NA	NA
2,3,4-Trimethylpentane	8	5.01	0.04	3.69
Toluene	12	4.89	0.25	3.59
2-Methylheptane	2	2.35	0.01	1.68
3-Methylheptane	3	0.79	0.16	0.56
1-Octene	0	NA	NA	NA
<i>n</i> -Octane	8	9.46	0.06	6.64
Ethylbenzene	12	11.02	0.10	7.61
<i>m,p</i> -Xylene	12	11.05	0.14	6.65
Styrene	7	10.37	0.37	7.26
<i>o</i> -Xylene	12	10.46	0.12	6.97
1-Nonene	4	25.52	0.14	15.87
<i>n</i> -Nonane	10	8.00	0.14	5.44
Isopropylbenzene	2	13.76	0.15	9.10
<i>a</i> -Pinene	9	197.90	1.32	33.85
<i>n</i> -Propylbenzene	8	18.85	0.16	11.96
<i>m</i> -Ethyltoluene	12	5.48	0.08	3.82
<i>p</i> -Ethyltoluene	8	7.43	0.06	4.79
1,3,5-Trimethylbenzene	10	37.85	0.42	20.52
<i>o</i> -Ethyltoluene	9	18.47	0.11	10.41
<i>b</i> -Pinene	6	8.62	0.40	6.67
1,2,4-Trimethylbenzene	12	7.37	0.09	5.66
1-Decene	0	NA	NA	NA
<i>n</i> -Decane	9	9.69	0.39	6.48
1,2,3-Trimethylbenzene	8	35.90	0.24	19.91
<i>m</i> -Diethylbenzene	8	25.58	0.15	16.00
<i>p</i> -Diethylbenzene	7	7.16	0.09	5.27
1-Undecene	0	NA	NA	NA
<i>n</i> -Undecane	8	10.91	0.17	7.54
1-Dodecene	0	NA	NA	NA
<i>n</i> -Dodecane	3	19.49	0.50	12.56

**Table 21-12. SNMOC Analytical Precision:
12 Replicate Analyses for Collocated Samples in North Brook, IL (NBIL) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
1-Tridecene	0	NA	NA	NA
<i>n</i> -Tridecane	0	NA	NA	NA
TNMOC (speciated)	12	8.35	6.92	5.62
TNMOC (w/ unknowns)	12	4.54	7.00	3.20

**Table 21-13. SNMOC Analytical Precision:
24 Replicate Analyses for Duplicate Samples in Bountiful, UT (BTUT)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
Ethylene	24	11.53	0.29	12.95
Acetylene	24	4.27	0.30	2.91
Ethane	24	7.02	0.60	5.53
Propylene	24	2.86	0.06	2.00
Propane	24	2.14	0.55	1.51
Propyne	0	NA	NA	NA
Isobutane	24	1.85	0.35	1.32
Isobutene/1-Butene	24	5.98	0.09	4.15
1,3-Butadiene	3	4.83	0.29	3.33
n-Butane	24	9.67	1.02	6.52
<i>trans</i> -2-Butene	24	29.63	0.07	16.44
<i>cis</i> -2-Butene	24	29.49	0.09	16.77
3-Methyl-1-butene	4	5.82	0.023	4.27
Isopentane	24	3.12	0.40	2.28
1-Pentene	20	12.63	0.06	8.29
2-Methyl-1-butene	11	5.74	0.21	4.24
n-Pentane	24	4.22	0.26	2.88
Isoprene	24	22.41	0.10	14.31
<i>trans</i> -2-Pentene	24	23.07	0.09	13.60
<i>cis</i> -2-Pentene	24	28.98	0.16	16.80
2-Methyl-2-butene	15	2.03	0.06	1.44
2,2-Dimethylbutane	16	16.00	0.10	10.58
Cyclopentene	8	9.72	0.04	6.42
4-Methyl-1-pentene	0	NA	NA	NA
Cyclopentane	22	7.84	0.09	5.47
2,3-Dimethylbutane	24	6.30	0.10	4.58
2-Methylpentane	24	5.15	0.15	3.52
3-Methylpentane	24	9.65	0.26	6.86
2-Methyl-1-pentene	0	NA	NA	NA
1-Hexene	13	28.51	0.24	19.56
2-Ethyl-1-butene	0	NA	NA	NA
n-Hexane	24	4.56	0.14	3.12
<i>trans</i> -2-Hexene	2	NA	0.31	NA
<i>cis</i> -2-Hexene	1	NA	NA	NA
Methylcyclopentane	24	6.23	0.09	4.26
2,4-Dimethylpentane	24	13.60	0.10	8.56
Benzene	24	2.51	0.07	1.77
Cyclohexane	20	8.96	0.10	6.08

**Table 21-13. SNMOC Analytical Precision:
24 Replicate Analyses for Duplicate Samples in Bountiful, UT (BTUT) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
2-Methylhexane	20	66.22	0.28	25.55
2,3-Dimethylpentane	24	17.46	0.22	11.30
3-Methylhexane	24	7.53	0.09	5.00
1-Heptene	0	NA	NA	NA
2,2,4-Trimethylpentane	24	5.50	0.11	3.86
<i>n</i> -Heptane	24	4.79	0.09	3.39
Methylcyclohexane	24	10.07	0.12	6.86
2,2,3-Trimethylpentane	4	10.24	0.17	7.75
2,3,4-Trimethylpentane	22	8.23	0.12	5.77
Toluene	24	2.11	0.21	1.47
2-Methylheptane	17	6.85	0.09	5.04
3-Methylheptane	18	13.18	0.13	9.28
1-Octene	0	NA	NA	NA
<i>n</i> -Octane	24	8.10	0.07	5.61
Ethylbenzene	24	6.83	0.08	4.65
<i>m,p</i> -Xylene	24	2.34	0.09	1.64
Styrene	12	7.36	0.10	5.31
<i>o</i> -Xylene	24	8.29	0.12	5.77
1-Nonene	1	NA	NA	NA
<i>n</i> -Nonane	24	8.29	0.06	5.88
Isopropylbenzene	7	23.54	0.38	17.74
<i>a</i> -Pinene	21	8.21	0.07	5.88
<i>n</i> -Propylbenzene	19	22.13	0.12	13.59
<i>m</i> -Ethyltoluene	24	7.48	0.06	5.00
<i>p</i> -Ethyltoluene	21	12.38	0.09	8.40
1,3,5-Trimethylbenzene	24	6.89	0.04	4.75
<i>o</i> -Ethyltoluene	24	17.34	0.10	12.95
<i>b</i> -Pinene	3	NA	0.43	NA
1,2,4-Trimethylbenzene	23	11.65	0.22	8.80
1-Decene	0	NA	NA	NA
<i>n</i> -Decane	19	16.48	0.16	10.47
1,2,3-Trimethylbenzene	20	11.09	0.08	8.20
<i>m</i> -Diethylbenzene	15	13.00	0.16	10.18
<i>p</i> -Diethylbenzene	14	24.54	0.17	21.31
<i>l</i> -Undecene	0	NA	NA	NA
<i>n</i> -Undecane	16	9.21	0.09	6.94
1-Dodecene	5	14.77	0.44	11.28
<i>n</i> -Dodecane	4	5.30	0.56	3.65

**Table 21-13. SNMOC Analytical Precision:
24 Replicate Analyses for Duplicate Samples in Bountiful, UT (BTUT) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
1-Tridecene	0	NA	NA	NA
<i>n</i> -Tridecane	0	NA	NA	NA
TNMOC (speciated)	24	17.62	66.25	19.64
TNMOC (w/ unknowns)	24	15.57	65.70	15.50

**Table 21-14. SNMOC Analytical Precision:
Four Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
Ethylene	4	0.93	0.04	0.66
Acetylene	4	4.47	0.26	3.08
Ethane	4	0.82	0.10	0.58
Propylene	4	2.82	0.04	2.02
Propane	4	2.39	0.35	1.66
Propyne	0	NA	NA	NA
Isobutane	4	4.93	0.12	3.58
Isobutene/1-Butene	4	9.40	0.17	6.14
1,3-Butadiene	0	NA	NA	NA
<i>n</i> -Butane	4	1.01	0.06	0.71
<i>trans</i> -2-Butene	4	12.71	0.03	9.94
<i>cis</i> -2-Butene	3	8.81	0.09	6.51
3-Methyl-1-butene	0	NA	NA	NA
Isopentane	4	2.14	0.09	1.49
1-Pentene	1	NA	NA	NA
2-Methyl-1-butene	0	NA	NA	NA
<i>n</i> -Pentane	4	5.40	0.13	3.71
Isoprene	0	NA	NA	NA
<i>trans</i> -2-Pentene	3	87.67	0.30	43.10
<i>cis</i> -2-Pentene	1	NA	NA	NA
2-Methyl-2-butene	4	20.40	0.11	16.06
2,2-Dimethylbutane	0	NA	NA	NA
Cyclopentene	1	NA	NA	NA
4-Methyl-1-pentene	0	NA	NA	NA
Cyclopentane	4	39.26	0.11	22.74
2,3-Dimethylbutane	4	2.84	0.01	1.96
2-Methylpentane	4	3.98	0.06	2.89
3-Methylpentane	4	17.79	0.33	13.78
2-Methyl-1-pentene	0	NA	NA	NA
1-Hexene	0	NA	NA	NA
2-Ethyl-1-butene	0	NA	NA	NA
<i>n</i> -Hexane	4	1.33	0.02	0.93
<i>trans</i> -2-Hexene	0	NA	NA	NA
<i>cis</i> -2-Hexene	0	NA	NA	NA
Methylcyclopentane	4	3.97	0.03	2.71
2,4-Dimethylpentane	2	16.20	0.05	10.60
Benzene	4	1.67	0.04	1.17
Cyclohexane	3	6.97	0.17	5.11

**Table 21-14. SNMOC Analytical Precision:
Four Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
2-Methylhexane	0	NA	NA	NA
2,3-Dimethylpentane	3	25.83	0.35	20.97
3-Methylhexane	4	38.10	0.44	33.33
1-Heptene	0	NA	NA	NA
2,2,4-Trimethylpentane	4	3.66	0.05	2.64
<i>n</i> -Heptane	4	4.61	0.03	3.20
Methylcyclohexane	4	12.70	0.04	9.61
2,2,3-Trimethylpentane	0	NA	NA	NA
2,3,4-Trimethylpentane	0	NA	NA	NA
Toluene	4	3.99	0.16	2.82
2-Methylheptane	0	NA	NA	NA
3-Methylheptane	0	NA	NA	NA
1-Octene	0	NA	NA	NA
<i>n</i> -Octane	4	17.32	0.08	11.27
Ethylbenzene	4	7.28	9.00	4.92
<i>m,p</i> -Xylene	4	2.96	0.06	2.11
Styrene	0	NA	NA	NA
<i>o</i> -Xylene	4	7.76	0.05	5.41
1-Nonene	0	NA	NA	NA
<i>n</i> -Nonane	4	16.79	0.04	11.98
Isopropylbenzene	0	NA	NA	NA
<i>α</i> -Pinene	0	NA	NA	NA
<i>n</i> -Propylbenzene	4	5.98	0.01	4.07
<i>m</i> -Ethyltoluene	4	5.77	0.03	3.95
<i>p</i> -Ethyltoluene	2	6.64	0.02	4.54
1,3,5-Trimethylbenzene	2	12.78	0.05	9.66
<i>o</i> -Ethyltoluene	4	6.61	0.02	4.85
<i>β</i> -Pinene	0	NA	NA	NA
1,2,4-Trimethylbenzene	3	14.40	0.15	9.50
1-Decene	0	NA	NA	NA
<i>n</i> -Decane	2	5.43	0.02	3.95
1,2,3-Trimethylbenzene	4	9.90	0.02	6.55
<i>m</i> -Diethylbenzene	0	NA	NA	NA
<i>p</i> -Diethylbenzene	0	NA	NA	NA
1-Undecene	0	NA	NA	NA
<i>n</i> -Undecane	0	NA	NA	NA
1-Dodecene	0	NA	NA	NA
<i>n</i> -Dodecane	0	NA	NA	NA

**Table 21-14. SNMOC Analytical Precision:
Four Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO) (Cont.)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbC)	Coefficient of Variation (%)
1-Tridecene	0	NA	NA	NA
<i>n</i> -Tridecane	0	NA	NA	NA
TNMOC (speciated)	4	0.73	0.60	0.52
TNMOC (w/ unknowns)	4	2.24	2.50	1.60

**Table 21-15. SNMOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites**

Compound	Average	Bountiful, UT (BTUT)	Custer, SD (CUSD)	North Brook, IL (NBIL)	Pascagoula, MS (PGMS)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)
Ethylene	6.53	12.95	12.84	7.85	0.82	0.66	4.03
Acetylene	4.21	2.91	9.73	5.96	0.81	3.08	2.79
Ethane	4.57	5.53	9.69	7.52	1.10	0.58	3.01
Propylene	3.41	2.00	6.23	4.94	0.87	2.02	4.37
Propane	3.87	1.51	11.56	5.42	1.53	1.66	1.56
Propyne	NA	NA	NA	NA	NA	NA	NA
Isobutane	4.75	1.32	13.92	4.17	1.91	3.58	3.58
Isobutene/1-Butene	5.63	4.15	10.26	3.26	3.96	6.14	6.00
1,3-Butadiene	3.33	3.33	NA	NA	NA	NA	NA
n-Butane	5.63	6.52	15.42	4.55	2.41	0.71	4.15
trans-2-Butene	14.98	16.44	15.10	15.21	2.64	9.94	30.57
cis-2-Butene	11.59	16.77	13.59	NA	4.23	6.51	16.87
3-Methyl-1-butene	4.27	4.27	NA	NA	NA	NA	NA
Isopentane	4.39	2.28	11.41	2.87	NA	1.49	3.91
1-Pentene	11.28	8.29	6.02	8.80	7.63	NA	25.68
2-Methyl-1-butene	3.64	4.24	3.04	NA	NA	NA	NA
n-Pentane	6.30	2.88	13.19	12.51	2.09	3.71	3.41
Isoprene	13.21	14.31	11.88	5.57	13.73	NA	20.58
trans-2-Pentene	16.06	13.60	8.17	2.72	2.61	43.10	26.15
cis-2-Pentene	19.12	16.80	23.44	18.88	2.35	NA	34.14
2-Methyl-2-butene	11.11	1.44	2.84	NA	24.10	16.06	NA
2,2-Dimethylbutane	13.61	10.58	12.11	7.35	NA	NA	24.40
Cyclopentene	5.32	6.42	3.76	5.78	NA	NA	NA
4-Methyl-1-pentene	3.60	NA	NA	NA	NA	NA	3.60
Cyclopentane	10.91	5.47	18.19	4.25	5.00	22.74	9.84
2,3-Dimethylbutane	7.60	4.58	18.77	2.72	3.37	1.96	14.18
2-Methylpentane	5.04	3.52	7.31	8.48	3.57	2.89	4.50
3-Methylpentane	10.10	6.86	9.32	9.93	5.86	13.78	14.86
2-Methyl-1-pentene	NA	NA	NA	NA	NA	NA	NA
1-Hexene	17.49	19.56	7.60	21.30	NA	NA	21.51
2-Ethyl-1-butene	NA	NA	NA	NA	NA	NA	NA
n-Hexane	4.76	3.12	11.20	4.66	1.72	0.93	6.95
trans-2-Hexene	NA	NA	NA	NA	NA	NA	NA
cis-2-Hexene	NA	NA	NA	NA	NA	NA	NA
Methylcyclopentane	5.24	4.26	10.56	6.38	3.38	2.71	4.14
2,4-Dimethylpentane	11.61	8.56	12.10	9.68	2.25	10.60	26.50

**Table 21-15. SNMOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Bountiful, UT (BTUT)	Custer, SD (CUSD)	North Brook, IL (NBIL)	Pascagoula, MS (PGMS)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)
Benzene	3.14	1.77	4.88	5.42	1.39	1.17	4.21
Cyclohexane	12.24	6.08	8.60	6.70	NA	5.11	34.69
2-Methylhexane	15.03	25.55	10.45	16.33	11.03	NA	11.78
2,3-Dimethylpentane	15.12	11.30	16.18	12.03	NA	20.97	NA
3-Methylhexane	11.52	5.00	9.00	8.15	5.42	33.33	8.26
1-Heptene	NA	NA	NA	NA	NA	NA	NA
2,2,4-Trimethylpentane	4.03	3.86	3.96	3.60	3.17	2.64	6.93
n-Heptane	7.29	3.39	13.79	5.89	1.77	3.20	15.70
Methylcyclohexane	9.17	6.86	6.04	9.06	8.47	9.61	14.94
2,2,3-Trimethylpentane	7.75	7.75	NA	NA	NA	NA	NA
2,3,4-Trimethylpentane	8.83	5.77	NA	3.69	1.12	NA	24.72
Toluene	4.31	1.47	13.41	3.59	1.72	2.82	2.84
2-Methylheptane	3.36	5.04	NA	1.68	NA	NA	NA
3-Methylheptane	7.20	9.28	11.77	0.56	NA	NA	NA
1-Octene	NA	NA	NA	NA	NA	NA	NA
n-Octane	7.95	5.61	6.09	6.64	2.54	11.27	15.56
Ethylbenzene	6.52	4.65	11.13	7.61	1.37	4.92	9.44
m,p - Xylene	5.35	1.64	13.61	6.65	1.60	2.11	6.47
Styrene	5.74	5.31	5.33	7.26	NA	NA	5.07
o-Xylene	7.59	5.77	14.48	6.97	1.68	5.41	11.24
1-Nonene	15.87	NA	NA	15.87	NA	NA	NA
n-Nonane	8.32	5.88	12.58	5.44	1.48	11.98	12.59
Isopropylbenzene	15.86	17.74	21.37	9.10	NA	NA	15.23
a-Pinene	10.27	5.88	4.53	33.85	2.23	NA	4.87
n-Propylbenzene	9.99	13.59	13.37	11.96	3.32	4.07	13.65
m-Ethyltoluene	6.11	5.00	11.56	3.82	1.97	3.95	10.32
p-Ethyltoluene	8.77	8.40	13.56	4.79	3.84	4.54	17.51
1,3,5-Trimethylbenzene	11.74	4.75	14.18	20.52	3.75	9.66	17.59
o-Ethyltoluene	11.24	12.95	13.54	10.41	5.44	4.85	20.25
b-Pinene	7.80	NA	5.46	6.67	11.27	NA	NA
1,2,4-Trimethylbenzene	7.44	8.80	7.85	5.66	2.05	9.50	10.82
1-Decene	NA	NA	NA	NA	NA	NA	NA
n-Decane	10.48	10.47	17.29	6.48	11.38	3.95	13.33
1,2,3-Trimethylbenzene	15.90	8.20	25.22	19.91	9.53	6.55	25.99
m-Diethylbenzene	13.20	10.18	18.57	16.00	NA	NA	8.03
p-Diethylbenzene	14.93	21.31	20.65	5.27	9.06	NA	18.38
1-Undecene	NA	NA	NA	NA	NA	NA	NA

**Table 21-15. SNMOC Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Bountiful, UT (BTUT)	Custer, SD (CUSD)	North Brook, IL (NBIL)	Pascagoula, MS (PGMS)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)
<i>n</i> -Undecane	12.15	6.94	34.14	7.54	3.12	NA	9.00
1-Dodecene	NA	11.28	NA	NA	NA	NA	NA
<i>n</i> -Dodecane	24.52	3.65	52.19	12.56	29.69	NA	NA
1-Tridecene	NA	NA	NA	NA	NA	NA	NA
<i>n</i> -Tridecane	NA	NA	NA	NA	NA	NA	NA
TNMOC (speciated)	10.07	19.64	28.01	5.62	1.78	0.52	4.86
TNMOC (w/ unknowns)	8.28	15.50	23.50	3.20	2.94	1.60	2.95
Average	9.09	8.23	14.18	8.72	4.84	7.31	12.39

**Table 21-16. Carbonyl Analytical Precision:
498 Replicate Analyses for all Duplicate and Collocated Samples**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	498	1.52	0.068	1.07
Acetaldehyde	498	1.23	0.019	0.86
Acetone	498	1.31	0.018	0.92
Propionaldehyde	446	5.25	0.009	3.40
Crotonaldehyde	495	5.22	0.003	3.59
Butyr/Isobutyraldehyde	498	3.89	0.005	2.72
Benzaldehyde	480	5.35	0.003	3.72
Isovaleraldehyde	210	8.65	0.005	5.78
Valeraldehyde	451	5.83	0.002	4.24
Tolualdehydes	448	7.62	0.003	5.20
Hexaldehyde	490	5.32	0.003	3.70
2,5-Dimethylbenzaldehyde	91	7.63	0.002	5.26

**Table 21-17. Carbonyl Analytical Precision:
158 Replicate Analyses for all Collocated Samples**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	158	1.64	0.154	1.18
Acetaldehyde	158	1.37	0.025	0.96
Acetone	158	1.81	0.032	1.27
Propionaldehyde	154	4.91	0.008	3.62
Crotonaldehyde	157	4.59	0.003	3.18
Butyr/Isobutyraldehyde	158	3.39	0.006	2.38
Benzaldehyde	157	5.43	0.005	3.85
Isovaleraldehyde	91	5.67	0.003	4.08
Valeraldehyde	156	3.91	0.002	2.85
Tolualdehydes	152	6.46	0.003	4.44
Hexaldehyde	156	5.01	0.005	3.45
2,5-Dimethylbenzaldehyde	44	4.66	0.001	3.06

**Table 21-18. Carbonyl Analytical Precision:
340 Replicate Analyses for all Duplicate Samples**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	340	1.46	0.027	1.02
Acetaldehyde	340	1.17	0.017	0.82
Acetone	340	1.07	0.011	0.76
Propionaldehyde	292	5.40	0.009	3.30
Crotonaldehyde	338	5.52	0.003	3.79
Butyr/Isobutyraldehyde	340	4.12	0.004	2.88
Benzaldehyde	323	5.32	0.002	3.65
Isovaleraldehyde	119	10.06	0.006	6.59
Valeraldehyde	295	6.74	0.003	4.89
Tolualdehydes	296	8.17	0.004	5.56
Hexaldehyde	334	5.47	0.002	3.82
2,5-Dimethylbenzaldehyde	47	9.04	0.002	6.30

**Table 21-19. Carbonyl Analytical Precision:
16 Replicate Analyses for Duplicate Samples in Tampa, FL (SYFL)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	16	2.43	0.023	1.75
Acetaldehyde	16	3.93	0.029	2.73
Acetone	16	1.69	0.007	1.20
Propionaldehyde	16	3.20	0.002	2.31
Crotonaldehyde	16	6.23	0.005	4.23
Butyr/Isobutyraldehyde	16	5.17	0.007	3.74
Benzaldehyde	16	3.42	0.001	2.51
Isovaleraldehyde	5	2.38	0.010	1.64
Valeraldehyde	16	5.04	0.002	3.56
Tolualdehydes	16	8.48	0.003	5.89
Hexaldehyde	16	6.67	0.002	4.54
2,5-Dimethylbenzaldehyde	0	NA	NA	NA

**Table 21-20. Carbonyl Analytical Precision:
100 Replicate Analyses for Collocated Samples in Detroit, MI (DEMI)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	100	0.82	0.346	0.58
Acetaldehyde	100	0.90	0.117	0.63
Acetone	100	1.24	0.093	0.87
Propionaldehyde	100	4.56	0.025	3.39
Crotonaldehyde	99	4.08	0.008	2.83
Butyr/Isobutyraldehyde	100	3.41	0.034	2.39
Benzaldehyde	100	4.15	0.003	2.94
Isovaleraldehyde	56	13.16	0.021	9.01
Valeraldehyde	100	3.20	0.005	2.25
Tolualdehydes	100	7.59	0.005	5.31
Hexaldehyde	100	5.05	0.006	3.62
2,5-Dimethylbenzaldehyde	27	13.11	0.002	9.41

**Table 21-21. Carbonyl Analytical Precision:
20 Replicate Analyses for Duplicate Samples in Grand Junction, CO (GPCO)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	20	0.92	0.016	0.65
Acetaldehyde	20	0.78	0.012	0.55
Acetone	20	0.52	0.009	0.37
Propionaldehyde	15	4.62	0.013	3.36
Crotonaldehyde	20	3.89	0.002	2.71
Butyr/Isobutyraldehyde	20	4.94	0.005	3.42
Benzaldehyde	20	4.30	0.002	2.93
Isovaleraldehyde	5	6.97	0.002	5.11
Valeraldehyde	15	5.53	0.005	3.77
Tolualdehydes	20	4.85	0.001	3.44
Hexaldehyde	20	6.38	0.002	4.40
2,5-Dimethylbenzaldehyde	3	9.09	0.008	6.73

**Table 21-22. Carbonyl Analytical Precision:
24 Replicate Analyses for all Duplicate Samples in Bountiful, UT (BTUT)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	24	1.37	0.038	0.97
Acetaldehyde	24	0.66	0.010	0.46
Acetone	24	0.76	0.012	0.54
Propionaldehyde	24	2.94	0.004	2.08
Crotonaldehyde	24	4.94	0.002	3.43
Butyr/Isobutyraldehyde	24	4.51	0.008	3.31
Benzaldehyde	24	5.12	0.003	3.49
Isovaleraldehyde	16	29.56	0.003	14.29
Valeraldehyde	24	3.49	0.002	2.49
Tolualdehydes	24	10.84	0.005	8.60
Hexaldehyde	24	3.19	0.003	2.31
2,5-Dimethylbenzaldehyde	8	32.94	0.003	23.16

**Table 21-23. Carbonyl Analytical Precision:
Six Replicate Analyses for Duplicate Samples in St. Louis, MO (S4MO)**

Compound	Number of Observations	Average RPD for Replicate Analyses (%)	Average Concentration Difference for Replicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	6	0.63	0.017	0.44
Acetaldehyde	6	0.00	0.000	0.00
Acetone	6	0.40	0.007	0.29
Propionaldehyde	6	0.75	0.001	0.53
Crotonaldehyde	6	5.53	0.003	3.85
Butyr/Isobutyraldehyde	6	1.52	0.003	1.07
Benzaldehyde	6	11.11	0.005	7.22
Isovaleraldehyde	5	36.67	0.006	21.89
Valeraldehyde	6	21.41	0.012	18.06
Tolualdehydes	6	8.07	0.004	6.33
Hexaldehyde	6	1.29	0.001	0.92
2,5-Dimethylbenzaldehyde	3	25.00	0.003	15.71

**Table 21-24. Carbonyl Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites**

Compound	Average	St. Petersburg, FL (AZFL)	Bountiful, UT (BTUT)	Camden, NJ (CANJ)	Candor, NC (CANC)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Tampa (Gandy), FL (GAFL)
Formaldehyde	1.10	1.41	0.97	0.42	1.28	0.80	1.00	0.58	0.97	0.56	0.80
Acetaldehyde	0.88	1.40	0.46	0.18	1.17	0.60	0.73	0.63	0.98	0.15	0.92
Acetone	0.92	1.52	0.54	0.27	1.24	0.58	0.63	0.87	2.49	0.62	0.84
Propionaldehyde	3.59	4.53	2.08	NA	2.08	2.66	9.69	3.39	3.45	5.18	3.44
Crotonaldehyde	3.81	1.48	3.43	4.71	2.26	3.27	5.45	2.83	7.34	3.45	2.99
Butyr/Isobutyraldehyde	2.69	3.51	3.31	2.54	2.25	3.33	4.40	2.39	2.27	1.37	3.16
Benzaldehyde	3.76	3.37	3.49	3.38	2.77	2.25	3.49	2.94	1.80	4.07	6.22
Isovaleraldehyde	8.31	12.64	14.29	NA	5.66	15.68	5.42	9.01	NA	12.76	2.21
Valeraldehyde	4.53	3.33	2.49	5.20	NA	6.09	4.24	2.25	2.94	3.82	4.19
Tolualdehydes	5.55	3.39	8.60	8.18	2.05	8.15	2.27	5.31	8.49	7.33	4.01
Hexaldehyde	4.04	4.04	2.31	3.21	NA	4.06	6.58	3.62	7.80	5.21	4.97
2,5-Dimethylbenzaldehyde	12.27	NA	23.16	NA	NA	10.10	NA	9.41	NA	17.36	NA
Average	4.29	3.69	5.43	3.12	2.31	4.80	3.99	3.60	3.85	5.16	3.07

**Table 21-24. Carbonyl Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Grand Junction, CO (GPCO)	Gulfport, MS (GPMS)	Grenada, MS (GRMS)	Jackson, MS (JAMS)	Kingsport, TN (KITN)	Loudon, TN (LDTN)	Nashville, TN (EATN)	Nashville, TN (LOTN)	Madison, WI (MAWI)	Orlando, FL (ORFL)	New Brunswick, NJ (NBNJ)
Formaldehyde	1.10	0.65	1.56	0.55	0.95	0.54	2.79	1.49	1.86	NA	2.31	0.80
Acetaldehyde	0.88	0.55	0.71	0.34	0.77	0.02	0.74	2.01	2.05	0.38	1.46	0.47
Acetone	0.92	0.37	1.02	0.50	0.88	0.92	0.48	1.76	1.74	0.58	0.94	0.75
Propionaldehyde	3.59	3.36	1.65	2.48	3.00	2.41	1.71	2.20	1.44	13.86	3.96	3.25
Crotonaldehyde	3.81	2.71	7.38	3.22	2.84	3.60	4.82	3.79	1.85	2.11	4.17	3.50
Butyr/Isobutyraldehyde	2.69	3.42	2.67	1.10	5.07	2.60	0.32	2.43	1.59	0.73	3.04	1.67
Benzaldehyde	3.76	2.93	4.97	3.01	1.82	4.60	7.87	2.92	1.64	7.07	1.49	5.51
Isovaleraldehyde	8.31	5.11	NA	7.02	NA	12.55	1.82	5.06	2.62	NA	11.71	4.50
Valeraldehyde	4.53	3.77	NA	5.68	9.56	1.75	3.24	1.16	1.09	7.07	2.31	2.53
Tolualdehydes	5.55	3.44	5.44	5.71	2.87	4.76	3.20	1.45	4.15	10.55	7.92	5.61
Hexaldehyde	4.04	4.40	3.62	2.26	4.47	3.86	6.11	2.82	1.62	NA	5.82	3.03
2,5-Dimethylbenzaldehyde	12.27	6.73	NA	10.11	NA	11.79	3.93	2.44	NA	NA	24.50	11.99
Average	4.29	3.12	3.22	3.50	3.22	4.12	3.08	2.46	1.97	5.30	5.80	3.63

**Table 21-24. Carbonyl Analytical Precision:
Coefficient of Variation for all Replicate Analyses, All Sites (Cont.)**

Compound	Average	Pascagoula, MS (PGMS)	Research Triangle Park, NC (RTPNC)	St. Louis, MO (Site 4 - S4MO)	Tampa, FL (SKFL)	Tampa, FL (SYFL)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
Formaldehyde	<i>1.10</i>	1.14	1.14	0.44	1.05	1.75	0.73	1.48
Acetaldehyde	<i>0.88</i>	0.73	0.61	NA	1.49	2.73	0.46	1.39
Acetone	<i>0.92</i>	0.54	1.36	0.29	1.20	1.20	0.74	0.94
Propionaldehyde	<i>3.59</i>	1.70	2.02	0.53	3.34	2.31	7.54	2.05
Crotonaldehyde	<i>3.81</i>	3.37	NA	3.85	2.84	4.23	7.53	1.55
Butyr/Isobutyraldehyde	<i>2.69</i>	2.30	6.82	1.07	2.87	3.74	2.73	3.35
Benzaldehyde	<i>3.76</i>	3.48	3.07	7.22	2.05	2.51	5.57	2.54
Isovaleraldehyde	<i>8.31</i>	6.22	NA	21.89	NA	1.64	NA	4.16
Valeraldehyde	<i>4.53</i>	4.88	6.15	18.06	4.11	3.56	3.71	5.47
Tolualdehydes	<i>5.55</i>	9.80	NA	6.33	2.68	5.89	6.66	1.31
Hexaldehyde	<i>4.04</i>	0.91	5.24	0.92	3.74	4.54	5.83	2.69
2,5-Dimethylbenzaldehyde	12.27	NA	NA	15.71	NA	NA	NA	NA
Average	<i>4.29</i>	<i>3.19</i>	<i>3.30</i>	<i>6.94</i>	<i>2.54</i>	<i>3.10</i>	<i>4.15</i>	<i>2.45</i>

**Table 21-25. VOC Sampling and Analytical Precision:
218 Duplicate and Collocated Samples**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	215	14.82	0.44	11.87
Propylene	215	23.22	0.13	14.42
Dichlorodifluoromethane	216	6.31	0.06	4.53
Chloromethane	217	10.22	0.08	7.21
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	73	10.00	0.04	7.24
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	130	47.47	3.26	17.90
Trichlorofluoromethane	216	22.54	0.12	12.96
Acrylonitrile	16	2.18	0.09	1.67
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	115	23.16	0.12	17.83
Trichlorotrifluoroethane	173	9.67	0.01	6.82
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	79	3.81	0.03	3.51
Methyl Ethyl Ketone	169	46.89	0.44	27.26
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	31	461.04	0.80	7.53
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloromethane	0	NA	NA	NA
1,1,1-Trichloroethane	8	4.60	0.04	4.06
Benzene	218	12.38	0.05	9.03
Carbon Tetrachloride	200	29.26	0.05	11.33
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	4	0.57	0.01	0.44
Methyl Methacrylate	7	5.22	0.21	5.98
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	39	25.04	0.13	7.22
<i>trans</i> -1,3-Dichloropropene	10	0.67	0.001	0.49
1,1,2 -Trichloroethane	0	NA	NA	NA

**Table 21-25. VOC Sampling and Analytical Precision:
218 Duplicate and Collocated Samples (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	218	46.58	0.34	15.83
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	75	51.99	0.60	7.13
Tetrachloroethylene	79	2.79	0.03	2.38
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	214	40.83	0.04	13.72
<i>m,p</i> -Xylene	218	42.46	0.12	14.75
Bromoform	0	NA	NA	NA
Styrene	158	29.03	0.03	13.37
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	216	37.42	0.04	13.39
1,3,5-Trimethylbenzene	136	10.63	0.02	9.55
1,2,4-Trimethylbenzene	179	20.45	0.06	14.27
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	14	1.17	0.01	0.88
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

Table 21-26. VOC Sampling and Analytical Precision: 70 Collocated Samples

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	67	25.50	0.82	18.48
Propylene	67	38.82	0.19	20.54
Dichlorodifluoromethane	69	7.57	0.09	5.05
Chloromethane	69	12.63	0.13	7.54
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	28	16.67	0.04	9.67
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	32	84.53	2.38	19.86
Trichlorofluoromethane	69	37.79	0.22	18.24
Acrylonitrile	3	0.91	0.17	0.67
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	38	27.76	0.19	21.59
Trichlorotrifluoroethane	46	12.23	0.02	8.42
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	10	2.49	0.03	1.68
Methyl Ethyl Ketone	52	53.69	0.70	28.81
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	20	1150.94	1.98	17.55
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloromethane	0	NA	NA	NA
1,1,1-Trichloroethane	6	11.49	0.08	10.15
Benzene	70	19.03	0.07	11.94
Carbon Tetrachloride	67	55.50	0.08	15.39
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	23	58.48	0.25	15.03
<i>trans</i> -1,3-Dichloropropene	8	0.83	0.001	0.61
1,1,2 -Trichloroethane	0	NA	NA	NA
Toluene	70	96.33	0.55	23.40

Table 21-26. VOC Sampling and Analytical Precision: 70 Collocated Samples (Cont.)

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	15	124.22	1.46	14.01
Tetrachloroethylene	46	2.96	0.05	2.08
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	70	86.84	0.07	21.09
<i>m,p</i> -Xylene	70	88.01	0.18	21.49
Bromoform	0	NA	NA	NA
Styrene	44	42.21	0.04	12.47
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	70	75.93	0.06	19.03
1,3,5-Trimethylbenzene	47	13.50	0.03	12.05
1,2,4-Trimethylbenzene	65	28.33	0.07	19.36
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	4	1.11	0.01	0.83
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

Table 21-27. VOC Sampling and Analytical Precision: 148 Duplicate Samples

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	148	7.71	0.19	7.46
Propylene	148	12.83	0.09	10.33
Dichlorodifluoromethane	147	5.48	0.04	4.19
Chloromethane	148	8.62	0.05	6.99
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	45	5.55	0.05	5.61
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	98	22.76	3.85	16.58
Trichlorofluoromethane	147	12.38	0.05	9.43
Acrylonitrile	13	3.02	0.03	2.34
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	77	20.10	0.07	15.32
Trichlorotrifluoroethane	127	7.96	0.01	5.76
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	69	4.69	0.04	4.73
Methyl Ethyl Ketone	117	42.36	0.27	26.24
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	11	1.11	0.01	0.86
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	0	NA	NA	NA
Benzene	148	7.95	0.04	7.10
Carbon Tetrachloride	133	11.77	0.02	8.62
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	3	0.95	0.01	0.73
Methyl Methacrylate	7	8.69	0.35	9.97
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	16	2.75	0.05	2.02
<i>trans</i> -1,3-Dichloropropene	2	0.56	0.001	0.41
1,1,2-Trichloroethane	0	NA	NA	NA
Toluene	148	13.42	0.19	10.79

Table 21-27. VOC Sampling and Analytical Precision: 148 Duplicate Samples (Cont.)

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	60	3.84	0.02	2.54
Tetrachloroethylene	33	2.69	0.01	2.57
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	144	10.16	0.02	8.81
<i>m,p</i> -Xylene	148	12.10	0.07	10.25
Bromoform	0	NA	NA	NA
Styrene	114	20.24	0.02	13.98
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	146	11.75	0.03	9.63
1,3,5-Trimethylbenzene	89	8.72	0.01	7.88
1,2,4-Trimethylbenzene	114	15.20	0.04	10.87
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	10	1.20	0.01	0.91
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-28. VOC Sampling and Analytical Precision:
30 Collocated Samples in Detroit, MI (DEMI)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	28	6.15	0.07	4.13
Propylene	28	9.50	0.04	6.57
Dichlorodifluoromethane	30	7.37	0.04	4.89
Chloromethane	30	7.07	0.05	5.06
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	8	17.17	0.03	11.45
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	19	38.57	1.20	42.25
Trichlorofluoromethane	29	10.06	0.06	6.05
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	14	12.69	0.04	9.69
Trichlorotrifluoroethane	20	6.18	0.01	4.34
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	19	24.31	0.15	17.18
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	2	20.00	0.01	15.71
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	0	NA	NA	NA
Benzene	30	9.15	0.04	6.83
Carbon Tetrachloride	28	13.80	0.01	9.24
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	1	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	8	23.87	0.10	19.20
<i>trans</i> -1,3-Dichloropropene	4	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-28. VOC Sampling and Analytical Precision:
30 Collocated Samples in Detroit, MI (DEMI) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	30	10.44	0.05	5.91
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	3	NA	0.04	NA
Tetrachloroethylene	30	14.95	0.14	10.98
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	30	4.98	0.005	3.67
<i>m,p</i> -Xylene	30	6.27	0.02	4.43
Bromoform	0	NA	NA	NA
Styrene	14	49.51	0.04	22.35
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	30	12.18	0.01	7.87
1,3,5-Trimethylbenzene	20	8.09	0.02	5.95
1,2,4-Trimethylbenzene	28	9.15	0.02	6.05
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	0	NA	NA	NA
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-29. VOC Sampling and Analytical Precision:
10 Duplicate Samples in Grand Junction, CO (GPCO)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	10	11.98	0.11	7.84
Propylene	10	14.83	0.06	9.44
Dichlorodifluoromethane	10	12.93	0.05	7.47
Chloromethane	10	13.59	0.06	8.20
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	6	19.52	0.02	14.21
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	0	NA	NA	NA
Trichlorofluoromethane	10	10.61	0.03	6.50
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	10	14.61	0.01	9.23
Trichlorotrifluoroethane	0	NA	NA	NA
<i>trans</i> -1,2-Dichloroethylene	10	90.46	0.42	34.51
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	0	NA	NA	NA
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	10	9.37	0.03	5.74
Chloroform	7	18.70	0.04	14.75
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	0	NA	NA	NA
Benzene	0	NA	NA	NA
Carbon Tetrachloride	4	34.44	0.07	19.05
<i>tert</i> -Amyl Methyl Ether	3	23.08	0.11	18.45
1,2-Dichloropropane	10	12.31	0.07	7.15
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	5	NA	0.02	NA
Methyl Methacrylate	3	NA	0.03	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	10	10.03	0.01	5.96
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	10	25.25	0.07	21.54

**Table 21-29. VOC Sampling and Analytical Precision:
10 Duplicate Samples in Grand Junction, CO (GPCO) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	10	15.08	0.01	10.85
Dibromochloromethane	10	10.37	0.02	6.76
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	0	NA	NA	NA
Tetrachloroethylene	0	NA	NA	NA
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	0	NA	NA	NA
<i>m,p</i> -Xylene	0	NA	NA	NA
Bromoform	0	NA	NA	NA
Styrene	0	NA	NA	NA
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	0	NA	NA	NA
1,3,5-Trimethylbenzene	4	NA	0.08	NA
1,2,4-Trimethylbenzene	10	12.27	0.04	7.29
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	10	10.35	0.01	6.15
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-30. VOC Sampling and Analytical Precision:
Four Collocate Samples in North Brook, IL (NBIL)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	4	98.11	6.14	87.11
Propylene	4	86.15	0.43	48.77
Dichlorodifluoromethane	4	17.16	0.16	10.84
Chloromethane	4	44.36	0.35	22.26
Dichlorotetrafluoroethane	1	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	0	NA	NA	NA
Bromomethane	1	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	2	0.00	7.52	0.00
Trichlorofluoromethane	4	229.86	1.76	99.81
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	3	90.00	1.40	115.71
Trichlorotrifluoroethane	4	20.83	0.03	12.19
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	4	140.51	1.94	79.05
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	4	11461.13	19.72	139.67
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	1	NA	NA	NA
Benzene	4	62.85	0.14	35.78
Carbon Tetrachloride	4	452.98	0.69	82.54
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	2	NA	6.30	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	2	NA	0.77	NA
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-30. VOC Sampling and Analytical Precision:
Four Collocate Samples in North Brook, IL (NBIL) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	4	400.00	1.40	90.91
Dibromochloromethane	2	NA	1.23	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	0	NA	NA	NA
Tetrachloroethylene	3	NA	0.03	NA
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	4	600.28	0.43	107.69
<i>m,p</i> -Xylene	4	695.91	1.27	111.99
Bromoform	1	NA	NA	NA
Styrene	1	NA	NA	NA
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	4	608.89	0.43	105.15
1,3,5-Trimethylbenzene	3	66.67	0.14	70.71
1,2,4-Trimethylbenzene	3	67.86	0.31	72.62
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	0	NA	NA	NA
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-31. VOC Sampling and Analytical Precision:
Four Collocate Samples in Phoenix, AZ (PSAZ)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	2	0.40	0.01	0.28
Propylene	2	13.73	0.14	10.42
Dichlorodifluoromethane	2	2.82	0.02	2.02
Chloromethane	2	NA	NA	NA
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	2	NA	NA	NA
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	2	17.52	0.41	13.58
Trichlorofluoromethane	2	6.06	0.02	4.42
Acrylonitrile	1	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	2	8.11	0.03	5.98
Trichlorotrifluoroethane	2	NA	NA	NA
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	1	NA	NA	NA
Methyl Ethyl Ketone	1	NA	NA	NA
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	1	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	2	69.47	0.66	75.27
Benzene	2	1.82	0.01	1.27
Carbon Tetrachloride	2	9.09	0.01	6.73
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	1	NA	NA	NA
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-31. VOC Sampling and Analytical Precision:
Four Collocate Samples in Phoenix, AZ (PSAZ) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	2	1.25	0.02	0.89
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	2	16.67	0.01	10.88
Tetrachloroethylene	2	NA	NA	NA
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	2	12.00	0.03	9.03
<i>m,p</i> -Xylene	2	2.78	0.02	1.99
Bromoform	0	NA	NA	NA
Styrene	2	NA	NA	NA
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	2	NA	NA	NA
1,3,5-Trimethylbenzene	2	14.29	0.01	10.88
1,2,4-Trimethylbenzene	2	10.00	0.02	6.73
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	1	NA	NA	NA
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-32. VOC Sampling and Analytical Precision:
12 Duplicate Samples in Bountiful, UT (BTUT)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	12	7.79	0.15	5.58
Propylene	12	8.27	0.06	6.58
Dichlorodifluoromethane	12	4.20	0.03	3.00
Chloromethane	12	3.37	0.02	2.45
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	8	7.31	0.03	5.49
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	6	22.62	0.18	13.78
Trichlorofluoromethane	12	3.22	0.01	2.27
Acrylonitrile	5	11.54	0.05	9.22
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	4	5.43	0.02	3.99
Trichlorotrifluoroethane	10	14.02	0.01	10.21
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	7	45.38	0.20	35.33
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	0	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	1	NA	NA	NA
Benzene	12	4.90	0.03	3.43
Carbon Tetrachloride	10	14.68	0.03	11.08
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	0	NA	NA	NA
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-32. VOC Sampling and Analytical Precision:
12 Duplicate Samples in Bountiful, UT (BTUT) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	12	2.45	0.03	1.76
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	9	6.76	0.02	4.61
Tetrachloroethylene	2	NA	NA	NA
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	12	3.68	0.01	2.51
<i>m,p</i> -Xylene	12	1.27	0.01	0.90
Bromoform	0	NA	NA	NA
Styrene	12	16.94	0.01	11.31
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	12	2.73	0.01	1.93
1,3,5-Trimethylbenzene	8	6.25	0.003	3.93
1,2,4-Trimethylbenzene	12	10.64	0.01	6.70
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	0	NA	NA	NA
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-33. VOC Sampling and Analytical Precision:
Two Duplicate Samples in St. Louis, MO (S4MO)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Acetylene	2	4.98	0.11	3.61
Propylene	2	1.96	0.01	1.37
Dichlorodifluoromethane	2	NA	NA	NA
Chloromethane	2	8.16	0.04	5.55
Dichlorotetrafluoroethane	0	NA	NA	NA
Vinyl Chloride	0	NA	NA	NA
1,3-Butadiene	0	NA	NA	NA
Bromomethane	0	NA	NA	NA
Chloroethane	0	NA	NA	NA
Acetonitrile	2	18.18	0.06	11.79
Trichlorofluoromethane	2	NA	NA	NA
Acrylonitrile	0	NA	NA	NA
1,1-Dichloroethene	0	NA	NA	NA
Methylene Chloride	2	4.17	0.01	3.01
Trichlorotrifluoroethane	0	NA	NA	NA
<i>trans</i> -1,2-Dichloroethylene	0	NA	NA	NA
1,1-Dichloroethane	0	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
Methyl Ethyl Ketone	0	NA	NA	NA
Chloroprene	0	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	0	NA	NA	NA
Bromochloromethane	0	NA	NA	NA
Chloroform	0	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	0	NA	NA	NA
1,2-Dichloroethane	0	NA	NA	NA
1,1,1-Trichloroethane	0	NA	NA	NA
Benzene	2	4.76	0.02	3.29
Carbon Tetrachloride	1	NA	NA	NA
<i>tert</i> -Amyl Methyl Ether	0	NA	NA	NA
1,2-Dichloropropane	0	NA	NA	NA
Ethyl Acrylate	0	NA	NA	NA
Bromodichloromethane	0	NA	NA	NA
Trichloroethylene	0	NA	NA	NA
Methyl Methacrylate	0	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	0	NA	NA	NA
Methyl Isobutyl Ketone	0	NA	NA	NA
<i>trans</i> -1,3-Dichloropropene	0	NA	NA	NA
1,1,2-Trichloroethane	0	NA	NA	NA

**Table 21-33. VOC Sampling and Analytical Precision:
Two Duplicate Samples in St. Louis, MO (S4MO) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Toluene	2	4.69	0.03	3.24
Dibromochloromethane	0	NA	NA	NA
1,2-Dibromoethane	0	NA	NA	NA
<i>n</i> -Octane	0	NA	NA	NA
Tetrachloroethylene	0	NA	NA	NA
Chlorobenzene	0	NA	NA	NA
Ethylbenzene	2	NA	NA	NA
<i>m,p</i> -Xylene	2	10.34	0.03	7.71
Bromoform	0	NA	NA	NA
Styrene	0	NA	NA	NA
1,1,2,2-Tetrachloroethane	0	NA	NA	NA
<i>o</i> -Xylene	2	9.09	0.01	6.73
1,3,5-Trimethylbenzene	0	NA	NA	NA
1,2,4-Trimethylbenzene	1	NA	NA	NA
<i>m</i> -Dichlorobenzene	0	NA	NA	NA
Chloromethylbenzene	0	NA	NA	NA
<i>p</i> -Dichlorobenzene	2	NA	NA	NA
<i>o</i> -Dichlorobenzene	0	NA	NA	NA
1,2,4-Trichlorobenzene	0	NA	NA	NA
Hexachloro-1,3-Butadiene	0	NA	NA	NA

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites**

Compound	Average	Bountiful, UT (BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Grand Junction, CO (GPCO)	Grenada, MS (GRMS)	Gulfport, MS (GPMS)
Acetylene	11.87	5.58	5.03	2.80	6.76	4.13	13.18	5.98	7.84	12.75	7.07
Propylene	14.42	6.58	9.72	7.32	5.67	6.57	16.53	3.74	9.44	15.90	12.63
Dichlorodifluoromethane	4.72	3.00	6.10	2.66	3.07	4.89	3.86	1.11	7.47	12.74	1.84
Chloromethane	7.51	2.45	6.21	4.34	9.49	5.06	12.41	4.65	8.20	9.00	2.16
Dichlorotetrafluoroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	18.09	5.49	22.33	NA	NA	11.45	NA	7.82	14.21	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	24.86	13.78	3.50	9.24	41.03	42.25	NA	21.91	NA	37.22	29.53
Trichlorofluoromethane	13.50	2.27	10.72	4.37	9.88	6.05	21.61	7.32	6.50	27.38	1.52
Acrylonitrile	10.45	9.22	NA	NA	NA	NA	NA	6.73	NA	19.11	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	21.91	3.99	8.71	5.66	47.14	9.69	NA	7.66	9.23	3.63	14.89
Trichlorotrifluoroethane	10.17	10.21	9.66	4.18	9.85	4.34	23.57	3.03	NA	14.03	NA
<i>trans</i> -1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA	34.51	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	8.27	NA	4.89	2.79	11.23	NA	NA	7.83	NA	NA	NA
Methyl Ethyl Ketone	30.50	35.33	17.56	11.90	20.94	17.18	42.60	35.90	NA	21.88	32.62
Chloroprene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	5.74	NA	NA

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites (Cont.)**

Compound	Average	Bountiful, UT (BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Grand Junction, CO (GPCO)	Grenada, MS (GRMS)	Gulfport, MS (GPMS)
Chloroform	26.55	NA	NA	NA	NA	15.71	NA	NA	14.75	NA	NA
Ethyl <i>tert</i> -Butyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	50.73	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzene	8.58	3.43	4.71	6.45	3.86	6.83	4.71	9.59	NA	20.68	4.26
Carbon Tetrachloride	13.91	11.08	5.15	9.70	11.77	9.24	NA	8.33	19.05	12.68	7.49
<i>tert</i> -Amyl Methyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	18.45	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA	NA	NA	7.15	NA	NA
Ethyl Acrylate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	6.98	NA	NA	NA	NA	NA	NA	NA	NA	10.88	NA
Methyl Methacrylate	77.72	NA	NA	NA	NA	NA	NA	130.49	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	29.49	NA	NA	NA	NA	19.20	101.75	11.79	5.96	NA	NA
<i>trans</i> -1,3-Dichloropropene	6.15	NA	NA	NA	6.15	NA	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	21.54	NA	NA
Toluene	16.19	1.76	5.35	3.11	15.05	5.91	59.33	3.58	10.85	19.25	21.39
Dibromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	6.76	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>n</i> -Octane	21.90	4.61	14.30	NA	NA	NA	NA	1.86	NA	NA	NA
Tetrachloroethylene	6.89	NA	2.48	NA	NA	10.98	NA	4.75	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	14.94	2.51	6.88	2.57	10.00	3.67	NA	2.70	NA	21.19	7.44
<i>m,p</i> -Xylene	14.16	0.90	4.99	3.35	10.22	4.43	7.49	3.50	NA	26.18	7.39

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites (Cont.)**

Compound	Average	Bountiful, UT (BTUT)	Camden, NJ (CANJ)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Grand Junction, CO (GPCO)	Grenada, MS (GRMS)	Gulfport, MS (GPMS)
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	16.97	11.31	6.71	12.86	27.68	22.35	NA	7.60	NA	24.05	28.81
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>o</i> -Xylene	14.78	1.93	4.87	10.43	9.16	7.87	10.59	4.15	NA	24.05	2.48
1,3,5-Trimethylbenzene	15.37	3.93	6.63	NA	NA	5.95	NA	7.91	NA	NA	11.87
1,2,4-Trimethylbenzene	16.33	6.70	5.59	9.43	34.67	6.05	36.66	6.01	7.29	NA	9.48
<i>m</i> -Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>p</i> -Dichlorobenzene	12.33	NA	1.81	NA	NA	NA	NA	NA	6.15	NA	NA
<i>o</i> -Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	18.21	6.96	7.56	6.29	15.45	10.45	27.25	12.64	11.63	18.48	11.93

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites (Cont.)**

Compound	Average	Jackson, MS (JAMS)	Kingsport, TN (KITT)	North Brook, IL (NBIL)	Nashville, TN (EATN)	Nashville, TN (LDTN)	Nashville, TN (LOTN)	Madison, WI (MAWI)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Phoenix, AZ (Site 1 - PSAZ)
Acetylene	11.87	28.44	3.14	87.11	13.48	5.09	30.25	16.37	6.12	1.38	0.28
Propylene	14.42	23.63	19.65	48.77	50.55	0.84	24.15	17.04	6.78	7.62	10.42
Dichlorodifluoromethane	4.72	6.93	3.70	10.84	1.09	0.99	4.20	14.32	3.60	1.44	2.02
Chloromethane	7.51	3.15	5.37	22.26	5.59	2.76	2.83	17.09	2.91	2.89	NA
Dichlorotetrafluoroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Butadiene	18.09	34.35	NA	NA	NA	37.22	28.28	8.32	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Acetonitrile	24.86	22.12	NA	NA	70.41	NA	67.98	NA	8.31	16.90	13.58
Trichlorofluoromethane	13.50	17.03	1.12	99.81	1.16	1.83	23.03	15.23	20.12	6.88	4.42
Acrylonitrile	10.45	NA	NA	NA	6.73	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methylene Chloride	21.91	NA	NA	115.71	42.98	NA	14.63	11.22	8.69	37.22	5.98
Trichlorotrifluoroethane	10.17	21.65	NA	12.19	NA	7.35	11.91	15.71	2.63	NA	NA
<i>trans</i> -1,2-Dichloroethylene	NA	37.18	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	8.27	NA	NA	NA	NA	NA	9.43	NA	12.80	NA	NA
Methyl Ethyl Ketone	30.50	NA	25.15	79.05	57.72	37.31	20.30	NA	19.36	43.40	NA
Chloroprene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromochloromethane	NA	22.77	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloroform	26.55	9.32	NA	139.67	7.44	3.05	NA	NA	12.86	NA	NA
Ethyl <i>tert</i> -Butyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites (Cont.)**

Compound	Average	Jackson, MS (JAMS)	Kingsport, TN (KITN)	North Brook, IL (NBIL)	Nashville, TN (EATN)	Nashville, TN (LDTN)	Nashville, TN (LOTN)	Madison, WI (MAWI)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Phoenix, AZ (Site 1 - PSAZ)
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,1,1-Trichloroethane	50.73	NA	NA	NA	NA	NA	NA	26.19	NA	NA	75.27
Benzene	8.58	NA	5.01	35.78	18.56	11.05	12.72	17.68	3.54	3.39	1.27
Carbon Tetrachloride	13.91	NA	10.10	82.54	NA	2.24	22.96	15.71	10.36	2.24	6.73
<i>tert</i> -Amyl Methyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	46.66	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Trichloroethylene	6.98	3.07	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Methacrylate	77.72	24.96	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	29.49	38.37	21.76	NA	NA	NA	NA	NA	NA	NA	NA
<i>trans</i> -1,3-Dichloropropene	6.15	NA	NA	NA	NA	6.15	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	24.35	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	16.19	35.80	2.74	90.91	20.59	5.16	12.36	16.64	7.71	3.18	0.89
Dibromochloromethane	NA	33.84	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>n</i> -Octane	21.90	NA	NA	NA	121.41	NA	NA	NA	NA	4.16	10.88
Tetrachloroethylene	6.89	NA	NA	NA	NA	NA	NA	NA	6.43	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Ethylbenzene	14.94	NA	4.71	107.69	47.71	1.89	10.15	18.13	8.31	8.81	9.03
<i>m,p</i> -Xylene	14.16	NA	4.98	111.99	38.62	4.53	14.64	17.85	7.86	8.28	1.99
Bromoform	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Styrene	16.97	NA	15.71	NA	59.46	3.63	15.27	NA	1.89	8.34	NA

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites (Cont.)**

Compound	Average	Jackson, MS (JAMS)	Kingsport, TN (KITN)	North Brook, IL (NBIL)	Nashville, TN (EATN)	Nashville, TN (LDTN)	Nashville, TN (LOTN)	Madison, WI (MAWI)	New Brunswick, NJ (NBNJ)	Pascagoula, MS (PGMS)	Phoenix, AZ (Site 1 - PSAZ)
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>o</i> -Xylene	14.78	NA	5.05	105.15	25.25	NA	7.86	21.06	6.03	12.57	NA
1,3,5-Trimethylbenzene	15.37	38.57	NA	70.71	NA	12.86	4.71	9.43	7.14	NA	10.88
1,2,4-Trimethylbenzene	16.33	35.83	5.89	72.62	25.59	1.63	10.10	18.68	7.17	1.90	6.73
<i>m</i> -Dichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>p</i> -Dichlorobenzene	<i>12.33</i>	33.05	NA	NA	NA	NA	NA	NA	NA	NA	NA
<i>o</i> -Dichlorobenzene	NA	11.79	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Average	18.21	25.13	8.94	76.05	34.13	8.09	17.39	16.27	8.12	<i>10.03</i>	<i>10.69</i>

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites (Cont.)**

Compound	Average	Phoenix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)	Spirit Lake, ND (SLND)	Tupelo, MS (TUMS)
Acetylene	11.87	11.79	3.61	5.00	1.25	12.26
Propylene	14.42	10.91	1.37	8.64	20.20	15.73
Dichlorodifluoromethane	4.72	4.64	NA	8.04	2.95	1.86
Chloromethane	7.51	2.00	5.55	12.35	1.46	30.06
Dichlorotetrafluoroethane	NA	NA	NA	NA	NA	NA
Vinyl Chloride	NA	NA	NA	NA	NA	NA
1,3-Butadiene	18.09	11.44	NA	NA	NA	NA
Bromomethane	NA	NA	NA	NA	NA	NA
Chloroethane	NA	NA	NA	NA	NA	NA
Acetonitrile	24.86	4.42	11.79	21.71	NA	11.73
Trichlorofluoromethane	13.50	8.17	NA	5.90	6.43	15.20
Acrylonitrile	10.45	NA	NA	NA	NA	NA
1,1-Dichloroethene	NA	NA	NA	NA	NA	NA
Methylene Chloride	21.91	15.69	3.01	NA	NA	50.63
Trichlorotrifluoroethane	10.17	9.16	NA	8.65	6.73	8.14
<i>trans</i> -1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA
Methyl <i>tert</i> -Butyl Ether	8.27	7.41	NA	9.76	NA	NA
Methyl Ethyl Ketone	30.50	8.74	NA	31.72	33.17	18.09
Chloroprene	NA	NA	NA	NA	NA	NA
<i>cis</i> -1,2-Dichloroethylene	NA	NA	NA	NA	NA	NA
Bromochloromethane	NA	NA	NA	NA	NA	NA
Chloroform	26.55	9.60	NA	NA	NA	NA
Ethyl <i>tert</i> -Butyl Ether	NA	NA	NA	NA	NA	NA
1,2-Dichloroethane	NA	NA	NA	NA	NA	NA

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites (Cont.)**

Compound	Average	Phoenix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)	Spirit Lake, ND (SLND)	Tupelo, MS (TUMS)
1,1,1-Trichloroethane	50.73	NA	NA	NA	NA	NA
Benzene	8.58	5.78	3.29	8.13	3.01	3.60
Carbon Tetrachloride	13.91	4.32	NA	15.21	NA	11.29
<i>tert</i> -Amyl Methyl Ether	NA	NA	NA	NA	NA	NA
1,2-Dichloropropane	NA	NA	NA	NA	NA	NA
Ethyl Acrylate	NA	NA	NA	NA	NA	NA
Bromodichloromethane	NA	NA	NA	NA	NA	NA
Trichloroethylene	6.98	NA	NA	NA	NA	NA
Methyl Methacrylate	77.72	NA	NA	NA	NA	NA
<i>cis</i> -1,3-Dichloropropene	NA	NA	NA	NA	NA	NA
Methyl Isobutyl Ketone	29.49	7.59	NA	NA	NA	NA
<i>trans</i> -1,3-Dichloropropene	6.15	NA	NA	NA	NA	NA
1,1,2-Trichloroethane	NA	NA	NA	NA	NA	NA
Toluene	16.19	19.42	3.24	12.71	NA	11.68
Dibromochloromethane	NA	NA	NA	NA	NA	NA
1,2-Dibromoethane	NA	NA	NA	NA	NA	NA
<i>n</i> -Octane	21.90	7.86	NA	NA	NA	10.10
Tetrachloroethylene	6.89	9.79	NA	NA	NA	NA
Chlorobenzene	NA	NA	NA	NA	NA	NA
Ethylbenzene	14.94	7.92	NA	10.66	NA	6.73
<i>m,p</i> -Xylene	14.16	8.39	7.71	11.19	10.88	8.26
Bromoform	NA	NA	NA	NA	NA	NA
Styrene	16.97	8.27	NA	22.45	NA	12.05
1,1,2,2-Tetrachloroethane	NA	NA	NA	NA	NA	NA
<i>o</i> -Xylene	14.78	7.44	6.73	11.83	NA	11.07

**Table 21-34. VOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Samples, All Sites (Cont.)**

Compound	Average	Phoenix, AZ (Site 2 - MCAZ)	St. Louis, MO (S4MO)	Sioux Falls, SD (SFSD)	Spirit Lake, ND (SLND)	Tupelo, MS (TUMS)
1,3,5-Trimethylbenzene	15.37	5.94	NA	7.86	NA	26.25
1,2,4-Trimethylbenzene	16.33	9.68	NA	17.96	NA	23.61
<i>m</i> -Dichlorobenzene	NA	NA	NA	NA	NA	NA
Chloromethylbenzene	NA	NA	NA	NA	NA	NA
<i>p</i> -Dichlorobenzene	12.33	8.32	NA	NA	NA	NA
<i>o</i> -Dichlorobenzene	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	NA	NA	NA	NA	NA	NA
Hexachloro-1,3-Butadiene	NA	NA	NA	NA	NA	NA
Average	18.21	8.59	5.14	12.76	9.56	15.18

Table 21-35. SNMOC Sampling and Analytical Precision: 52 Duplicate Samples

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
Ethylene	50	12.42	0.56	11.30
Acetylene	52	11.43	0.17	7.27
Ethane	51	61.81	7.22	21.05
Propylene	52	27.36	0.22	14.98
Propane	52	61.84	3.50	22.14
Propyne	0	NA	NA	NA
Isobutane	52	71.88	0.80	22.83
Isobutene/1-Butene	49	35.15	0.42	24.99
1,3-Butadiene	2	0.83	0.005	0.60
<i>n</i> -Butane	52	64.69	1.08	22.65
<i>trans</i> -2-Butene	34	12.28	0.05	9.20
<i>cis</i> -2-Butene	29	5.30	0.08	4.01
3-Methyl-1-butene	2	1.21	0.005	0.88
Isopentane	44	16.99	1.33	13.06
1-Pentene	27	20.30	0.23	14.28
2-Methyl-1-butene	7	0.68	0.77	0.47
<i>n</i> -Pentane	52	44.10	0.57	18.76
Isoprene	40	16.69	0.15	9.99
<i>trans</i> -2-Pentene	28	5.27	0.14	3.81
<i>cis</i> -2-Pentene	27	14.63	0.07	14.45
2-Methyl-2-butene	12	3.23	0.22	2.46
2,2-Dimethylbutane	18	4.06	0.26	2.81
Cyclopentene	13	22.11	0.27	15.20
4-Methyl-1-pentene	2	3.00	0.02	1.95
Cyclopentane	39	18.95	0.10	10.59
2,3-Dimethylbutane	35	12.66	0.33	10.75
2-Methylpentane	51	101.74	0.72	18.03
3-Methylpentane	49	111.67	0.62	25.47
2-Methyl-1-pentene	0	NA	NA	NA
1-Hexene	20	36.73	0.24	11.88
2-Ethyl-1-butene	0	NA	NA	NA
<i>n</i> -Hexane	52	29.23	0.47	16.78
<i>trans</i> -2-Hexene	0	NA	NA	NA
<i>cis</i> -2-Hexene	0	NA	NA	NA
Methylcyclopentane	52	34.39	0.15	15.71
2,4-Dimethylpentane	30	12.15	0.19	7.58
Benzene	52	17.67	0.18	9.94
Cyclohexane	22	3.77	0.08	2.50
2-Methylhexane	30	35.49	0.31	22.58

Table 21-35. SNMOC Sampling and Analytical Precision: 52 Duplicate Samples (Cont.)

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
2,3-Dimethylpentane	27	7.60	0.28	5.82
3-Methylhexane	51	31.23	0.35	18.95
1-Heptene	0	NA	NA	NA
2,2,4-Trimethylpentane	45	23.23	0.28	13.46
<i>n</i> -Heptane	47	15.17	0.20	13.70
Methylcyclohexane	49	43.50	0.23	20.54
2,2,3-Trimethylpentane	0	NA	NA	NA
2,3,4-Trimethylpentane	19	4.36	0.11	3.38
Toluene	52	65.61	1.47	20.54
2-Methylheptane	14	1.06	0.21	0.78
3-Methylheptane	14	4.52	0.25	2.94
1-Octene	0	NA	NA	NA
<i>n</i> -Octane	40	17.50	0.18	16.42
Ethylbenzene	51	122.70	0.47	26.42
<i>m,p</i> -Xylene	52	127.62	1.47	27.35
Styrene	21	20.39	0.77	10.78
<i>o</i> -Xylene	52	116.34	0.50	27.31
1-Nonene	0	NA	NA	NA
<i>n</i> -Nonane	39	146.46	0.69	28.48
Isopropylbenzene	11	8.43	0.28	5.09
<i>α</i> -Pinene	35	36.75	0.45	17.80
<i>n</i> -Propylbenzene	34	22.44	0.23	22.29
<i>m</i> -Ethyltoluene	50	145.20	0.46	34.49
<i>p</i> -Ethyltoluene	35	22.37	0.40	20.48
1,3,5-Trimethylbenzene	42	68.14	0.33	23.38
<i>o</i> -Ethyltoluene	43	74.77	0.27	26.37
<i>β</i> -Pinene	16	62.32	0.78	20.06
1,2,4-Trimethylbenzene	44	126.02	0.74	36.00
1-Decene	0	NA	NA	NA
<i>n</i> -Decane	36	52.99	1.68	41.67
1,2,3-Trimethylbenzene	35	28.41	0.21	25.57
<i>m</i> -Diethylbenzene	25	21.49	0.21	18.76
<i>p</i> -Diethylbenzene	28	11.32	0.33	8.35
1-Undecene	0	NA	NA	NA
<i>n</i> -Undecane	23	144.31	6.21	36.02
1-Dodecene	2	0.21	0.003	0.15
<i>n</i> -Dodecane	10	86.02	4.15	11.97
1-Tridecene	0	NA	NA	NA
<i>n</i> -Tridecane	0	NA	NA	NA

Table 21-35. SNMOC Sampling and Analytical Precision: 52 Duplicate Samples (Cont.)

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
TNMOC (speciated)	52	58.28	30.78	21.87
TNMOC (w/unknowns)	52	54.06	66.14	23.11

**Table 21-36. SNMOC Sampling and Analytical Precision:
Six Duplicate Samples in North Brook, IL (NBIL)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
Ethylene	4	38.14	2.64	41.23
Acetylene	6	39.83	0.33	22.69
Ethane	5	358.12	42.55	117.50
Propylene	6	109.01	0.82	52.83
Propane	6	339.79	16.95	104.36
Propyne	0	NA	NA	NA
Isobutane	6	367.12	3.37	102.29
Isobutene/1-Butene	5	76.28	0.54	41.61
1,3-Butadiene	0	NA	NA	NA
<i>n</i> -Butane	6	259.43	4.17	87.23
<i>trans</i> -2-Butene	1	NA	NA	NA
<i>cis</i> -2-Butene	0	NA	NA	NA
3-Methyl-1-butene	0	NA	NA	NA
Isopentane	3	47.16	4.07	43.64
1-Pentene	1	NA	NA	NA
2-Methyl-1-butene	0	NA	NA	NA
<i>n</i> -Pentane	6	113.62	1.34	56.68
Isoprene	6	32.88	0.34	19.01
<i>trans</i> -2-Pentene	1	NA	NA	NA
<i>cis</i> -2-Pentene	2	67.05	0.29	71.32
2-Methyl-2-butene	0	NA	NA	NA
2,2-Dimethylbutane	2	0.00	0.95	0.00
Cyclopentene	4	59.29	0.25	33.05
4-Methyl-1-pentene	0	NA	NA	NA
Cyclopentane	4	1.60	0.18	1.14
2,3-Dimethylbutane	4	23.32	1.18	18.66
2-Methylpentane	6	549.08	3.76	74.46
3-Methylpentane	6	535.61	2.00	77.91
2-Methyl-1-pentene	0	NA	NA	NA
1-Hexene	1	NA	NA	NA
2-Ethyl-1-butene	0	NA	NA	NA
<i>n</i> -Hexane	6	130.70	2.23	73.42
<i>trans</i> -2-Hexene	0	NA	NA	NA
<i>cis</i> -2-Hexene	0	NA	NA	NA
Methylcyclopentane	6	130.84	0.52	56.77
2,4-Dimethylpentane	4	11.80	0.30	8.87
Benzene	6	77.20	0.69	39.23
Cyclohexane	2	0.00	0.37	0.00

**Table 21-36. SNMOC Sampling and Analytical Precision:
Six Duplicate Samples in North Brook, IL (NBIL) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
2-Methylhexane	4	67.96	0.77	72.79
2,3-Dimethylpentane	4	19.21	0.45	15.02
3-Methylhexane	6	49.08	0.41	31.05
1-Heptene	0	NA	NA	NA
2,2,4-Trimethylpentane	6	85.16	0.98	41.49
<i>n</i> -Heptane	4	59.75	0.93	60.25
Methylcyclohexane	6	209.79	1.00	87.23
2,2,3-Trimethylpentane	0	NA	NA	NA
2,3,4-Trimethylpentane	4	20.92	0.54	16.52
Toluene	6	329.31	6.81	85.93
2-Methylheptane	1	NA	NA	NA
3-Methylheptane	1	NA	NA	NA
1-Octene	0	NA	NA	NA
<i>n</i> -Octane	4	65.19	0.77	68.39
Ethylbenzene	6	658.79	2.31	106.32
<i>m,p</i> -Xylene	6	685.92	7.27	109.36
Styrene	3	0.00	2.16	0.00
<i>o</i> -Xylene	6	615.09	2.36	105.21
1-Nonene	2	0.00	0.58	0.00
<i>n</i> -Nonane	5	801.10	3.76	117.06
Isopropylbenzene	1	NA	NA	NA
<i>a</i> -Pinene	5	148.41	0.81	61.79
<i>n</i> -Propylbenzene	4	78.50	1.12	91.36
<i>m</i> -Ethyltoluene	6	726.22	1.78	102.90
<i>p</i> -Ethyltoluene	4	74.42	1.66	83.81
1,3,5-Trimethylbenzene	5	348.07	1.39	104.07
<i>o</i> -Ethyltoluene	5	362.02	1.26	93.64
<i>b</i> -Pinene	2	0.00	1.69	0.00
1,2,4-Trimethylbenzene	6	575.82	2.99	94.05
1-Decene	0	NA	NA	NA
<i>n</i> -Decane	4	87.38	5.17	109.73
1,2,3-Trimethylbenzene	4	65.37	0.74	68.67
<i>m</i> -Diethylbenzene	4	63.63	0.64	65.98
<i>p</i> -Diethylbenzene	3	0.00	0.52	0.00
1-Undecene	0	NA	NA	NA
<i>n</i> -Undecane	4	83.15	2.71	100.63
1-Dodecene	0	NA	NA	NA
<i>n</i> -Dodecane	1	NA	NA	NA

**Table 21-36. SNMOC Sampling and Analytical Precision:
Six Duplicate Samples in North Brook, IL (NBIL) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
1-Tridecene	0	NA	NA	NA
<i>n</i> -Tridecane	0	NA	NA	NA
TNMOC (speciated)	6	293.80	137.10	92.63
TNMOC (w/unknowns)	6	250.31	279.80	86.77

**Table 21-37. SNMOC Sampling and Analytical Precision:
12 Duplicate Samples in Bountiful, UT (BTUT)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
Ethylene	12	10.71	0.29	8.27
Acetylene	12	4.98	0.22	3.61
Ethane	12	4.32	0.25	2.93
Propylene	12	6.74	0.09	5.41
Propane	12	2.23	0.56	1.60
Propyne	0	NA	NA	NA
Isobutane	12	0.59	0.09	0.41
Isobutene/1-Butene	12	14.16	0.44	11.69
1,3-Butadiene	2	5.00	0.029	3.63
<i>n</i> -Butane	12	4.97	0.44	3.58
<i>trans</i> -2-Butene	12	10.51	0.03	8.43
<i>cis</i> -2-Butene	12	11.11	0.03	8.52
3-Methyl-1-butene	2	7.23	0.029	5.31
Isopentane	12	6.26	0.82	4.89
1-Pentene	10	24.74	0.36	21.21
2-Methyl-1-butene	5	4.06	0.37	2.80
<i>n</i> -Pentane	12	2.45	0.22	1.75
Isoprene	12	7.58	0.04	5.46
<i>trans</i> -2-Pentene	12	9.15	0.05	6.66
<i>cis</i> -2-Pentene	12	8.41	0.04	6.14
2-Methyl-2-butene	8	3.21	0.04	2.32
2,2-Dimethylbutane	8	11.38	0.05	7.25
Cyclopentene	4	37.35	0.19	27.08
4-Methyl-1-pentene	0	NA	NA	NA
Cyclopentane	12	10.03	0.06	6.78
2,3-Dimethylbutane	12	6.91	0.16	5.42
2-Methylpentane	12	1.81	0.06	1.29
3-Methylpentane	12	9.82	0.22	7.18
2-Methyl-1-pentene	0	NA	NA	NA
1-Hexene	5	4.18	0.19	3.01
2-Ethyl-1-butene	0	NA	NA	NA
<i>n</i> -Hexane	12	1.80	0.07	1.27
<i>trans</i> -2-Hexene	0	NA	NA	NA
<i>cis</i> -2-Hexene	0	NA	NA	NA
Methylcyclopentane	12	4.05	0.05	2.97
2,4-Dimethylpentane	12	3.16	0.03	2.26
Benzene	12	4.29	0.13	2.98
Cyclohexane	10	2.42	0.02	1.73

**Table 21-37. SNMOC Sampling and Analytical Precision:
12 Duplicate Samples in Bountiful, UT (BTUT) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
2-Methylhexane	10	7.20	0.05	4.88
2,3-Dimethylpentane	12	8.01	0.14	6.15
3-Methylhexane	12	7.58	0.11	5.89
1-Heptene	0	NA	NA	NA
2,2,4-Trimethylpentane	12	7.83	0.13	5.31
<i>n</i> -Heptane	12	4.58	0.06	3.15
Methylcyclohexane	12	7.72	0.08	5.12
2,2,3-Trimethylpentane	2	NA	NA	NA
2,3,4-Trimethylpentane	11	3.43	0.09	2.49
Toluene	12	1.80	0.12	1.25
2-Methylheptane	8	5.39	0.05	3.99
3-Methylheptane	8	10.71	0.03	6.56
1-Octene	0	NA	NA	NA
<i>n</i> -Octane	12	5.09	0.05	3.47
Ethylbenzene	12	6.00	0.07	4.25
<i>m,p</i> -Xylene	12	1.62	0.06	1.14
Styrene	6	14.52	0.59	10.93
<i>o</i> -Xylene	12	2.65	0.03	1.83
1-Nonene	0	NA	NA	NA
<i>n</i> -Nonane	12	8.95	0.05	6.04
Isopropylbenzene	3	3.08	0.19	2.21
<i>a</i> -Pinene	11	14.84	0.11	10.71
<i>n</i> -Propylbenzene	9	11.73	0.08	8.51
<i>m</i> -Ethyltoluene	12	7.64	0.05	5.16
<i>p</i> -Ethyltoluene	11	16.96	0.11	10.66
1,3,5-Trimethylbenzene	12	9.90	0.06	6.48
<i>o</i> -Ethyltoluene	12	13.28	0.05	8.70
<i>b</i> -Pinene	1	NA	NA	NA
1,2,4-Trimethylbenzene	11	17.66	0.38	10.89
1-Decene	0	NA	NA	NA
<i>n</i> -Decane	9	1.40	0.19	0.98
1,2,3-Trimethylbenzene	9	7.27	0.07	5.34
<i>m</i> -Diethylbenzene	8	13.72	0.09	11.21
<i>p</i> -Diethylbenzene	7	13.57	0.10	8.85
1-Undecene	0	NA	NA	NA
<i>n</i> -Undecane	8	10.11	0.10	7.16
1-Dodecene	2	1.27	0.02	0.89
<i>n</i> -Dodecane	3	11.98	0.44	7.99

**Table 21-37. SNMOC Sampling and Analytical Precision:
12 Duplicate Samples in Bountiful, UT (BTUT) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
1-Tridecene	0	NA	NA	NA
<i>n</i> -Tridecane	0	NA	NA	NA
TNMOC (speciated)	12	1.58	2.37	1.13
TNMOC (w/unknowns)	12	8.13	15.77	6.22

**Table 21-38. SNMOC Sampling and Analytical Precision:
Two Duplicate Samples in St. Louis, MO (S4MO)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
Ethylene	2	2.93	0.14	2.04
Acetylene	2	3.52	0.21	2.53
Ethane	2	1.67	0.20	1.17
Propylene	2	NA	NA	NA
Propane	2	3.31	0.50	2.38
Propyne	0	NA	NA	NA
Isobutane	2	2.13	0.05	1.52
Isobutene/1-Butene	2	59.09	1.10	59.30
1,3-Butadiene	0	NA	NA	NA
<i>n</i> -Butane	2	2.02	0.13	1.42
<i>trans</i> -2-Butene	2	7.66	0.02	5.22
<i>cis</i> -2-Butene	1	NA	NA	NA
3-Methyl-1-butene	0	NA	NA	NA
Isopentane	2	1.26	0.05	0.89
1-Pentene	0	NA	NA	NA
2-Methyl-1-butene	0	NA	NA	NA
<i>n</i> -Pentane	2	1.71	0.04	1.22
Isoprene	0	NA	NA	NA
<i>trans</i> -2-Pentene	1	NA	NA	NA
<i>cis</i> -2-Pentene	0	NA	NA	NA
2-Methyl-2-butene	2	16.16	0.09	12.43
2,2-Dimethylbutane	0	NA	NA	NA
Cyclopentene	1	NA	NA	NA
4-Methyl-1-pentene	0	NA	NA	NA
Cyclopentane	2	14.98	0.04	9.85
2,3-Dimethylbutane	2	5.03	0.02	3.47
2-Methylpentane	2	1.86	0.03	1.31
3-Methylpentane	2	50.00	0.67	28.28
2-Methyl-1-pentene	0	NA	NA	NA
1-Hexene	0	NA	NA	NA
2-Ethyl-1-butene	0	NA	NA	NA
<i>n</i> -Hexane	2	2.74	0.04	1.91
<i>trans</i> -2-Hexene	0	NA	NA	NA
<i>cis</i> -2-Hexene	0	NA	NA	NA
Methylcyclopentane	2	5.56	0.04	3.83
2,4-Dimethylpentane	1	NA	NA	NA
Benzene	2	0.83	0.02	0.59
Cyclohexane	2	5.43	0.02	3.74

**Table 21-38. SNMOC Sampling and Analytical Precision:
Two Duplicate Samples in St. Louis, MO (S4MO) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
2-Methylhexane	0	NA	NA	NA
2,3-Dimethylpentane	1	NA	NA	NA
3-Methylhexane	2	3.39	0.04	2.44
1-Heptene	0	NA	NA	NA
2,2,4-Trimethylpentane	2	7.09	0.09	5.20
<i>n</i> -Heptane	2	2.91	0.02	2.09
Methylcyclohexane	2	0.93	0.003	0.66
2,2,3-Trimethylpentane	0	NA	NA	NA
2,3,4-Trimethylpentane	0	NA	NA	NA
Toluene	2	5.75	0.23	4.19
2-Methylheptane	0	NA	NA	NA
3-Methylheptane	0	NA	NA	NA
1-Octene	0	NA	NA	NA
<i>n</i> -Octane	2	5.47	0.03	3.98
Ethylbenzene	2	15.55	0.13	11.92
<i>m,p</i> -Xylene	2	18.34	0.42	14.28
Styrene	0	NA	NA	NA
<i>o</i> -Xylene	2	22.15	0.17	17.61
1-Nonene	0	NA	NA	NA
<i>n</i> -Nonane	2	18.97	0.05	14.82
Isopropylbenzene	0	NA	NA	NA
<i>a</i> -Pinene	0	NA	NA	NA
<i>n</i> -Propylbenzene	2	14.35	0.03	10.93
<i>m</i> -Ethyltoluene	2	47.11	0.25	43.58
<i>p</i> -Ethyltoluene	1	NA	NA	NA
1,3,5-Trimethylbenzene	1	NA	NA	NA
<i>o</i> -Ethyltoluene	2	27.82	0.08	22.85
<i>b</i> -Pinene	0	NA	NA	NA
1,2,4-Trimethylbenzene	2	65.63	0.40	69.07
1-Decene	0	NA	NA	NA
<i>n</i> -Decane	1	NA	NA	NA
1,2,3-Trimethylbenzene	2	43.20	0.11	38.96
<i>m</i> -Diethylbenzene	0	NA	NA	NA
<i>p</i> -Diethylbenzene	0	NA	NA	NA
1-Undecene	0	NA	NA	NA
<i>n</i> -Undecane	0	NA	NA	NA
1-Dodecene	0	NA	NA	NA
<i>n</i> -Dodecane	0	NA	NA	NA

**Table 21-38. SNMOC Sampling and Analytical Precision:
Two Duplicate Samples in St. Louis, MO (S4MO) (Cont.)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbC)	Coefficient of Variation (%)
1-Tridecene	0	NA	NA	NA
<i>n</i> -Tridecane	0	NA	NA	NA
TNMOC (speciated)	2	5.58	4.70	4.06
TNMOC (w/ unknowns)	2	2.65	3.00	1.90

**Table 21-39. SNMOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Analyses, All Sites**

Compound	Average	Bountiful, UT (BTUT)	Custer, SD (CUSD)	North Brook, IL (NBIL)	Pascagoula, MS (PGMS)	St. Louis, MO (Site 4 - S4MO)	Sioux Falls, SD (SFSD)
Ethylene	7.48	8.27	4.62	41.23	2.95	2.04	8.70
Acetylene	3.62	3.61	5.99	22.69	1.77	2.53	7.02
Ethane	3.14	2.93	1.68	117.50	0.76	1.17	2.26
Propylene	9.29	5.41	4.85	52.83	15.97	NA	10.83
Propane	6.39	1.60	15.55	104.36	0.90	2.38	8.04
Propyne	NA	NA	NA	NA	NA	NA	NA
Isobutane	10.71	0.41	19.05	102.29	1.60	1.52	12.12
Isobutene/1-Butene	15.54	11.69	17.98	41.61	8.29	59.30	11.09
1,3-Butadiene	7.06	3.63	NA	NA	NA	NA	NA
<i>n</i> -Butane	6.67	3.58	26.03	87.23	4.55	1.42	13.10
<i>trans</i> -2-Butene	8.34	8.43	11.36	NA	9.94	5.22	20.25
<i>cis</i> -2-Butene	6.96	8.52	9.17	NA	NA	NA	6.36
3-Methyl-1-butene	5.61	5.31	NA	NA	NA	NA	NA
Isopentane	11.24	4.89	9.94	43.64	NA	0.89	19.02
1-Pentene	26.64	21.21	26.45	NA	34.02	NA	3.99
2-Methyl-1-butene	11.60	2.80	NA	NA	NA	NA	NA
<i>n</i> -Pentane	11.14	1.75	29.49	56.68	3.81	1.22	19.63
Isoprene	11.42	5.46	15.65	19.01	5.45	NA	14.36
<i>trans</i> -2-Pentene	8.14	6.66	9.34	NA	5.45	NA	1.40
<i>cis</i> -2-Pentene	10.09	6.14	3.80	71.32	0.53	NA	4.92
2-Methyl-2-butene	19.03	2.32	NA	NA	NA	12.43	NA
2,2-Dimethylbutane	12.63	7.25	6.93	NA	NA	NA	2.66
Cyclopentene	18.83	27.08	NA	33.05	NA	NA	31.08
4-Methyl-1-pentene	30.37	NA	NA	NA	NA	NA	11.68
Cyclopentane	18.07	6.78	12.44	1.14	3.01	9.85	30.33
2,3-Dimethylbutane	11.38	5.42	7.44	18.66	1.52	3.47	28.00
2-Methylpentane	19.47	1.29	16.72	74.46	2.85	1.31	11.54
3-Methylpentane	19.00	7.18	21.07	77.91	1.07	28.28	17.32
2-Methyl-1-pentene	NA	NA	NA	NA	NA	NA	NA
1-Hexene	17.29	3.01	33.91	NA	NA	NA	34.34
2-Ethyl-1-butene	NA	NA	NA	NA	NA	NA	NA
<i>n</i> -Hexane	14.52	1.27	11.77	73.42	0.23	1.91	12.08
<i>trans</i> -2-Hexene	NA	NA	NA	NA	NA	NA	NA
<i>cis</i> -2-Hexene	1.31	NA	NA	NA	NA	NA	NA
Methylcyclopentane	9.69	2.97	16.08	56.77	2.84	3.83	11.79

**Table 21-39. SNMOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Analyses, All Sites (Cont.)**

Compound	Average	Bountiful, UT (BTUT)	Custer, SD (CUSD)	North Brook, IL (NBIL)	Pascagoula, MS (PGMS)	St. Louis, MO (Site 4 - S4MO)	Sioux Falls, SD (SFSD)
2,4-Dimethylpentane	6.40	2.26	3.86	8.87	9.72	NA	20.79
Benzene	5.81	2.98	4.03	39.23	4.15	0.59	8.68
Cyclohexane	8.86	1.73	7.89	NA	NA	3.74	1.61
2-Methylhexane	21.60	4.88	12.12	72.79	42.40	NA	3.29
2,3-Dimethylpentane	15.88	6.15	11.10	15.02	0.14	NA	2.53
3-Methylhexane	21.15	5.89	17.21	31.05	23.62	2.44	33.47
1-Heptene	24.46	NA	NA	NA	NA	NA	NA
2,2,4-Trimethylpentane	10.32	5.31	8.00	41.49	7.39	5.20	13.39
<i>n</i> -Heptane	13.98	3.15	4.60	60.25	2.71	2.09	9.38
Methylcyclohexane	11.67	5.12	3.77	87.23	17.59	0.66	8.86
2,2,3-Trimethylpentane	14.16	NA	NA	NA	NA	NA	NA
2,3,4-Trimethylpentane	8.86	2.49	NA	16.52	1.03	NA	0.24
Toluene	13.72	1.25	15.33	85.93	2.44	4.19	14.09
2-Methylheptane	11.30	3.99	NA	NA	NA	NA	0.71
3-Methylheptane	14.83	6.56	8.07	NA	NA	NA	2.99
1-Octene	28.75	NA	NA	NA	NA	NA	NA
<i>n</i> -Octane	8.98	3.47	14.78	68.39	3.31	3.98	4.60
Ethylbenzene	12.70	4.25	18.01	106.32	6.59	11.92	11.43
<i>m,p</i> -Xylene	16.52	1.14	13.73	109.36	13.10	14.28	12.48
Styrene	34.27	10.93	20.34	NA	NA	NA	33.38
<i>o</i> -Xylene	14.19	1.83	13.56	105.21	13.91	17.61	11.71
1-Nonene	16.51	NA	NA	NA	NA	NA	NA
<i>n</i> -Nonane	14.72	6.04	17.57	117.06	4.57	14.82	10.80
Isopropylbenzene	13.72	2.21	3.61	NA	NA	NA	24.73
<i>a</i> -Pinene	37.76	10.71	19.85	61.79	8.79	NA	5.68
<i>n</i> -Propylbenzene	11.78	8.51	11.33	91.36	3.58	10.93	8.03
<i>m</i> -Ethyltoluene	11.66	5.16	16.22	102.90	22.43	43.58	16.63
<i>p</i> -Ethyltoluene	10.23	10.66	6.70	83.81	13.59	NA	8.10
1,3,5-Trimethylbenzene	10.64	6.48	17.65	104.07	4.91	NA	7.16
<i>o</i> -Ethyltoluene	13.52	8.70	18.01	93.64	10.19	22.85	4.83
<i>b</i> -Pinene	24.18	NA	23.02	NA	9.49	NA	87.83
1,2,4-Trimethylbenzene	16.38	10.89	35.95	94.05	1.86	69.07	4.16
1-Decene	NA	NA	NA	NA	NA	NA	NA
<i>n</i> -Decane	20.06	0.98	42.12	109.73	88.19	NA	9.01
1,2,3-Trimethylbenzene	15.49	5.34	20.55	68.67	7.25	38.96	12.65
<i>m</i> -Diethylbenzene	17.78	11.21	11.72	65.98	NA	NA	23.64

**Table 21-39. SNMOC Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Analyses, All Sites (Cont.)**

Compound	Average	Bountiful, UT (BTUT)	Custer, SD (CUSD)	North Brook, IL (NBIL)	Pascagoula, MS (PGMS)	St. Louis, MO (Site 4 - S4MO)	Sioux Falls, SD (SFSD)
<i>p</i> -Diethylbenzene	17.58	8.85	12.60	NA	NA	NA	28.68
1-Undecene	10.19	NA	NA	NA	NA	NA	NA
<i>n</i> -Undecane	<i>14.76</i>	7.16	69.43	100.63	NA	NA	38.92
1-Dodecene	<i>NA</i>	0.89	NA	NA	NA	NA	NA
<i>n</i> -Dodecane	18.49	7.99	63.81	NA	NA	NA	NA
1-Tridecene	<i>NA</i>	NA	NA	NA	NA	NA	NA
<i>n</i> -Tridecane	<i>NA</i>	NA	NA	NA	NA	NA	NA
TNMOC (speciated)	21.87	1.13	7.91	92.63	14.75	4.06	10.75
TNMOC (w/ unknowns)	23.11	6.22	10.39	86.77	12.74	1.90	20.63
Average	<i>14.33</i>	<i>5.13</i>	17.18	71.27	<i>10.97</i>	<i>12.86</i>	15.65

**Table 21-40. Carbonyl Sampling and Analytical Precision:
224 Duplicate and Collocated Samples**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	224	12.14	0.183	7.51
Acetaldehyde	224	9.49	0.108	6.71
Acetone	224	12.30	0.131	8.34
Propionaldehyde	198	19.16	0.017	13.37
Crotonaldehyde	222	14.82	0.008	9.82
Butyr/Isobutyraldehyde	224	13.21	0.016	9.68
Benzaldehyde	215	12.68	0.006	8.53
Isovaleraldehyde	97	16.17	0.004	11.18
Valeraldehyde	199	16.65	0.005	10.97
Tolualdehydes	200	21.79	0.009	14.85
Hexaldehyde	220	19.37	0.011	12.34
2,5-Dimethylbenzaldehyde	42	10.20	0.002	6.77

**Table 21-41. Carbonyl Sampling and Analytical Precision:
54 Collocated Samples**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	54	21.56	0.297	12.08
Acetaldehyde	54	12.58	0.093	9.16
Acetone	54	10.63	0.139	7.60
Propionaldehyde	52	26.90	0.018	19.62
Crotonaldehyde	54	20.92	0.007	13.16
Butyr/Isobutyraldehyde	54	11.52	0.013	8.74
Benzaldehyde	54	15.94	0.010	9.82
Isovaleraldehyde	38	5.42	0.004	3.96
Valeraldehyde	53	12.95	0.006	9.41
Tolualdehydes	51	16.31	0.012	11.34
Hexaldehyde	53	17.40	0.016	11.59
2,5-Dimethylbenzaldehyde	20	12.16	0.002	7.97

**Table 21-42. Carbonyl Sampling and Analytical Precision:
170 Duplicate Samples**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	170	8.18	0.135	5.58
Acetaldehyde	170	8.19	0.114	5.67
Acetone	170	13.00	0.128	8.66
Propionaldehyde	146	15.91	0.017	10.74
Crotonaldehyde	168	12.25	0.008	8.41
Butyr/Isobutyraldehyde	170	13.92	0.017	10.07
Benzaldehyde	161	11.31	0.004	7.99
Isovaleraldehyde	59	20.70	0.004	14.22
Valeraldehyde	146	18.20	0.005	11.62
Tolualdehydes	149	24.09	0.007	16.33
Hexaldehyde	167	20.20	0.008	12.65
2,5-Dimethylbenzaldehyde	22	9.37	0.002	6.26

**Table 21-43. Carbonyl Sampling and Analytical Precision:
Eight Duplicate Samples in Tampa, FL (SYFL)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	8	20.15	0.159	12.27
Acetaldehyde	8	5.87	0.036	3.93
Acetone	8	6.86	0.026	5.00
Propionaldehyde	8	18.07	0.012	11.37
Crotonaldehyde	8	9.54	0.010	6.87
Butyr/Isobutyraldehyde	8	36.36	0.097	33.29
Benzaldehyde	8	18.24	0.005	11.16
Isovaleraldehyde	2	23.53	0.004	14.89
Valeraldehyde	8	8.75	0.003	6.98
Tolualdehydes	8	12.93	0.005	9.49
Hexaldehyde	8	19.30	0.006	12.63
2,5-Dimethylbenzaldehyde	0	NA	NA	NA

**Table 21-44. Carbonyl Sampling and Analytical Precision:
26 Collocated Samples in Detroit, MI (DEMI)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	26	31.96	0.382	11.52
Acetaldehyde	26	18.50	0.127	9.63
Acetone	26	21.41	0.231	14.24
Propionaldehyde	26	53.45	0.018	13.46
Crotonaldehyde	26	48.63	0.013	13.77
Butyr/Isobutyraldehyde	26	14.84	0.023	10.35
Benzaldehyde	26	33.66	0.006	14.58
Isovaleraldehyde	21	14.17	0.007	9.07
Valeraldehyde	26	26.17	0.007	13.50
Tolualdehydes	26	20.45	0.009	16.39
Hexaldehyde	26	14.50	0.008	10.50
2,5-Dimethylbenzaldehyde	11	18.80	0.005	14.33

**Table 21-45. Carbonyl Sampling and Analytical Precision:
10 Duplicate Samples in Grand Junction, CO (GPCO)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	10	2.11	0.036	1.49
Acetaldehyde	10	3.60	0.050	2.48
Acetone	10	3.25	0.054	2.26
Propionaldehyde	7	14.84	0.019	10.02
Crotonaldehyde	10	5.77	0.002	4.11
Butyr/Isobutyraldehyde	10	9.68	0.011	6.53
Benzaldehyde	10	8.93	0.004	6.32
Isovaleraldehyde	2	23.08	0.003	14.63
Valeraldehyde	7	23.21	0.004	14.08
Tolualdehydes	10	32.90	0.009	21.73
Hexaldehyde	10	16.40	0.004	12.32
2,5-Dimethylbenzaldehyde	2	0.00	0.013	0.00

**Table 21-46. Carbonyl Sampling and Analytical Precision:
12 Duplicate Samples in Bountiful, UT (BTUT)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	12	10.59	0.332	6.67
Acetaldehyde	12	11.27	0.183	7.27
Acetone	12	25.11	0.330	13.88
Propionaldehyde	12	16.86	0.023	10.28
Crotonaldehyde	12	14.08	0.005	8.78
Butyr/Isobutyraldehyde	12	25.52	0.032	14.56
Benzaldehyde	12	16.78	0.006	10.39
Isovaleraldehyde	8	20.00	0.002	12.74
Valeraldehyde	12	51.07	0.020	22.64
Tolualdehydes	12	35.14	0.015	21.43
Hexaldehyde	12	94.90	0.064	31.24
2,5-Dimethylbenzaldehyde	4	40.00	0.003	22.10

**Table 21-47. Carbonyl Sampling and Analytical Precision:
Two Duplicate Samples in St. Louis, MO (S4MO)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ppbv)	Coefficient of Variation (%)
Formaldehyde	2	3.64	0.090	2.62
Acetaldehyde	2	2.13	0.030	1.52
Acetone	2	3.66	0.060	2.64
Propionaldehyde	2	7.41	0.008	5.44
Crotonaldehyde	2	6.38	0.003	4.66
Butyr/Isobutyraldehyde	2	6.73	0.015	4.92
Benzaldehyde	2	2.04	0.001	1.46
Isovaleraldehyde	2	16.67	0.001	12.86
Valeraldehyde	2	20.59	0.007	16.23
Tolualdehydes	2	0.00	0.00	0.00
Hexaldehyde	2	12.50	0.007	9.43
2,5-Dimethylbenzaldehyde	1	NA	NA	NA

**Table 21-48. Carbonyl Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Analyses, All Sites**

Compound	Average	St. Petersburg, FL (AZFL)	Bountiful, UT (BTUT)	Camden, NJ (CANJ)	Candor, NC (CANC)	Chester, NJ (CHNJ)	Custer, SD (CUSD)	Detroit, MI (DEMI)	Dickson, TN (DITN)	Elizabeth, NJ (ELNJ)	Tampa (Gandy), FL (GAFL)
Formaldehyde	7.51	5.19	6.67	3.15	30.68	2.89	10.49	11.52	1.48	2.00	7.82
Acetaldehyde	6.71	2.11	7.27	2.64	24.20	5.72	11.85	9.63	3.04	1.39	11.42
Acetone	8.34	7.29	13.88	6.60	15.74	4.56	10.34	14.24	3.06	4.08	14.02
Propionaldehyde	13.88	15.22	10.28	NA	51.12	6.91	27.40	13.46	11.28	7.76	15.41
Crotonaldehyde	9.82	4.48	8.78	7.90	33.47	5.42	12.52	13.77	9.91	6.98	12.76
Butyr/Isobutyraldehyde	9.68	4.35	14.56	6.07	30.06	11.25	21.17	10.35	2.42	1.92	14.33
Benzaldehyde	8.86	11.26	10.39	7.28	7.53	7.21	14.74	14.58	3.37	4.71	6.45
Isovaleraldehyde	17.76	38.57	12.74	NA	NA	29.04	22.78	9.07	NA	16.32	35.90
Valeraldehyde	11.84	11.07	22.64	12.41	31.43	4.61	10.92	13.50	5.12	4.55	25.07
Tolualdehydes	16.04	17.33	21.43	18.18	22.81	23.41	14.51	16.39	16.14	19.68	19.64
Hexaldehyde	12.81	7.60	31.24	14.30	14.28	14.32	15.63	10.50	18.01	6.20	14.89
2,5-Dimethylbenzaldehyde	16.61	NA	22.10	NA	NA	20.20	NA	14.33	NA	28.28	NA
Average	<i>11.66</i>	<i>11.32</i>	15.16	8.73	26.13	<i>11.30</i>	15.67	12.61	7.38	8.65	16.16

**Table 21-48. Carbonyl Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Analyses, All Sites (Cont.)**

Compound	Average	Grand Junction, CO (GPCO)	Gulfport, MS (GPMS)	Grenada, MS (GRMS)	Jackson, MS (JAMS)	Kingsport, TN (KITN)	Loudon, TN (LDTN)	Nashville, TN (EATN)	Nashville, TN (LOTN)	Orlando, FL (ORFL)	New Brunswick, NJ (NBNJ)
Formaldehyde	7.51	1.49	17.00	2.28	3.29	2.10	2.93	11.48	4.23	8.21	1.46
Acetaldehyde	6.71	2.48	15.08	1.83	5.60	0.63	2.80	11.25	4.78	8.42	1.57
Acetone	8.34	2.26	10.03	4.87	7.52	2.80	2.10	10.93	4.64	22.40	8.29
Propionaldehyde	13.88	10.02	19.55	2.24	8.14	4.29	3.61	12.59	0.73	4.83	5.94
Crotonaldehyde	9.82	4.11	12.69	5.81	8.97	3.59	9.00	9.69	9.18	15.47	4.76
Butyr/Isobutyraldehyde	9.68	6.53	15.98	7.82	10.80	4.60	2.63	12.64	5.52	11.35	2.26
Benzaldehyde	8.86	6.32	NA	9.25	4.02	6.44	14.95	11.79	7.07	6.57	7.43
Isovaleraldehyde	17.76	14.63	NA	10.88	NA	NA	4.18	NA	18.45	12.49	4.71
Valeraldehyde	11.84	14.08	NA	6.63	18.54	6.68	8.88	7.44	2.24	8.20	7.79
Tolualdehydes	16.04	21.73	12.86	21.48	9.86	10.12	8.53	7.14	9.61	17.63	11.36
Hexaldehyde	12.81	12.32	6.00	11.04	6.40	8.46	13.66	13.20	14.63	11.41	12.51
2,5-Dimethylbenzaldehyde	16.61	NA	NA	13.47	NA	12.86	1.89	16.97	17.68	27.50	7.44
Average	<i>11.66</i>	8.72	<i>13.65</i>	<i>8.13</i>	<i>8.31</i>	<i>5.69</i>	<i>6.26</i>	<i>11.37</i>	8.23	12.87	6.29

**Table 21-48. Carbonyl Sampling and Analytical Precision:
Coefficient of Variation for all Duplicate Analyses, All Sites (Cont.)**

Compound	Average	Pascagoula, MS (PGMS)	Research Triangle Park, NC (RTPNC)	St. Louis, MO (S4MO)	Tampa, FL (SKFL)	Tampa, FL (SYFL)	Sioux Falls, SD (SFSD)	Tupelo, MS (TUMS)
Formaldehyde	7.51	3.50	32.23	2.62	10.90	12.27	3.84	0.98
Acetaldehyde	6.71	6.28	17.00	1.52	15.74	3.93	1.48	1.45
Acetone	8.34	5.87	7.30	2.64	11.08	5.00	10.84	12.90
Propionaldehyde	13.88	9.96	59.92	5.44	27.78	11.37	9.95	5.83
Crotonaldehyde	9.82	6.18	16.64	4.66	11.33	6.87	12.83	7.34
Butyr/Isobutyraldehyde	9.68	8.93	1.70	4.92	7.29	33.29	5.29	3.27
Benzaldehyde	8.86	6.04	12.86	1.46	17.52	11.16	11.86	8.19
Isovaleraldehyde	17.76	16.10	NA	12.86	NA	14.89	NA	28.28
Valeraldehyde	11.84	5.52	NA	16.23	24.24	6.98	8.76	12.52
Tolualdehydes	16.04	10.70	NA	NA	37.09	9.49	19.25	4.64
Hexaldehyde	12.81	2.97	NA	9.43	22.89	12.63	13.15	15.38
2,5-Dimethylbenzaldehyde	16.61	NA	NA	NA	NA	NA	NA	NA
Average	<i>11.66</i>	<i>7.46</i>	21.09	<i>6.18</i>	18.59	<i>11.62</i>	<i>9.72</i>	<i>9.16</i>

**Table 21-49. Metal Sampling and Analytical Precision:
106 Collocated Samples**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ng/m³)	Coefficient of Variation (%)
Antimony Compounds	90	7.81	155.50	9.30
Arsenic Compounds	106	11.91	289.34	11.40
Beryllium Compounds	11	10.49	88.32	7.10
Cadmium Compounds	100	25.04	139.41	14.97
Chromium Compounds	106	13.73	379.23	11.31
Cobalt Compounds	87	25.66	105.20	13.81
Lead Compounds	106	15.55	1105.73	12.84
Manganese Compounds	106	8.58	1701.78	9.54
Mercury Compounds	23	40.90	92.72	23.58
Nickel Compounds	106	48.49	1141.59	22.86
Selenium Compounds	91	16.93	313.64	15.03

**Table 21-50. Metal Sampling and Analytical Precision:
52 Collocated Samples in Boston, MA (BOMA)**

Compound	Number of Observations	Average RPD for Duplicate Analyses (%)	Average Concentration Difference for Duplicate Analyses (ng/m³)	Coefficient of Variation (%)
Antimony Compounds	52	8.06	142.65	11.86
Arsenic Compounds	52	13.45	416.68	19.65
Beryllium Compounds	3	NA	247.90	NA
Cadmium Compounds	52	85.97	536.54	33.50
Chromium Compounds	52	12.42	615.12	16.75
Cobalt Compounds	50	13.25	48.21	12.54
Lead Compounds	52	13.55	1045.51	13.74
Manganese Compounds	52	10.91	1385.87	16.26
Mercury Compounds	9	21.94	17.45	32.48
Nickel Compounds	52	19.46	702.97	10.07
Selenium Compounds	44	27.68	1103.10	20.77

22.0 Conclusions and Recommendations

As indicated throughout this report, UATMP monitoring data offer a wealth of information for evaluating trends and patterns in air quality and should ultimately help a wide range of audiences understand the complex nature of urban air pollution. The following discussion summarizes the main conclusions of this report and presents recommendations for ongoing urban air monitoring efforts.

22.1 Conclusions

Analyses of the 2004 UATMP monitoring data identified the following notable trends and patterns in national-level and state-by-state urban air pollution:

22.1.1 National-level Conclusions

- *Ambient air concentration data sets generally met data quality objectives for completeness.* Completeness, or the number of valid samples collected compared to the number expected from a 6 or 12 day sampling schedule, measures the reliability of the sampling and analytical equipment as well as the efficiency of the program. Typically, a completeness of 85-100% is desired for a complete data set. Fourteen of eight-three data sets failed to comply with the data quality objective of 85% completeness. Twenty-three data sets achieved 100% completeness.
- *Several UATMP sites are also NATTS sites.* Eight of the forty-four sites are EPA-designated NATTS sites (PSAZ, NBIL, BOMA, DEMI, GPCO, S4MO, SYFL, and BTUT). These sites have more detailed analyses included in their respective sections.
- *Total number of samples for UATMP compounds.* Nearly 106,045 measurements of VOC and carbonyl compounds were made: 27,540 measurements of SNMOC; 1,597 measurements of SVOC; and 2,926 measurements of metal compounds. This total number of samples is about 15% less than the 2003 sampling season. However, ten less sites participated in the 2004 UATMP than in 2003.
- *Total number of samples for VOC and carbonyl compounds.* Of the 106,115 measurements of VOC and carbonyl compounds, 30.3% were hydrocarbons, 22.4% were halogenated hydrocarbons, 7.0% were polar compounds, and 40.4% were carbonyl compounds. These percentages are very close to the 2003 percentages.
- *Ambient air concentrations of VOC and carbonyl compounds.* Nearly 85% of the measured concentrations of VOC and carbonyl compounds were less than 1 ppbv. Less than 2% of the concentrations were greater than 5 ppbv.

- *Detects.* Detection of a UATMP pollutant is subject to the analytical methods used and the limitations of the instruments. Method detection limits are the lowest concentration an instrument can reliably quantify. Hence, a compound present in very low concentrations in the air may not be detected by the instrument. For 2004, seven compounds (chloromethylbenzene, 1,2-dibromoethane, hexachloro-1,3-butadiene, 1,1,2,2-tetrachloroethane, 1,2,4-trichlorobenzene, bromochloroethane, and 1,1,2-trichloroethane) were not detected at any of the participating sites.
- *Nationwide Prevalent Cancer Compounds.* Prevalence was determined differently for the 2004 program year. As in 2003, toxicity values were used to determine which compounds were most detrimental to human health. Twelve cancer compounds (1,2-dichloroethane, 1,2-dichloropropane, 1,3-butadiene, acetaldehyde, acrylonitrile, benzene, carbon tetrachloride, *cis*-1,3-dichloropropene, ethyl acrylate, *p*-dichlorobenzene, tetrachloroethylene, and vinyl chloride) were considered prevalent, based on weighted toxicity, across the entire program.
- *Nationwide Prevalent Noncancer Compounds.* Eleven noncancer compounds (1,2-dichloropropane, 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, bromomethane, chloroprene, *cis*-1,3-dichloropropene, formaldehyde, and xylenes (total)) were considered prevalent, based on weighted toxicity, across the entire program. Several compounds are listed as both cancer and noncancer compounds as they can induce other health ailments, such as asthma, as well as cancer.
- *Pearson Correlations.* Pearson Correlations were computed at each site between each compound and various meteorological parameters. Generally, the meteorological parameters had poor correlations with the nationwide prevalent compounds across all the sites. The Pearson Correlations were much stronger at the individual sites.
- *Automobile Impacts.* Maricopa County, AZ had both the highest car registration and highest hydrocarbon average concentration of all the UATMP counties. The Schiller Park site (SPIL) near Chicago had the highest daily traffic passing by the monitor (214,900), while the Arizona sites in Maricopa County had the highest onroad and nonroad emissions of all the participating sites. The Candor site (CANC) in North Carolina has the lowest daily traffic volume (100).
- *Reformulated Gasoline Areas.* Reformulated Gasoline (RFG) programs, either mandated or voluntary, are intended to reduce ozone-forming compounds and toxic air pollutants. These programs can last year-round or may be required only in specific seasons. Fifteen participating UATMP sites are in RFG areas: the New Jersey, Connecticut, and Chicago sites (CANJ, CHNJ, ELNJ, HACT, INDEM, NBIL, NBNJ, and SPIL) are required to participate in RFG programs year-round. The Arizona sites (MCAZ, PSAZ, QVAZ, and SPAZ) are required to participate only during the winter season. The Boston and St. Louis sites (BOMA, S4MO, and SLMO) have opted to participate year-round.
- *Gasoline Additives.* The following observations were made:

- ▶ ETBE (ethyl *tert*-butyl ether) is a gasoline additive used near the CHNJ, ELNJ, HACT, and NBNJ sites. However, ETBE was not detected at any of the New Jersey sites. The Hartford site sampled only carbonyl compounds and therefore no assessment can be made of ETBE concentrations.
- ▶ TAME (*tert*-amyl methyl ether) is a gasoline additive used near the BOMA, CANJ, CHNJ, ELNJ, HACT, NBNJ, S4MO, and SLMO sites. TAME was detected 4 times at the CANJ and ELNJ sites only. However, the HACT and BOMA sites did not sample VOC and therefore no assessment can be made of TAME concentrations.
- ▶ MTBE (methyl *tert*-butyl ether) is a gasoline additive used near the BOMA, CANJ, CHNJ, ELNJ, HACT, NBIL, NBNJ, S4MO, SLMO, and SPIL sites. This compound was detected on 200 occasions at the New Jersey and St. Louis sites only. However, the BOMA and HACT sites did not sample VOC and therefore no assessment can be made of MTBE concentrations.
- ▶ Ethanol is a gasoline additive used near all of the RFG sites. Increases in formaldehyde concentrations in the trends analysis due to combustion of ethanol occurred at the sites in Chicago, Hartford, and St. Louis, where the ethanol blend is high (75%).
- *Multi-Year Trends Analysis.* The following observations were made:
 - ▶ Since 2002, average formaldehyde concentrations have decreased every year at the following sites: AZFL, CUSD, GAFL, GPMS, JAMS, SFSD, SLMO, and TUMS.
 - ▶ Since 2002, average benzene concentrations have slightly decreased every year at the following sites: CANJ, CHNJ, EATN, ELNJ, GPMS, JAMS, LOTN, NBNJ, SFSD, and TUMS.

22.1.2 State-level Conclusions

- *Arizona.*
 - The prevalent compounds at each site are:
 - MCAZ: 1,3-butadiene, acrylonitrile, benzene, carbon tetrachloride, chloromethane, *p*-dichlorobenzene, tetrachloroethylene, total xylenes, toluene, and *trans*-1,3-dichloropropene.
 - PSAZ: 1,3-butadiene, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, *p*-dichlorobenzene, and total xylenes.

- QVAZ: acetonitrile, acrylonitrile, benzene, carbon tetrachloride, chloromethane, and *trans*-1,3-dichloropropene.
 - SPAZ: 1,3-butadiene, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, *p*-dichlorobenzene, tetrachloroethylene, toluene, total xylenes.
- ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
 - MCAZ: 0.74 between total xylenes and maximum temperature and -0.74 between benzene and relative humidity.
 - PSAZ: 0.89 between *p*-dichlorobenzene and maximum temperature.
 - QVAZ: -0.92 between benzene and dew point temperature.
 - SPAZ: 0.84 between *p*-dichlorobenzene and average temperature.
 - ▶ The Phoenix MSA sites are subject to RFG regulations during the winter season. Impacts of RFG regulations could not be determined because the Phoenix sites on sampled through the middle of March.
 - ▶ As illustrated by the composite 24-hour back trajectory maps, the airshed domain reached is smaller than most sites, as the farthest away a back trajectory originated is 300 miles. However, these sites sampled for only the first quarter of the year.
 - ▶ PSAZ is a NATTS site. The regulation analysis shows that a 12% reduction in VOC is expected after the five applicable regulations are implemented.
 - ▶ A high acrylonitrile concentration was measured at PSAZ on February 27, 2004. The emission tracer analysis determined that the air being sampled on this day originated to the south of the monitoring site. However, the back trajectory for this day originates to the southwest of the monitor. According to the NEI, there are a few acrylonitrile-emitting sources located to the southwest of the site that may have contributed to the high concentration.
- *Colorado.*
 - ▶ The prevalent compounds at the GPCO site were: 1,3-butadiene, acetaldehyde, acrylonitrile, benzene, bromomethane, carbon tetrachloride, formaldehyde, tetrachloroethylene, and total xylenes.

- ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are 0.99 between acrylonitrile and the v -component of the wind.
 - ▶ As illustrated by its composite 24-hour back trajectory map, the airshed domain reached greater than 400 miles. However, 80% of the trajectories were within 300 miles of the site, and 97% were within 400 miles.
 - ▶ GPCO is a NATTS site. The regulation analysis shows that an 8% reduction in VOC and a 26% reduction in carbonyl compounds is expected after the six applicable regulations are implemented.
 - ▶ High acetaldehyde and formaldehyde concentrations were measured at GPCO on September 6, 2004. The emission tracer analysis determined that the air being sampled on this day originated to the southeast of the monitoring site. However, the back trajectory for this day originates to the south and west of the monitor. According to the NEI, there are few, if any, acetaldehyde and formaldehyde sources are located in this direction.
- *Connecticut.*
 - The prevalent compounds at HACT are acetaldehyde and formaldehyde. This site sampled carbonyl compounds only.
 - Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for the site. The strongest correlation is 0.39 between formaldehyde and the v -component of the wind.
 - As illustrated by the composite 24-hour back trajectory map, the airshed domain reached greater than 800 miles. However, 56% of the trajectories were within 400 miles of the site, and 96% were within 800 miles.
 - The Connecticut site is subject to RFG regulations year-round. However, the HACT site did not sample for VOCs, so an RFG analysis of VOC concentrations could not be conducted.
 - *Florida.*
 - ▶ The prevalent compounds at all of the Florida sites are acetaldehyde and formaldehyde. These sites sampled carbonyl compounds only.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:

- AZFL: -0.53 between acetaldehyde and the *u*-component of the wind
 - GAFL: -0.32 between acetaldehyde and the *u*-component of the wind
 - ORFL: 0.66 between formaldehyde and the maximum temperature
 - SKFL: 0.31 between formaldehyde and the maximum temperature
 - SYFL: -0.23 between acetaldehyde and the relative humidity
- ▶ As illustrated by the composite 24-hour back trajectory maps, the airshed domain reached greater than 600 miles, although the number and length of back trajectories varied by site.
 - ▶ SYFL is a NATTS site. The regulation analysis shows that a 5% reduction in carbonyl compounds is expected after the two applicable regulations are implemented. As no prevalent compound noncancer concentration exceeded its adverse health threshold, an emission tracer analysis was not conducted.
- *Illinois.*
 - ▶ The prevalent compounds at each site are:
 - NBIL: 1,2-dichloroethane, 1,2-dichloropropane, 1,3-butadiene, acetonitrile, acrylonitrile, benzene, bromomethane, carbon tetrachloride, chloroform, chloroprene, *p*-dichlorobenzene, tetrachloroethylene, total xylenes, and *trans*-1,3-dichloropropene.
 - SPIL: 1,3-butadiene, acetonitrile, acrylonitrile, benzene, bromomethane, carbon tetrachloride, *p*-dichlorobenzene, tetrachloroethylene, total xylenes, and *trans*-1,3-dichloropropene.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
 - NBIL: -0.80 between 1,3-butadiene and wet bulb temperature
 - SPIL: 0.40 between total xylenes and maximum temperature.
 - ▶ In addition to VOC, NBIL sampled for SNMOC. Of the total NMOC measured (244.69 ppbC), 79% could be identified through speciation at NBIL.
 - ▶ The Chicago MSA sites are subject to RFG regulations year-round. For comparison:

- The NBIL and BTUT (located in a non-RFG area) sites both have similar traffic volumes and both sampled for VOCs. The BTEX concentrations at NBIL are less than the BTUT concentrations (9.01 $\mu\text{g}/\text{m}^3$ vs. 12.71 $\mu\text{g}/\text{m}^3$). The RFG requirements may be effective at NBIL.
- The SPIL and ELNJ (also located in a RFG area) sites both have similar traffic volumes, and both sampled for VOCs. The BTEX concentrations at SPIL are lower than the ELNJ concentrations (9.02 $\mu\text{g}/\text{m}^3$ vs. 11.43 $\mu\text{g}/\text{m}^3$). The RFG requirements may be more effective at SPIL.
- ▶ As illustrated by the composite 24-hour back trajectory maps, the airshed domain reached greater than 700 miles at each site, although the number and length of back trajectories varied by site.
- ▶ NBIL is a NATTS site. The regulation analysis shows that a 14% reduction in VOC is expected after the fifteen applicable regulations are implemented. There were no exceedances of the noncancer benchmarks, so no emission tracer analysis was conducted.
- *Indiana.*
 - The prevalent compounds at INDEM are acetaldehyde and formaldehyde. This site sampled carbonyl compounds only.
 - Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for the site. The strongest correlation is 0.61 between acetaldehyde and both the average temperature and wet bulb temperature.
 - The INDEM site is subject to RFG regulations year-round. However, this site did not sample for VOCs, so an RFG analysis of VOC concentrations could not be conducted.
 - As illustrated by the composite 24-hour back trajectory map, the airshed domain reached greater than 900 miles. However, 68% of the trajectories were within 400 miles of the site, and 97% were within 800 miles.
- *Massachusetts.*
 - ▶ The BOMA site sampled for metal compounds only. The prevalent compounds at BOMA are arsenic compounds, cadmium compounds, manganese compounds, and nickel compounds.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest

correlations computed was -0.45 between nickel compounds and the v-component of the wind.

- ▶ The Boston MSA site is voluntarily subject to RFG regulations year-round. The BOMA site did not sample for VOC, so an analysis of VOC concentrations could not be conducted.
 - ▶ As illustrated by the composite 24-hour back trajectory map, the airshed domain reached greater than 800 miles at BOMA. However, 60% of the trajectories were within 400 miles of the site, and 96% were within 800 miles.
 - ▶ BOMA is a NATTS site. The regulation analysis shows that a less than 2% reduction in metal compounds is expected after the four applicable regulations are implemented. There were no exceedances of the noncancer benchmarks, so no emission tracer analysis was conducted.
- *Michigan.*
 - ▶ The prevalent compounds at each site are:
 - APMI: 1,3-butadiene, acetaldehyde, acetonitrile, benzene, bromomethane, carbon tetrachloride, formaldehyde, tetrachloroethylene, and total xylenes.
 - DEMI: 1,3-butadiene, acetaldehyde, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, and tetrachloroethylene.
 - HOMI: acetaldehyde, acetonitrile, benzene, carbon tetrachloride, formaldehyde, and tetrachloroethylene.
 - ITCMI: 1,3-butadiene, acetonitrile, acrylonitrile, benzene, bromomethane, and carbon tetrachloride.
 - YFMI: 1,3-butadiene, benzene, carbon tetrachloride, chloromethane, tetrachloroethylene, toluene, and total xylenes.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
 - APMI: -0.86 between 1,3-butadiene and dew point, and between acetonitrile and the v-component of the wind.
 - DEMI: 0.36 between benzene and dew point, and -0.36 between 1,3-butadiene and the u-component of the wind.

- HOMI: none
 - ITCMI: 0.24 between carbon tetrachloride and both the dew point and wet bulb temperatures.
 - YFMI: 0.76 between chloromethane and maximum temperature.
- ▶ As illustrated by the composite 24-hour back trajectory maps, the airshed domain for the Michigan sites reached greater than 700 miles at each site, although the number and length of back trajectories varied by site.
 - ▶ ITCMI and YFMI also sampled SVOC. The average SVOC concentration was 27.80 ng/m³ at ITCMI and 52.83 ng/m³ at YFMI.
 - ▶ DEMI is a NATTS site. The regulation analysis shows that a 2% reduction in VOC and a 62% reduction in carbonyl compounds is expected after the eleven applicable regulations are implemented.
 - ▶ High concentrations of acetaldehyde and formaldehyde were measured at DEMI on September 6, 2004. The emission tracer analysis determined that the air being sampled on these days originated to the south of the monitoring site. The back trajectory for this day confirms the wind direction. According to the NEI, there are acetaldehyde and formaldehyde sources located in this direction. A high acetonitrile concentration was measured on October 18, 2004. The emission tracer analysis determined that the air being sampled on this day originated to the east of the monitoring site. The back trajectory for this day confirms the wind direction. According to the NEI, there is one acrylonitrile source located in this direction.
- ▶ *Mississippi.*
 - ▶ The prevalent compounds at each site are:
 - GPMS: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, ethyl acrylate, formaldehyde, *p*-dichlorobenzene, tetrachloroethylene, *trans*-1,3-dichloropropene, and total xylenes.
 - GRMS: acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, *trans*-1,3-dichloropropene, and total xylenes.
 - JAMS: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, tetrachloroethylene, *trans*-1,3-dichloropropene, and total xylenes.

- PGMS: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, and total xylenes.
 - TUMS: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, vinyl chloride, and total xylenes.
- ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
- GPMS: -0.99 between 1,3-butadiene and both the dewpoint and wetbulb temperatures.
 - GRMS: -0.48 between benzene and average temperature.
 - JAMS: 0.72 between both acrylonitrile and dew point and *p*-dichlorobenzene with sea level pressure.
 - PGMS: 0.64 between total xylenes and maximum temperature.
 - TUMS: 0.78 between formaldehyde and maximum temperature.
- ▶ As illustrated by the composite 24-hour back trajectory maps, the airshed domain for the Michigan sites reached greater than 500 miles at each site, although the number and length of back trajectories varied by site.
- ▶ The PGMS site sampled SNMOC in addition to VOC and carbonyl compounds. Of the total NMOC measured (158.04 ppbC), 62% could be identified through speciation.
- *Missouri*.
 - ▶ The prevalent compounds at each site are:
 - BTMO: acetaldehyde, benzene, and formaldehyde.
 - S4MO: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, arsenic compounds, benzene, bromomethane, cadmium compounds, carbon tetrachloride, formaldehyde, manganese compounds, *n*-hexane, *p*-dichlorobenzene, tetrachloroethylene, and total xylenes.
 - SLMO: acetaldehyde, benzene, formaldehyde, and total xylenes.

- ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
 - BTMO: 0.99 between acetaldehyde and the v -component of the wind.
 - S4MO: 0.75 between n -hexane and relative humidity.
 - SLMO: 0.91 between acetaldehyde and the v -component of the wind.
- ▶ The St. Louis MSA sites voluntarily participate in RFG regulations year-round. However, SLMO did not sample for VOCs. For comparison:
 - The S4MO and GPMS (located in a non-RFG area) sites both have similar traffic volumes, and both sampled for VOCs. The BTEX concentrations at S4MO are higher than the GPMS concentrations ($9.51 \mu\text{g}/\text{m}^3$ vs. $5.50 \mu\text{g}/\text{m}^3$). The RFG requirements may not be effective at S4MO.
- ▶ As illustrated by the composite 24-hour back trajectory map for S4MO, the airshed domain reached greater than 700 miles at each site. However, over half of the trajectories originated within 300 miles of this site.
- ▶ The Missouri sites sampled SNMOC in addition to VOC and/or carbonyl compounds. Of the total NMOC measured at BTMO, S4MO, and SLMO (92.35, 160.74, and 203.40 ppbC, respectively), 43%, 76%, and 52%, respectively, could be identified through speciation.
- ▶ S4MO also sampled metal compounds. The average metal compound concentration was $38.47 \text{ ng}/\text{m}^3$.
- ▶ S4MO is a NATTS site. The regulation analysis shows that a 5% reduction in VOC, a 8% reduction in metal compounds, and a 4% reduction in carbonyl compounds is expected after the twenty-six applicable regulations are implemented.
- ▶ High concentrations of acetaldehyde and formaldehyde were measured at S4MO on August 31, 2004. The emission tracer analysis determined that the air being sampled on this day originated to the north of the monitoring site. The back trajectory for this day originates to the north and northwest. According to the NEI, there are many acetaldehyde and formaldehyde sources are located in this direction. A high manganese compound concentration was measured on this day as well. According to the NEI, there are many manganese compound sources located in this direction.

- *New Jersey.*
 - ▶ The prevalent compounds at each site are:
 - CANJ: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, bromomethane, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, tetrachloroethylene, and vinyl chloride.
 - CHNJ: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, bromomethane, carbon tetrachloride, formaldehyde, tetrachloroethylene, and *trans*-1,3-dichloropropene.
 - ELNJ: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, tetrachloroethylene, total xylenes, and *trans*-1,3-dichloropropene.
 - NBNJ: 1,2-dichloropropane, 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, and total xylenes.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
 - CANJ: -0.69 between acrylonitrile and the *v*-component of the wind.
 - CHNJ: -0.87 between *trans*-1,3-dichloropropene and the *v*-component of the wind.
 - ELNJ: 0.46 between acetonitrile and the average temperature and wet bulb temperature, as well as 0.46 between acetaldehyde and maximum temperature.
 - NBNJ: -0.81 between 1,3-butadiene and maximum temperature.
 - ▶ The Philadelphia MSA site (CANJ) and New York MSA sites (CHNJ, ELNJ, and NBNJ) are subject to RFG regulations year-round. For comparison:
 - The CANJ and NBNJ sites both have traffic volumes similar to APMI (located in a non-RFG area). The BTEX concentrations at both sites are less than at APMI (CANJ = 9.92 $\mu\text{g}/\text{m}^3$; NBNJ = 7.58 $\mu\text{g}/\text{m}^3$; and APMI = 12.35 $\mu\text{g}/\text{m}^3$). The RFG requirements may be effective at CANJ and NBNJ.

- The CHNJ and JAMS (located in a non-RFG area) sites both have similar traffic volumes. The BTEX concentrations at CHNJ are less than half of the JAMS concentrations (CHNJ = 4.39 $\mu\text{g}/\text{m}^3$; JAMS = 12.06 $\mu\text{g}/\text{m}^3$). The RFG requirements may be effective at CHNJ.
- The ELNJ and SPIL (also located in a RFG area) sites both have similar traffic volumes, and both sampled for VOCs. The BTEX concentrations at ELNJ were higher than SPIL concentrations (11.43 $\mu\text{g}/\text{m}^3$ vs. 9.02 $\mu\text{g}/\text{m}^3$). The RFG requirements may not be effective at ELNJ. However, this observation may point to stationary sources of the BTEX compounds surrounding the ELNJ as the reason for the higher concentrations.
- ▶ As illustrated by the composite 24-hour back trajectory maps, the airshed domain for the New Jersey sites reached greater than 1100 miles, although the number and length of back trajectories varied by site.
- ▶ *North Carolina.*
 - ▶ The prevalent compounds at both sites are acetaldehyde and formaldehyde. Both sites sampled carbonyl compounds only.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
 - CANC: 0.56 between formaldehyde and average temperature.
 - RTPNC: -0.87 between acetaldehyde and dew point temperature.
 - As illustrated by the composite 24-hour back trajectory maps, the airshed domain for the North Carolina sites reached greater than 900 miles, although the number and length of back trajectories varied by site.
- *North Dakota.*
 - ▶ The prevalent compounds at SLND are acetonitrile, acrylonitrile, benzene, carbon tetrachloride, chloromethane, methyl ethyl ketone, *p*-dichlorobenzene, and total xylenes. SLND sampled VOC and SVOC only.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlation computed is 0.56 between acrylonitrile and both average temperature and wet bulb temperature.

- ▶ As illustrated by the composite 24-hour back trajectory map, the airshed domain reached greater than 700 miles. However, 67% of the trajectories were within 400 miles of the site, and 97% were within 700 miles.
- ▶ SLND also sampled SVOC. The average SVOC concentration was 4.56 ng/m³.
- *South Dakota.*
 - ▶ The prevalent compounds at each site are:
 - CUSD: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, tetrachloroethylene, and *trans*-1,3-dichloropropene.
 - SFSD: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, bromomethane, carbon tetrachloride, and formaldehyde.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
 - CUSD: -0.81 between 1,3-butadiene and relative humidity.
 - SFSD: 0.51 between formaldehyde and maximum, average, and wet bulb temperatures.
 - ▶ The South Dakota sites sampled SNMOC in addition to VOC and carbonyl compounds. Of the total NMOC measured, 27% could be identified through speciation at CUSD, while only 25% (of 151.58 ppbC) could be identified at SFSD.
 - ▶ As illustrated by the composite 24-hour back trajectory maps, the airshed domain for the South Dakota sites reached greater than 800 miles, although the number and length of back trajectories varied by site.
- *Tennessee.*
 - ▶ The prevalent compounds at each site are:
 - DITN: acetaldehyde, acetonitrile, benzene, carbon tetrachloride, formaldehyde, tetrachloroethylene, toluene, *trans*-1,3-dichloropropene, and total xylenes.

- EATN: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, arsenic compounds, benzene, carbon tetrachloride, ethyl acrylate, formaldehyde, manganese compounds, tetrachloroethylene, and total xylenes.
 - KITN: 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, *p*-dichlorobenzene, tetrachloroethylene, *trans*-1,3-dichloropropene, and total xylenes.
 - LDTN: 1,3-butadiene, acetaldehyde, acrylonitrile, benzene, carbon tetrachloride, formaldehyde, tetrachloroethylene, and *trans*-1,3-dichloropropene.
 - LOTN: 1,3-butadiene, acetaldehyde, acetonitrile, arsenic compounds, benzene, carbon tetrachloride, formaldehyde, manganese compounds, tetrachloroethylene, *trans*-1,3-dichloropropene, and total xylenes.
- ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed are listed as follows:
- DITN: -0.94 between benzene and maximum temperature.
 - EATN: 0.91 between formaldehyde and both average temperature and wet bulb temperature.
 - KITN: -0.97 between tetrachloroethylene and maximum temperature.
 - LDTN: 0.63 between acrylonitrile and maximum temperature, and -0.63 between acrylonitrile and sea level pressure.
 - LOTN: 0.77 between formaldehyde and average temperature.
- ▶ As illustrated by the composite 24-hour back trajectory maps, the airshed domain for the Tennessee sites reached greater than 800 miles, although the number and length of back trajectories varied by site.
- ▶ The Nashville sites also sampled metal compounds. The average metal compound concentration was 30.44 ng/m³ at EATN and at 26.03 ng/m³ LOTN.
- *Utah.*
 - ▶ The prevalent compounds at BTUT are 1,3-butadiene, acetaldehyde, acetonitrile, acrylonitrile, arsenic compounds, benzene, cadmium compounds, carbon tetrachloride, formaldehyde, manganese compounds, *p*-dichlorobenzene, tetrachloroethylene, *trans*-1,3-dichloropropene, and total xylenes.

- ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed is -0.70 between tetrachloroethylene and dew point.
 - ▶ As illustrated by a composite 24-hour back trajectory map, the airshed domain reached over 400 miles. However, 63% of the trajectories generally originated within 200 miles away from the site, and 92% were within 400 miles.
 - ▶ BTUT is a NATTS site. The regulation analysis shows that a 10% reduction in VOC, a 5% reduction in metal compounds, and a 11% reduction in carbonyl compounds is expected after the fifteen applicable regulations are implemented.
 - ▶ High concentrations of acetaldehyde and formaldehyde were measured at BTUT on August 31, 2004. The emission tracer analysis determined that the air being sampled on this day originated to the east of the monitoring site. The back trajectory for this day originates to the east and northeast. According to the NEI, there are no acetaldehyde sources and a few formaldehyde sources are located in this direction. A high arsenic compound concentration was measured on February 15, 2004. The emission tracer analysis determined that the air being sampled on this days originated to the south of the monitoring site. The back trajectory for this day originates to the south and southwest. According to the NEI, there are several arsenic compound sources located in this direction.
- *Wisconsin.*
 - ▶ The prevalent compounds at MAWI are 1,3-butadiene, acetaldehyde, benzene, carbon tetrachloride, chloromethane, formaldehyde, tetrachloroethylene, and total xylenes.
 - ▶ Pearson Correlations were computed between the site-specific prevalent compounds and various meteorological parameters for each site. The strongest correlations computed is 0.67 between chloromethane and average temperature.
 - ▶ As illustrated by the composite 24-hour back trajectory map, the airshed domain reached greater than 700 miles. However, 53% of the trajectories were within 400 miles of the site, and 93% were within 700 miles.

22.1.3 Data Quality

The precision of the sampling methods and concentration measurements was analyzed for the 2004 UATMP using relative percent difference (RPD), coefficient of variation (CV), and average concentration difference calculations based on duplicate and collocated samples. The overall precision was well within UATMP data quality objectives and Monitoring Method

guidelines. Sampling and analytical method accuracy is assured by using proven methods and following strict quality control and quality assurance guidelines.

22.2 Recommendations

In light of the lessons learned from the 2004 UATMP, a number of recommendations for future ambient air monitoring are supported:

- Use risk calculations to design SIPs to implement policies that will reduce the potential for human health risk.
- *Encourage state/local/tribal agencies to develop and/or verify HAP and VOC emission inventories.* State/local/tribal agencies should use the data collected from the UATMP to develop and validate an emissions inventory, or at the very least, identify and/or verify emission sources of concern. Ideally, state/local/tribal agencies would compare the ambient monitoring results with an emission inventory for source category completeness. The emissions inventory would then be used to develop modeled concentrations useful to compare against ambient monitoring data.
- *Continue to identify and implement improvements to the sampling and analytical methods.* The improvements made to the analytical methods prior to the 1999-2000 UATMP allowed for measurement of ambient air concentrations of 11 compounds that were not measured during previous programs. This improvement provides sponsoring agencies and a variety of interested parties with important information about air quality within their urban areas. Further research is encouraged to identify other method improvements that would allow the UATMP to characterize an even wider range of components in urban air pollution.
- *Continue to strive to develop standard conventions for interpreting air monitoring data.* The lack of consistent approaches to present and summarize ambient air monitoring data complicates or invalidates comparisons between different studies. Additional research should be conducted on the feasibility of establishing standard approaches for analyzing and reporting air monitoring data.
- *Prepare a report* characterizing all years of the UATMP and then update it yearly to better assess trends and better understand the nature of U.S. urban air pollution.
- *Expand the analyses used for NATTS sites* to be used for non-NATTS sites. The additional analyses (composite back trajectory analysis, regulation analysis, and emission tracer analysis) used for NATTS sites may be beneficial to other state/local/tribal agencies for their sites.

- *Consider more rigorous study of the impact of automobile emissions on ambient air quality using the complete UATMP data set.* Because the UATMP has monitoring sites where years of continuous data are collected, a real opportunity exists to evaluate the importance and impact of automobile emissions on ambient air quality. Suggested areas of study include:
 1. *Signature Compound Assessment.* Sample data from each site should be evaluated to look for signature compounds from mobile sources—that is, species typically associated with only diesel and/or gasoline combustion. If the appropriate compounds are included in the UATMP speciation, sites lacking these compounds can be excluded from subsequent analyses.
 2. *Parking Lot Characterizations.* Several monitoring locations are situated in or near parking lots. Evaporative emissions from parked gasoline vehicles could have a very significant impact on the monitors for these sites (depending upon the species of concern). Therefore we recommend determining the size of the lots in question in terms of number of spaces, as well as an average occupancy rate with total vehicles per day (to determine the number of start episodes). The occupancy rate should be a 24 hour annual average, and can be established either through observation or local “experts” (e.g., the lot operator). Also, it should be determined if the parking is covered or open—covered lots can significantly decrease crankcase temperatures and therefore lower evaporative emissions rates.
- *Encourage continued participation in the UATMP.* Ongoing ambient air monitoring at fixed locations can provide insight into long-term trends in urban air quality and the potential for urban air pollution to cause adverse health effects among the general population. Therefore, state and local agencies should be strongly encouraged either to develop and implement their own ambient air monitoring programs or to participate in future UATMP monitoring efforts.

23.0 References

- Conner, et al., 1995. "Transportation-Related Volatile Hydrocarbon Source Profiles Measured in Atlanta." Teri L. Conner, William A. Lonneman, Robert L. Seila. Journal of the Air and Waste Management Association, 45: 383-394. 1995.
- DieselNet, 2005. Emission Standards, USA: Cars and Light-Duty Trucks. Internet Address: <http://www.dieselnet.com/standards/us/light.html>
- Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (Hybrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (<http://www.arl.noaa.gov/ready/hysplit4.html>). NOAA Air Resources Laboratory. Silver Spring. MD.
- Eastern Research Group, Inc., 2004. "Support for the EPA National Monitoring Programs (NMOC, UATMP, PAMS, HAPs, and NATTS), Quality Assurance Project Plan, Category 1, 2004/2005." Internet address: <http://www.ergweb2.com/uatmp/user/index.cfm>
- EIA, 2004. Energy Information Administration. Car Registration by State. October 2004.
- Fujita, et al., 1994. "Validation of the Chemical Mass Balance Receptor Model Applied to Hydrocarbon Source Apportionment in the Southern California Air Quality Study." Eric M. Fujita, John G. Watson, Judith C. Chow, and Zhiqiang Lu. Environmental Science and Technology, 28:1633-1649. 1994.
- Godish, 1997. "Air Quality." Thad Godish. Lewis Publishers. 1997.
- Harnett, 1982. "Statistical Methods." Donald L. Harnett, Addison-Wesley Publishing Company, Third Edition. 1982.
- IMPROVE, 2004. Interagency Monitoring of Protected Visual Environments (IMPROVE), Administered by Colorado State University. Internet address: <http://vista.cira.colostate.edu/improve/>
- NRC, 1991. "Rethinking the Ozone Problem in Urban and Regional Air Pollution." National Research Council: National Academy Press, 1991.
- Ramamoorthy and Ramamoorthy, 1997. "Chlorinated Organic Compounds in the Environment: Regulatory and Monitoring Assessment." Sub Ramamoorthy and Sita Ramamoorthy. Lewis Publishers. 1997.
- Rogers and Yau, 1989. "A Short Course in Cloud Physics." R. R. Rogers and M. K. Yau. Pergamon Press. 1989.

- Ruffner and Bair, 1987. "The Weather Almanac." James A. Ruffner and Frank E. Bair. Gale Research Company. 1987.
- Seinfeld, 1986. "Atmospheric Chemistry and Physics of Air Pollution." John H. Seinfeld. John Wiley & Sons, Inc. 1986.
- TNRCC, 2002. "Technical Support Document." Texas Natural Resource Conservation Commission, Technical Analysis Division, Air Modeling and Data Analysis Section. June 5, 2002.
- Topozone. Maps a la Carte, Inc. 2003. www.topozone.com
- US Census Bureau, 2005. Metropolitan and Micropolitan Statistical Areas, 2003. Internet address: <http://www.census.gov/population/www/estimates/metroarea.html>
- USEPA, 1994. "Vehicle Fuels and the 1990 Clean Air Act." U.S. Environmental Protection Agency, Office of Mobile Sources. August, 1994.
- USEPA, 1997. "National Air Pollutant Emission Trends, 1900 - 1996." U.S. Environmental Protection Agency, Office of Air and Radiation, Office of Air Quality Planning and Standards. December, 1997.
- USEPA, 1998. Notice of Source Category Listings for Specific Pollutants: Section 112(c)(6). Internet address: <http://www.epa.gov/ttn/atw/112c6/112c6fac.html>
- USEPA, 1999a. "Compendium Method TO-11A: Determination of Formaldehyde in Ambient Air Using Adsorbent Cartridge Followed by High Performance Liquid Chromatography (HPLC)." U.S. Environmental Protection Agency, Center for Environmental Research and Information. EPA/625/R-96/010b. January, 1999.
- USEPA, 1999b. "Compendium Method TO-15: Determination of Volatile Organic Compounds (VOC) in Ambient Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)." U.S. Environmental Protection Agency, Center for Environmental Research and Information. EPA/625/R-96/010b. January, 1999.
- USEPA, 1999c. "Phase II Reformulated Gasoline: The Next Major Step Toward Cleaner Air." U.S. Environmental Protection Agency, Office of Air and Radiation. November, 1999.
- USEPA, 2001. "State Winter Oxygenated Fuel Program Requirements for Attainment or Maintenance of CO NAAQS." U.S. Environmental Protection Agency, Office of Transportation and Air Quality. October, 2001.
- USEPA, 2002. "2001 Nonmethane Organic Compounds (NMOC) and Speciated Nonmethane Organic Compounds (SNMOC) Monitoring Program." July 2002.

USEPA, 2003a. 1999 National Emissions Inventory. United States Environmental Protection Agency, Emission Factors and Inventory Group. Downloaded from the internet at: <ftp.epa.gov/Emis Inventory/>

USEPA, 2003b. "Information on Gasoline Properties and Emissions Performance by Area and Season." U.S. Environmental Protection Agency, Office of Transportation and Air Quality. November, 2003.

USEPA, 2003c. "Fact Sheet Addendum, EPA Policy on Cross Border Sales of 2003 MY California Vehicles."

USEPA, 2004. Historical Archive of Ambient Monitoring Data. Data retrieved from Mr. Jawad Touma, U.S. EPA.

USEPA, 2005a. National Emission Inventories for the U.S. Internet address: <http://www.epa.gov/ttn/chief/net/index.html>

USEPA, 2005b. U.S. EPA. Clean Air Act Amendments. OAQPS. Internet address: http://www.epa.gov/air/oaq_caa.html/

USEPA, 2005c. Air Toxics Strategy: Overview. Internet address: <http://www.epa.gov/ttn/atw/urban/urbanpg.html>

USEPA, 2005d. The National-Scale Air Toxics Assessment. Internet address: <http://www.epa.gov/ttn/atw/nata/>

USEPA, 2005e. About the AQS Subsystem. Internet address: <http://www.epa.gov/air/data/aqsdb.html>

Warneck, 1988. "Chemistry of the Natural Atmosphere." Peter Warneck Academic Press, Inc. 1998.

TECHNICAL REPORT DATA

(Please read Instructions on reverse before completing)

1. REPORT NO. EPA-454/R-06-001	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE 2004 Urban Air Toxics Monitoring Program (UATMP) Final Report	5. REPORT DATE December 2005	
	6. PERFORMING ORGANIZATION CODE OAQPS-EMAD	
7. AUTHOR(S) Eastern Research Group, Inc. 1600 Perimeter Park Morrisville, NC 27560-8421	8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Office of Air Quality Planning and Standards Emissions, Monitoring and Analysis Division U.S. Environmental Protection Agency Research Triangle Park, NC 27711	10. PROGRAM ELEMENT NO.	
	11. CONTRACT/GRANT NO. 68-D-03-049	
12. SPONSORING AGENCY NAME AND ADDRESS Director Office of Air Quality Planning and Standards Office of Air and Radiation U.S. Environmental Protection Agency Research Triangle Park, NC 27711	13. TYPE OF REPORT AND PERIOD COVERED Annual 2004	
	14. SPONSORING AGENCY CODE EPA/200/04	
15. SUPPLEMENTARY NOTES		
16. ABSTRACT Reporting data results for the Urban Air Toxics Monitoring Program (UATMP) for 2004.		
17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Carbonyls, SNMOC, VOC, Semivolatiles, Dioxins, Metals, Hexavalent chromium, Analysis and Monitoring, Risk, Trends	Air Pollution control	
18. DISTRIBUTION STATEMENT Release Unlimited	19. SECURITY CLASS (<i>Report</i>) Unclassified	21. NO. OF PAGES 741 + 1351
	20. SECURITY CLASS (<i>Page</i>) Unclassified	22. PRICE

United States
Environmental Protection
Agency

Office of Air Quality Planning and Standards
Emissions, Monitoring and Analysis Division
Research Triangle Park, NC 27711

Publication No. EPA-454/R-06-001
December 2005
